SOIL AND WATER CONSERVATION MEASURES CAN CONTRIBUTE TO ENHANCEMENT OF LANDSCAPE QUALITY IN THE LITENČICKÁ UPLAND

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Abstract

Since 2019, the quality of soil and water as two basic environment components has been monitored in the southern foothills of the Litenčická Upland. The research focuses on the transport of nutrients (nitrogen and phosphorus) and pesticides in the Uhřický Pond basin. The article presents partial results of monitoring. The project aim is to create a design of comprehensive measures to reduce erosion, leaching of potentially hazardous substances, for protection of soil and water, which will also be close to nature. If implemented, the measures will contribute to increasing ecological stability and aesthetics of the landscape in this area and thus enhance its recreation attractivity.

Key words: Rural countryside, nitrogen, phosphorus, pesticides, measures

Introduction

Litenčická Upland is located in the South Moravian Region, southeast of Vyškov. It is interwoven with a network of hiking trails, forest and field roads suitable for cycling. It is partially covered by forests, but its foothills are intensively used for agriculture. The whole hilly area has its own charm, but it is not a mass recreation destination and therefore tourists can undisturbedly enjoy the distant views, rugged landscape, picturesque villages hiding interesting monuments and bathing ponds.

Catchment of the Uhřický Pond was chosen as one from 3 experimental areas for research of transport processes of nutrients and pesticides in the system soil – water. This area is very intensively exploited for farming and the soils are fertile but due to erosion degraded. To ensure consistently high yields, farmers supply fertilizers (mostly artificial) and plant protection products to the soil. These matters are transported by water erosion and leaching through soil profiles to the surface water bodies and affect water quality.

Material and methods

Uhřický Pond is located on the stream of Hvězdlička, between the villages Milonice and Uhřice in the Vyškov region. The Hvězdlička Stream, as well as its right-hand tributary Pavlovický Stream, springs in the Litenčická Uplands. The pond basin covers 2570 ha. The highest peak of the basin is Klín (443 m a.s.l.), the dam of the pond is located at a height of 255 m a.s.l. Long undulated slopes, mostly ploughed, are typical for the terrain relief. The average slope of the basin reaches 5.3° (Sáňka et al. 2021).

The geological substrate of the catchment is formed by Neogene rocks: clay, sand, gravel, sandstone or conglomerates. They are often covered with loess or loess clay. Soil types of Chernozems and Luvisols have developed on them, which are often degraded due to declination and intensive farming. Along the streams, there are fluvial soils on calcareous alluvial deposits.

More than half of the catchment area is ploughed, namely 1414 ha (= 55%). Mainly cereals, corn, sunflower, beet and potatoes are grown on arable land. Permanent grasslands are located only on 38 ha. 37% of the catchment area (953 ha) is covered by forests.

In the Uhřický Pond catchment (Fig. 1), 2 transects on sloping blocks of arable land were selected. One above the inlet of the pond (US1) and the other in the central part of the basin (US2). Mixed soil samples were taken monthly from the slope top (infiltration section), the slope middle (transport section) and the slope heel (accumulation section). Furthermore, samples of bottom sediments were taken from the stream (UB2) and from the pond (UB1). Surface water samples (U1 - U4) were also taken monthly, 3 from streams and 1 from the pond (Fig. 1). In the 2019 - 2021, overall 78 samples of soil, 26 samples of sediment and 83 samples of surface water were here taken and analyzed.

