PROPOSAL OF TECHNICAL SOLUTIONS FOR WATER REGIME RENEWAL IN THE EASTERN SLOVAKIAN LOWLAND

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ABSTRACT

The lowlands by their water cycle significantly affect the climatic conditions of the area. Over the past 60 years, there have been significant changes in the hydrological regime of the Eastern Slovak Lowland, mainly due to anthropogenic activity. The drainage of the lowland resulted in a significant decrease in the groundwater supply and an increase in dry periods. This paper summarizes the human activities that have changed the character of the eastern Slovakian lowland and the possibilities how to improve the hydrological regime of the lowland by simple water structures. Improving the water regime improves the climate in the lowland area, improves the living conditions of fauna and flora and significantly increases the biodiversity of the lowland area.

Key words: lowland, Eastern Slovak, water regime of lowland, anthropogenic activities

1. INTRODUCTION

Wetlands belong among the most productive ecosystems in the world (Davie, 2008). They are important for water management function, decreasing flood impacts, trapping sediments, cleaning impure water, climate stabilization in an area and recreation (Juráková, Skalová, 2005). Many lowlands have been altered by anthropogenic activity during the last years. Many new environmental problems are currently being addressed in the world, some of which result from anthropogenic activities and from changes in use and human intervention in the country. One such problem is the problem of water scarcity, drought and rising average temperature.

In the territory of the Slovak Republic, water scarcity is particularly apparent in the lowlands, where major anthropogenic interventions occurred in the 1950s-1960s. In the region of Eastern Slovak lowland there was a problem with periodic floods as well as with disorder runoff conditions. It has been gradually solved by building-up pumping stations, dams, embankments and river control. The dams and embankments along the rivers worsened internal water runoff (Tegelhoffová, 2010). This induces the waterlogging and flooding of agricultural land. Internal waters appeared mainly in the spring time after snow melting or during the vegetation period after intensive or long-lasting rainfall. In that case problems with waterlogging occur in the summer time mainly after heavy rain storms. Large drainage systems in the Eastern Slovak Lowland (bordered by the Ondava, Laborec, Uh, Latorica and Bodrog rivers) are built to solve this problem (Pálinkášová, Šoltész, 2012). This is also evident in many areas of the Eastern Slovak Lowland, where in the 1960s an extensive network of hydro-amelioration constructions was built, especially drainage and irrigation canals with a number of pumping stations, but also flood protection constructions, especially raising of banks of the hydrologically important rivers. Such interventions in the country caused the water that should be retained in the country and thus create suitable conditions not only for the life of many protected animals and plants, but also for people being is quickly drained away from the whole territory of the Eastern Slovak Lowland. As a result, water scarcity, groundwater levels are dropping, causing problems caused by hydrological drought. There are several positive examples in the world for improving the water regime in anthropologically altered areas. Only a few such measures have been implemented in Slovakia, particularly in the Eastern Slovak Lowland area.

2. STUDY AREA AND ANALYSIS OF CURRENT SITUATION

The Eastern Lowland is located in the southern part of eastern Slovakia in Central Europe. The southern border forms the state border with Hungary, in the east it is bordered by the state border with Ukraine, in the west it passes into the Slanské vrchy mountains and in the north, it borders on the Beskydy foothills and Vihorlatské vrchy. The altitude ranges from 150 to 200m. Near the village of Streda nad Bodrogom, there is the lowest point of the East Slovakian Lowland and at the same time of the whole Slovakia, which has an altitude of only 94 m.

The most important watercourses include Ondava, Topľa, Laborec and Latorica, which flow near the border with Hungary into the river Bodrog. The most important watercourses include Ondava, Topľa, Laborec and Latorica, which together form the Bodrog River near the Hungarian border. The area is characteristic by warm and dry climate, especially in summer, which is currently characterized by frequent periods of drought, as evidenced by the fact that the SHMI (Slovak Hydrometeorological Institute) has started drought monitoring in recent years. Location of the Eastern Slovak Lowland in Slovakia is shown in the Figure 1.

