Nitrogen and phosphorus trend analysis in Latvia agricultural monitoring stations

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Background information

Agriculture is one of the main sources, that cause water quality pollution and eutrophication. The use of fertilizers not only improve soil fertility, crop yield and quality, but also cause water pollution. Human activities, including the use of fertilizer, promote nutrient (nitrogen N and phosphorus P) concentrations in water. The aim of the research is to analyze N_{tot} and P_{tot} concentration fluctuations in a time period.

Materials

Research objects are two monitoring stations of Latvia (Fig 1) – Bērze and Mellupīte - with three research scales: small catchment, drainage field and groundwater wells (perforation 2-6 m). In Mellupīte small catchment area is larger (960 ha) than ir Bērze (368 ha) (Fig 2, 3). Research tasks are:

- to analyze N_{tot} and P_{tot} concentrations and trends in small catchment and drainage runoff (1995-2010) and in groundwater (2006-2010) (Fig 7, 8);
- to calculate average monthly N and P loads from drainage field and concentrations in groundwater and define periods with the highest nutrient leaching and interaction between drainage runoff and its impact on N and P loads.

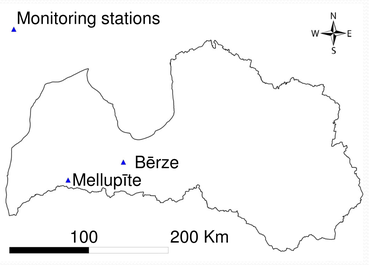

Figure 1. Location of monitoring stations

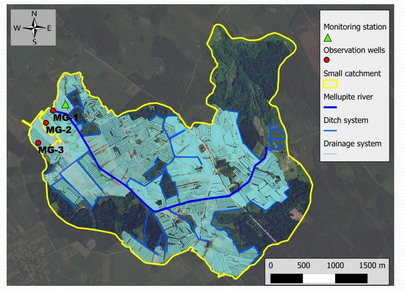

Figure 2. Monitoring station Mellupīte

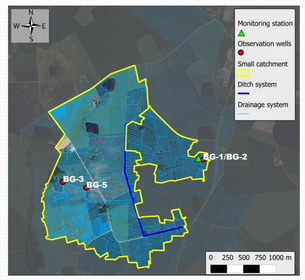

Figure 3. Monitoring station Bērze

Discussion and results

In monitoring stations Bērze and Mellupīte the defined values of Nitrates Directive were exceeded. The concentration of NO_3-N in water from drainage field exceeds 11.3 mg/l. The most polluted are drainage field, but the lowest N_{tot} and P_{tot} concentrations are in groundwater (Fig 4). Highest nutrient concentrations in drainage runoff and groundwater were observed in winter and spring, particularly in thaw periods, while lowest nutrient concentrations are in summer (Fig 5). After dry summer season when cracks are deep, high N_{tot} and P_{tot} values are expected in groundwater (Fig 6).

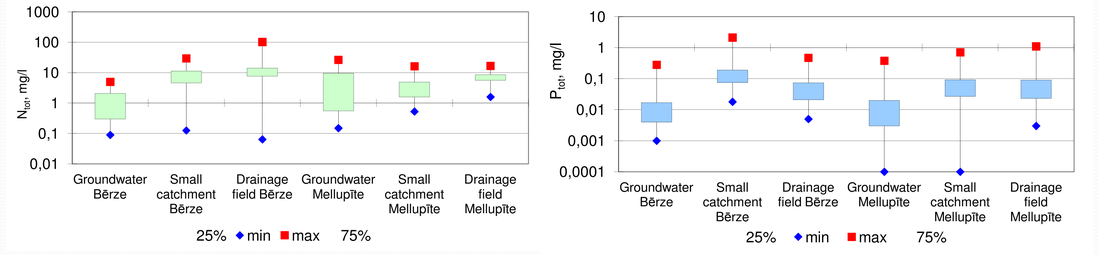

Figure 4. Average N_{tot} and P_{tot} values in groundwater, small catchment and drainage runoff (1995-2010)