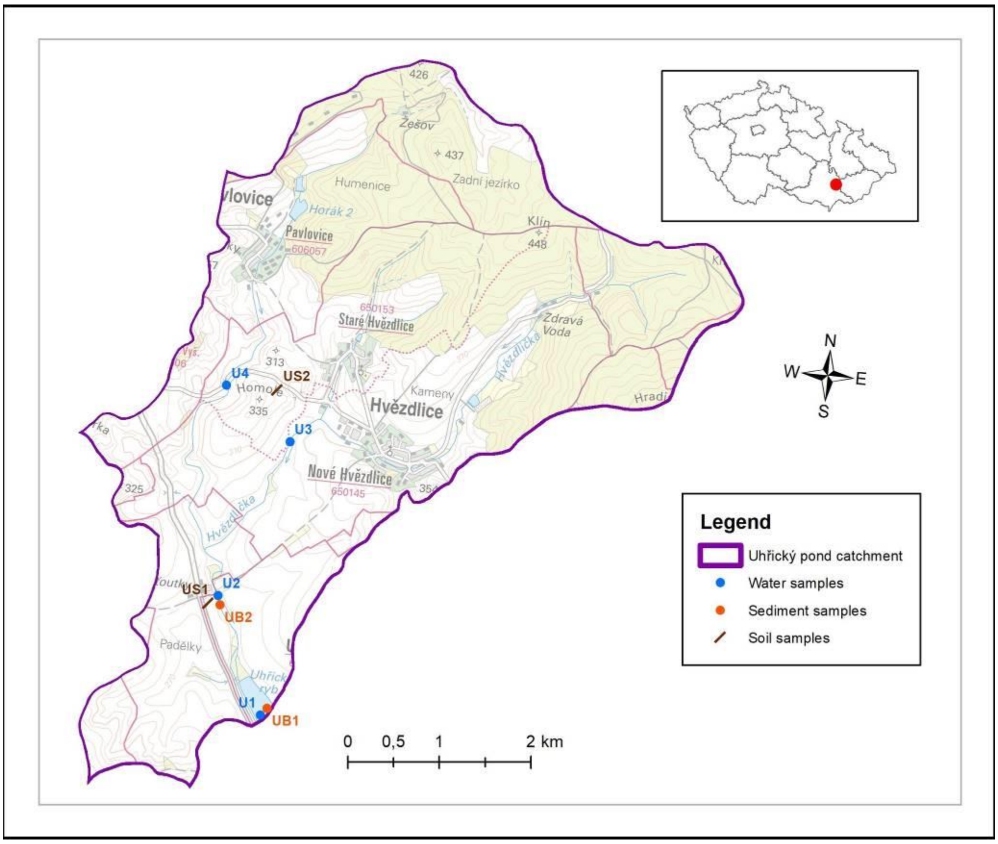

Fig. 1: Catchment of the Uhřický Pond and monitored places

Results and discussion
Soils at the Litenčická Uplands slopes are relatively quality and fertile. In taken samples of soils approximate concentration of Ntot reached 2.30 g/kg and Ptot 0.96 g/kg (2019-2021). Fig. 2 demonstrates marked tendency of nitrogen accumulation in the slope heels, the tendency for phosphorus is less evident. Nevertheless both nutrients are transported from arable land to water bodies with erosion and washing processes (e.g. Krasa et al. 2019; Dupas et al. 2020). Higher concentrations of Ntot (3.10 g/kg) and Ptot (1.31 g/kg) in bottom sediments than in soils (Fig. 2) prove this fact. Of course, municipal wastes have an important share in sediments pollution (Konečná et al. 2017).