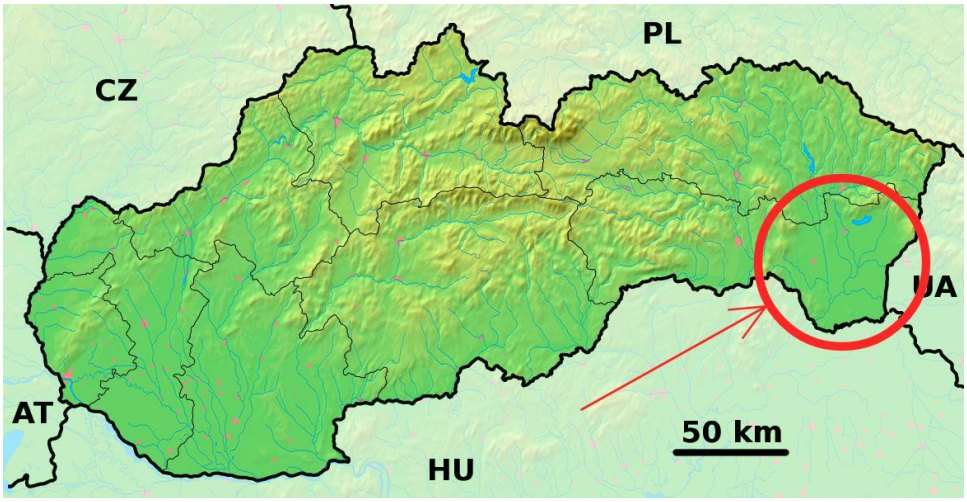

Fig. 1. Location of the Eastern Slovak Lowland in Slovakia

The character of the Eastern Lowland was significantly changed by human activity in the 1950s. With the main aim of fertilization, the largest possible area of the territory and to create suitable conditions for agricultural activity, the entire eastern Slovakian plain was drained significantly. Drainage channels with a number of pumping stations and flood protection constructions were built, which drain water from the area as quickly as possible. These human interventions in the environment significantly changed the hydrological regime of the Eastern Slovakian lowland, the groundwater level decreased, the amount of evaporation and the total amount of water in the lowland decreased too.

Fig. 2. Location of the Eastern Slovak Lowland in Slovakia

The lowland area has been significantly altered by anthropogenic activity, especially by building flood protection and a hydromelioration network. Flood protection was realized by raising the banks of hydrologically important watercourses, especially by building of embankments on the banks. These embankments cause the water to be kept in the river bed in the event of floods and to be quickly discharged from the basin. Before the realization of these embankments, the water was maintained in terrain depressions after the flood event and had long-term

subsidized groundwater reserves. The second important water structure is a hydromelioration (drainage) network of pipelines, canals and pumping stations, which drains water from the lowland to the rivers. In the Figure 2, there is shown comparison of the same area in Eastern Slovak Lowland in 1950 and in 2015. It is clear from the figure that the construction of the embankment stopped the water supply to the area of wetland from the river, and at the same time the water level was reduced by drainage of this area.

3. THE POSSIBILITY OF RESTORATION OF WATER REGIME

Comprehensive restoration of the water regime in the territory of the Eastern Slovak Lowland is a demanding task that will require a large amount of funds. However, retaining a significant amount of water in a drained lowland country can also be achieved by building small, cost-effective water structures. The simplest measure is the construction of sluice gates in the drainage channels, which will cause the water level in the area above the sluice gates to rise. An example of such a measure is the sluice gate near the village Iňačovce (Figure 3, which can hold water in the drainage channel K23 up to 2 km and was realized in 2015.

Fig. 3. Sluice gate near Iňačovce in K23 drainage channel

Another very good example is a sluice built on a "Severný Radský" drainage channel. The sluice gate is used for tapping the water level in channels up to 11 km long. The total area of the backwater after implementation of this sluice is approximately 995 thousand m^2. By building this simple water structure, the amount of 267 thousand m^3 may be detained for a long time in a previously drained area. In the Figure 4, there is a photo of realizes sluice gate and also the map of affected area. The green dot in the left picture shows location of sluice gate and yellow area is area where water is retained and raised in drainage channel.

Fig. 4. Sluice gate in drainage channel and affected area by this structure

4. CONCLUSION

The Eastern Slovakian Lowland, which is an important lowland located in the southern part of Eastern Slovakia, has been significantly changed by human activity. This paper presents two positive examples of the implementation of simple water structures to improve the water regime in this area. The water regime can be improved by construction sluice gates in the drainage channels, which has a positive effect on the amount of water retained in the lowland area and it also raises groundwater levels. These constructions with low investment costs can retain water over a large area, as demonstrated by the sluice gate on a "Severný Radský" drainage channel. Consequently, such measures also have a positive impact on the lowland climate especially on water cycle, but mainly on the biodiversity of the territory. In particular, a significant increase in the occurrence of fauna and flora after re-irrigation of the area was proved. Such measures and technical proposals are a suitable and economically advantageous solution for drained areas.

ACKNOWLEDGEMENT

This work has been supported by the Slovak Research and Development Agency by supporting the project SK-PT-18-0008.

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