RESTORATION OF SMALL RIVER TO INCREASE THE RECREATIONAL AND TOURIST POTENTIAL OF RURAL AREA

Andrej Škrinár, Michaela Danáčová, Roman Výleta
Department of Land and Water Resources Management, Faculty of Civil Engineering, the Slovak University of Technology in Bratislava, Radlinského 11, 810 05 Bratislava, Slovakia

https://doi.org/10.11118/978-80-7509-831-3-0292

Abstract
The study is focused on increasing the recreational and tourist potential of the rural part of the western Slovak village Vrbovce. The Teplica River, flowing through the village, has been inappropriately regulated neglecting the river ecosystem and currently provides very few opportunities for recreational use. The study was also initiated by the efforts to improve the ecological condition of the river by implementing restoration measures including the use of the stream potential for the aesthetic creation of public space.
The proposal for a scenario is described to achieve a highly positive effect with relatively low financial resources. In this locality, there is an old unused millrace, which is in very poor condition and full of waste material. Its restoration and connection to the regulated main riverbed will create a side arm and a valuable variable microhabitat will be obtained in the aquatic environment as a counterweight to the monotonous regulated reach. The re-connection of the millrace will provide an important microhabitat for the biota, especially in the summer period of minimum flows. This measure together with the revitalisation and replenishment of the existing greenery and the design of the nature trail will significantly increase the attractiveness of the area for recreation and tourism development.

Key words: Public space, millrace, rural greenery, river regulation, Teplica

Introduction

With the gradual historical economic expansion, people concentrated their activities and the development of settlements in the floodplains of rivers - river inundation areas with sufficient water sources, especially for the development of agriculture. In the first phase, the settlements were secured against floods passively - they were built on elevated places, but with an increasing number of inhabitants, it was necessary to start with the active protection, so the stream regulation activities began. By regulating the streams, people gradually ensured the flood protection of their settlements, while neglecting the ecological function of the river network, which is an important biocorridor and artery of life in the landscape, especially the rural space. Over time, the rivers and streams were perceived mainly as a threat, therefore their regulation was performed mainly from by the means of flood protection. The most widely used tool of the stream regulation was to change the morphology of the originally naturally fragmented riverbeds to such an extent that a monotonous environment was created, and such a habitat became almost uninhabitable for aquatic animals and even plants. Massive technical and, unfortunately, often inappropriate stream regulations have significant negative effects on river landscape ecosystems, with an obvious spill-over into the rural and urban environment.
Moreover, these river regulations are designed to support the quick outflow of the water from the upper river basin thus negatively influencing the water balance (Rončák et al., 2019) and soil Moisture Regime (Rončák et al., 2021). Furthermore, the river regulation is usually reflected in a significant reduction in the attractiveness of the surrounding area and public space for recreation and leisure activities.
The Teplica riverbed is such an example and this study is aimed at the efforts to increase the ecological, recreational and tourist potential of its inundation area.
In previous research (Výleta et al., 2019), we assessed the ecological stability of the whole cadastral area of the village of Vrbovce in both historical and current contexts using similar methods to Ivan et al. (2014) and Valent et al. (2016). From the analysis of land use from the history to the present, there is a tendency for the arable land to decline and to increase the vegetation and grassland areas. Landscape-ecological stability calculations in various mapping periods suggest that the current landscape is much closer to its natural state than it was during the historical periods. Different types of functional utilization of the area have been recorded in the area, mainly arable land, meadows and forest areas are dominant. The actual level of ecological stability is relatively favourable, it reaches a moderate level (2.80), however, several negative phenomena have been recorded in the territory,

which have a negative impact on biodiversity and ecological stability of the country. The results of the analysis suggest that there is a potential for improving its ecological stability.

Material and methods

Teplica as a left tributary of the Morava River flows through two countries – Czech Republic and Slovakia and it crosses the SK-CZ border in rkm 26,2 in the cadastre of the western Slovak village Vrbovce (Fig. 1). Outside the built-up area, there is mostly agricultural land on both banks in the inundation area.

The riverbed of the upper reach of the river Teplica (rkm 18,0 - 32,0) was heavily modified in the in the last century with a straight path and a prismatic cross-section creating a monotonous habitat within the entire section of the river regulation. In recent years, the river restoration was performed in the upstream river reaches in the Czech part of the river (above rkm 26,0) thus creating the favourable environment for the instream biota. On the contrary, the Slovak part of the river remains heavily regulated providing a good potential for further downstream river restoration.

The waters of Teplica are significantly eutrophic. This is mainly due to the high content of organic matter in the stream, which comes from sewage, agricultural activities, and other unidentified sources of pollution. One of the causes of eutrophication is the total absence of riparian vegetation. In this part, the watercourse is directly exposed to sunlight, which also has a negative effect on the quality of the water in the stream. As a first step, it is therefore necessary to improve the quality of the water in the stream - to build a sewerage network connected to a wastewater treatment plant and to apply various erosion-control measures reducing the income of nutrients into the stream.