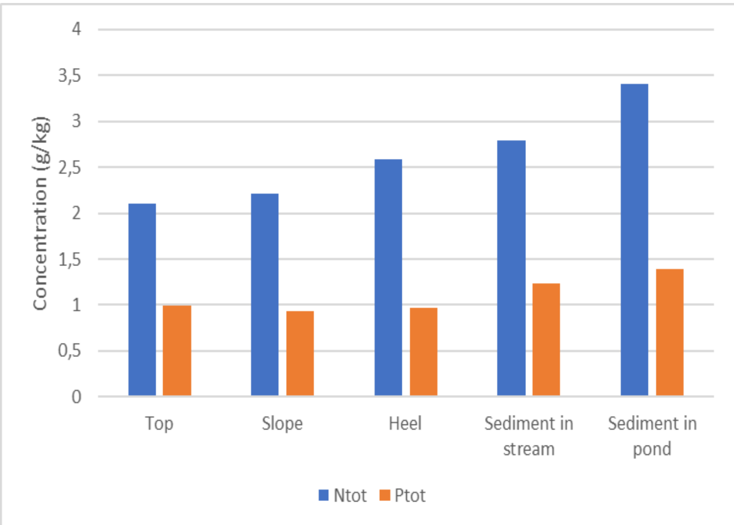

Fig. 2: Nutrients content in soils and sediments

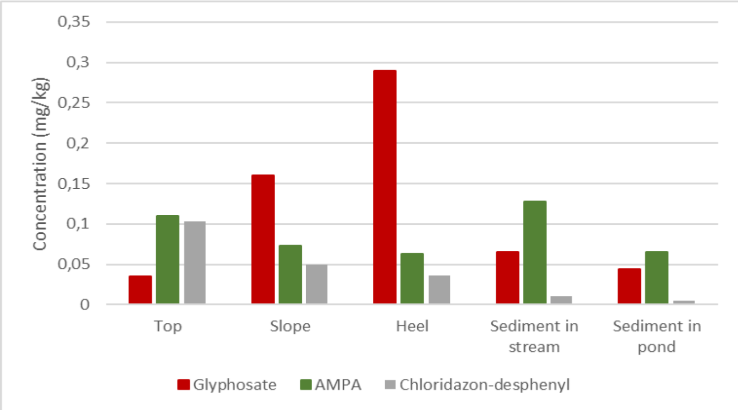

Fig. 3: Pesticides content in soils and sediments

From about 300 analysed pesticide matters, following 3 were identified in almost all samples of soil and sediment: glyphosate, AMPA and chloridazon-desphenyl. The finding corresponds with spectrum of plant protective preparations used in this area. Glyphosate appears in soil in average concentration 0.16 mg/kg. It is transported down slope and accumulates in the heels (Fig. 3) likewise nutrients. During time glyphosate degrades, its metabolite AMPA (av. 0.08 mg/kg in soil) originates. The AMPA concentrations in sediments are higher than glyphosate. Chloridazon-desphenyl (av. 0.06 mg/kg in soil) is an irrelevant metabolite of chloridazon. Average contents of monitored matters in sediments were: glyphosate 0.01, AMPA 0.10, chloridazon-desphenyl 0.05 mg/kg (Fig. 3). Zajíček et al. (2018) confirm our finding that parent pesticide compounds occur in more rate usually in soils and their metabolites in water bodies.