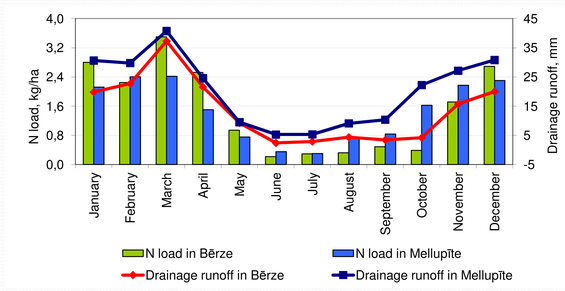

Figure 5. Average monthly N load and drainage runoff

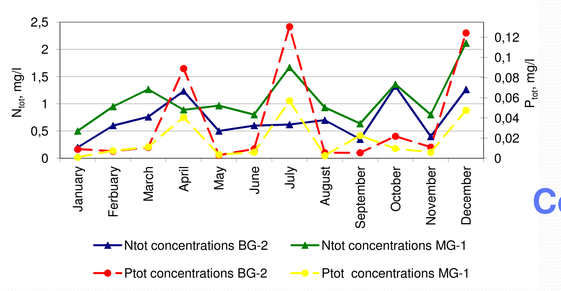

Figure 6. Average monthly N_{tot} and P_{tot} values in groundwater

References:
1. Heathwaite A.L., Yohnes P.J., Peters N.E.1996. Trends in nutrients. Hydrological Processes, Vol. 10, 263-293.
2. Lagzdiņš A., Jansons V., Abramenko K. 2008. Setting of the Water Quality Standards for Nutrients in Run – off from Agricultural Land. LUA, 21 (315), 96-105.

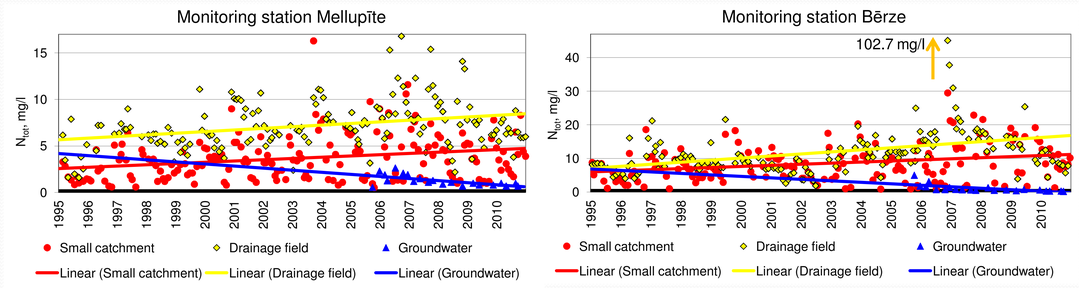

Figure 7. N_{tot} trends in groundwater (2006-2010), small catchment and drainage runoff (1995-2010)

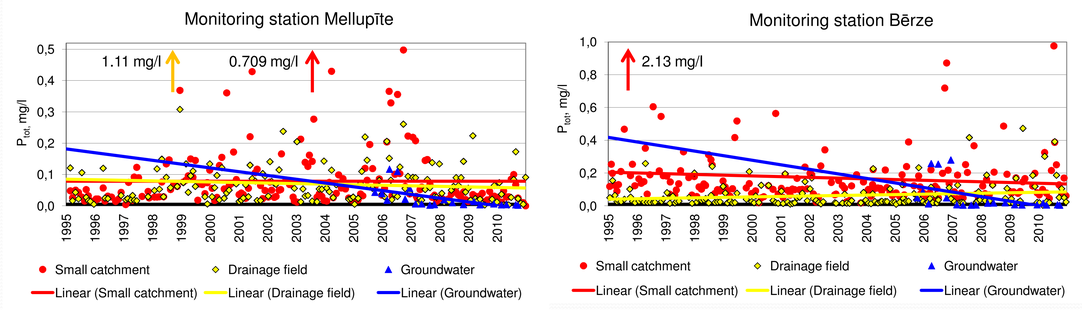

Figure 8. P_{tot} trends in groundwater (2006-2010), small catchment and drainage runoff (1995-2010)

Conclusions

- There are positive trends of nutrient concentrations from 1995-2010 in both – drainage and small catchment runoff, but in groundwater trends of N_{tot} and P_{tot} values are negative.
- In a period from 2006 N_{tot} and P_{tot} concentrations are decreasing because of rational fertilizer use.
- To decrease nutrient leaching, should notice suggestions of fertilizer use, specially in vulnerable zones. When runoff is high N and P loads from drainage field are high, especially in winter and spring. It is important to notice fertilizer use in a period with high runoff.

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