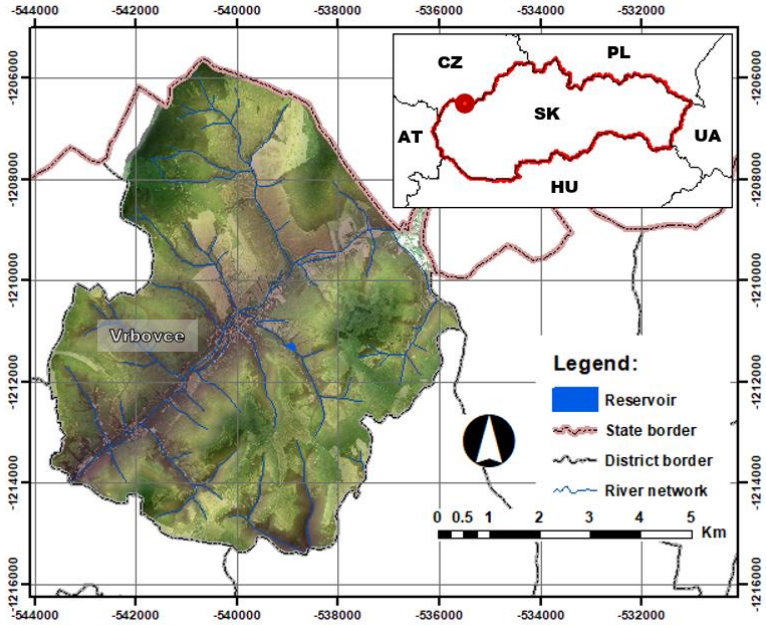

Fig. 1: Position of the cadastral area of village Vrbovce in Slovakia

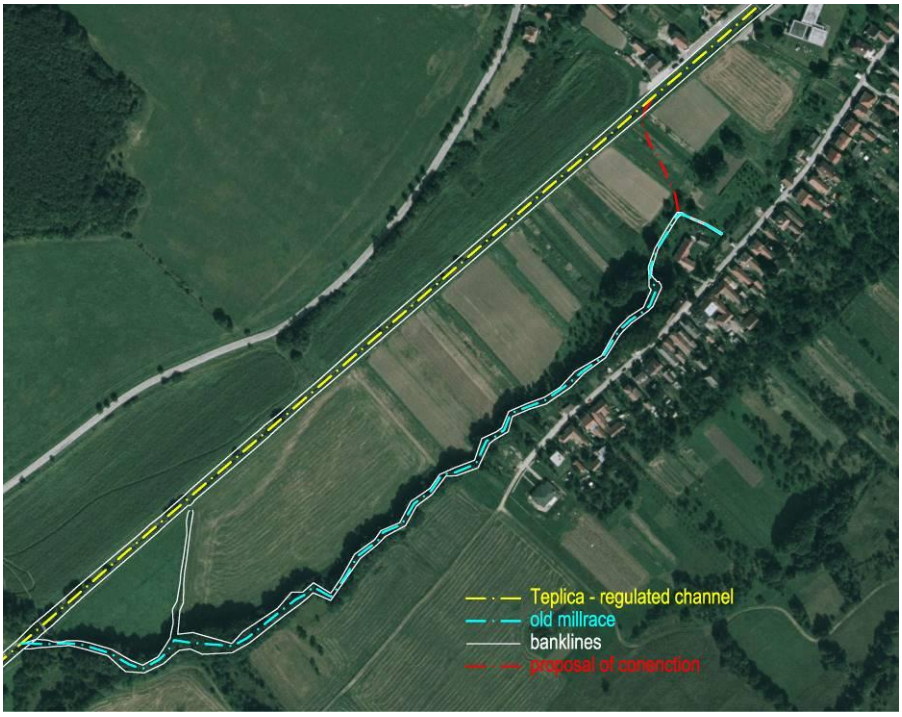

Fig. 2: Scheme of the restoration proposal

To increase the channel variability of the regulated stream, the best step is to recreate the original meanders along with implementing changes in the longitudinal profile. In this locality, there is an old unused millrace, which is in poor condition, full of waste material and heavily eutrophicated (Fig. 3). By its restoration and connection to the regulated main riverbed a side arm will be created (Fig. 2, Fig. 4) and a valuable variable microhabitat will be obtained in the aquatic environment as a counterweight to the monotonous regulated reach.