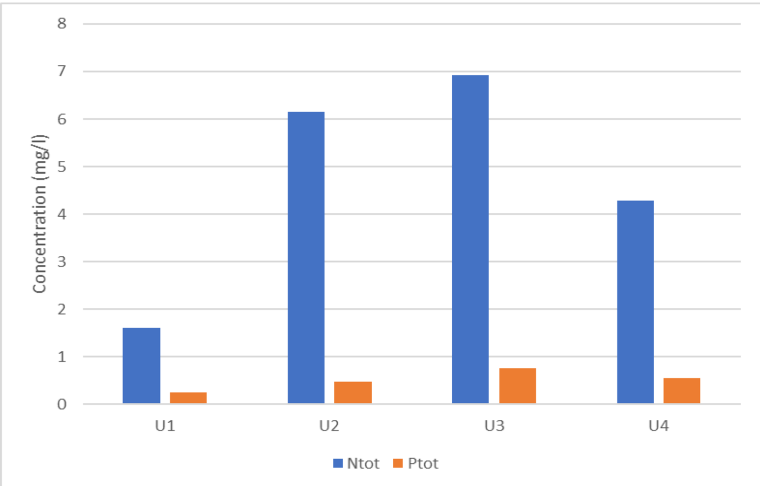

Fig. 4: Nutrients content in surface water

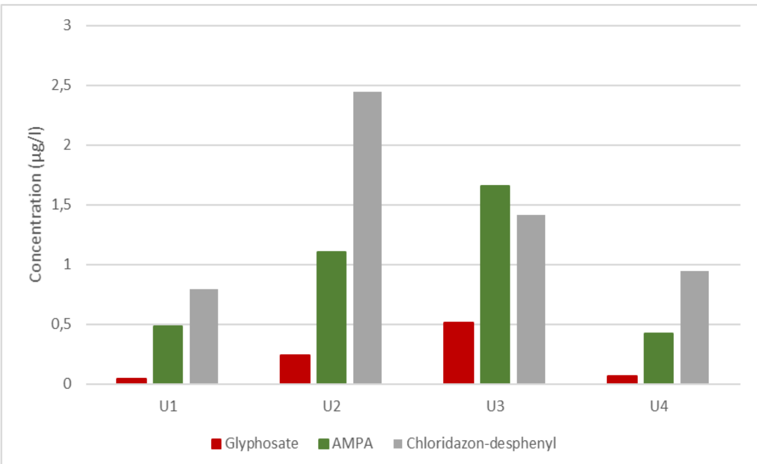

Fig. 5: Pesticides content in surface water

Concentrations of Ntot (av. 4.75 mg/l) and Ptot (av. 0.50 mg/l) in surface waters are different on sampling site (Fig. 1 and 4). The lowest are in pond (U1: Ntot 1.61 mg/l, Ptot 0.25 mg/l). Water quality in streams (namely U2, U3) is affected by near settlement.
Pesticide load in surface waters keeps similar pattern (Fig. 5), water in pond is cleaner than in streams. Main water contaminant is chloridazon-desphenyl (av. 1.43 µg/l). AMPA occurs in average concentration of 0.80 µg/l and its parent matter glyphosate of 0.22 µg/l. Limit for pesticides in drinking water is 0.1 µg/l (Halešová et al. 2021).
With an aim to improve water quality and minimize soil degradation, a complex system of measures will be designed for the Uhřický Pond catchment. The measures will restrict surface erosion and decelerate transport nutrients and risk matters to water bodies. Following types of measures will be systematically located in the arable land:

- Protective agrotechnologies (seeding to mulch or stable, catch crops, …).
- Sheet and belt grassing.
- Grassed hedges, contour furrows or ditches.

Along some protective measures with permanent character (grassing, line elements) new roads and paths with tourist resting and view points can be designed. So, there is a real potential to increase the landscape patency. Design of grassing and bio-technological measures involves accompanying greenery. It is apparent from Fig. 6 and 7, that the landscape of studied catchment is visually nice shaped but thanks to large blocks of arable land rather monotonic.

Fig. 6: View at south-east part of the catchment

The landscape needs more green elements, lines and nests of trees and bushes. Design of soil and water conservation measures can help to solve this situation. It will be prepared as a study utilizable in process of land consolidation, which represent the main tool for implementation for environmental measures in countryside in the CR (Konečná et al. 2017).
Development of environmentally sound agriculture is one of fundamental conditions for development of rural tourism (Hájek 2002). Support and implementation of polyfunctional measures for soil and water conservation is important also for sustainable exploitation and development of rural landscape.

Fig. 7: View at north-west part of the catchment

Conclusion

The project aim is to create a design of comprehensive measures to reduce erosion, leaching of potentially hazardous substances, for protection of soil and water, which will also be close to nature. If implemented, the measures will contribute to increasing ecological stability and aesthetics of the landscape in this area, also to its better patency. More greenery, roads and tourist resting points extend potentially recreation attractivity of the area.

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Souhrn

Od roku 2019 je na jižních svazích Litenčické pahorkatiny sledována kvalita půdy a vody jako dvou základních složek životního prostředí. Výzkum je zaměřen na transport živin (N a P) a pesticidů v povodí Uhřického rybníka. Prokázalo se, že problémem povodí jsou erozní procesy na půdě a intenzivní vstupy živin a potenciálně rizikových látek do vodních útvarů. Cílem projektu je vytvořit návrh komplexních opatření ke snížení eroze, vyplavování látek ze zemědělských půd, pro ochranu půdy a vody, které budou zároveň přírodě blízké. Opatření v případě realizace přispějí ke zvýšení ekologické stability a estetiky krajiny v této oblasti a zvýší tak její rekreační atraktivitu.

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