Fig. 3: Waste dumps with eutrophicated millrace and rendering of the design


Fig. 4: Current state of the area and rendering of the connection design

Fig. 5: Current state of Teplica and proposal of the riparian vegetation

Riparian vegetation by autochthonous tree species (Fig. 5) was also proposed to create a local greenery along the river.
The basic input for the study was a topographic and elevation plan of the current state - digital terrain model (DTM) created by the study's authors from several data sources in Autocad Civil3D software. The basis was the database of geodetic survey points provided by Slovak Water-management Enterprise, and own detailed geodetic survey in the wider vicinity of the riverbed and millrace, carried out by the team of the study's authors. Highly precise geodetic GNSS instrument and total station were used for detailed elevation and topography surveying. Elevation data in the inundation area were taken from a DTM created using LiDAR aerial laser scanning. The DHI Mike21FM 2D hydrodynamic model of unsteady flow was used to simulate the water flow in a locality.

Results and discussion
Outputs of the hydrodynamic model (Fig. 6) show that to recreate a full flowing side arm of the river no significant interventions are required in the millrace, only local cleaning by light mechanisms so that obstacles to the flowing water are removed. Straightening of the path and any efforts to model the prismatic profile are undesirable - the revitalized millrace must be left as natural as possible.

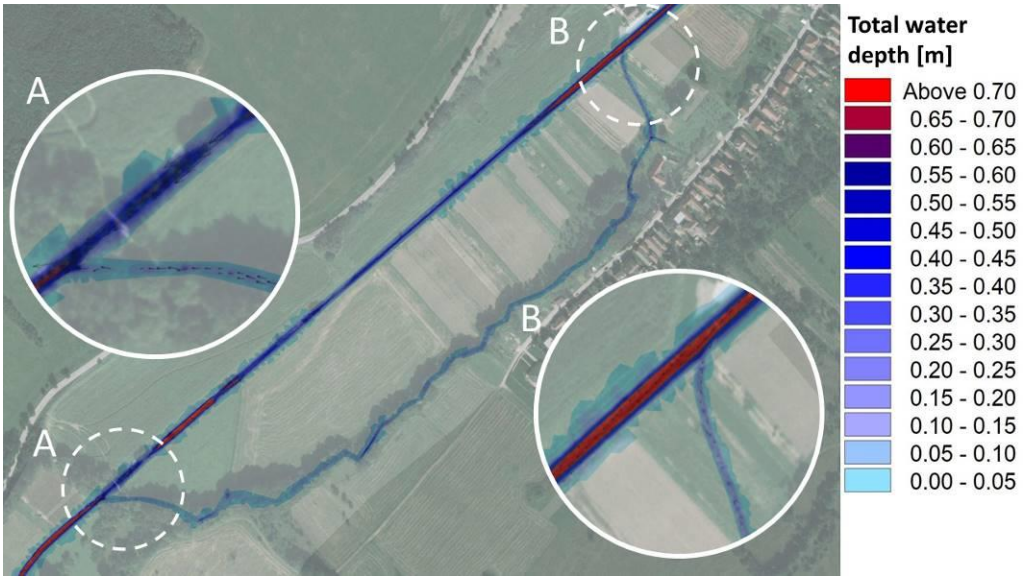

Fig. 6: Outputs of the hydrodynamic model

This measure together with design of the riparian vegetation along Teplica and design of the nature trail will significantly increase the attractiveness of the area for recreation and tourism development. Furthermore, the millrace restoration and revitalisation of the whole area will contribute to drought management by water retention in the landscape (Šurda et al., 2020) and will support the adaptation to microclimate change (Vasilaki et al., 2017).

Conclusion

The area around the millrace is currently in very poor condition and serves local citizens as a waste dump and septic (Fig. 3), where sewage is discharged from individual houses. Waste dump removal together with the construction of a sewage network or responsible individual sewage management is a prerequisite for the successful restoration of Teplica and the millrace. The connection of the millrace will be the first step towards the revitalization of the whole area, where the flowing water is expected to bring life to the locality and the measures were designed to use the flow potential for aesthetic formation of public space and increase the attractiveness of the area for recreation and tourism development.

References

Ivan, P., Macura, V., Belčáková, I. (2014). Various approaches to evaluation of ecological stability. SGEM 2014, Vol. I. Sofia: ISBN 978-619-7105-17-9.

Rončák, P., Vitková, J., Šurda, P. (2019). The components of water balance in changing climate in future horizons in Slovakia. SGEM 2014. Vol. 19, Sofia

Rončák, P., Šurda, P., Vitková, J. (2021). Analysis of a Topsoil Moisture Regime Through an Effective Precipitation Index for the Locality of Nitra, Slovakia. Slovak Journal of Civil Engineering, 29(1), 9-14.

Šurda, P., Vitková, J., Rončák, P. (2020). Regional Drought Assessment Based on the Meteorological Indices. Bull. Georg. Natl. Acad. Sci, 14(2).

Valent, P., Rončák, P., Maliariková, M., Behan, Š. (2016). Utilization of historical maps in the land use change impact studies: a case study from Myjava river basin. Slovak Journal of Civil Engineering. Vol. 24, no. 4, ISSN 1210-3896.

Vasilaki, M., Kohnová, S., Hanel, M., Szolgay, J., Hlavčová, K., Loukas, A., Rončák, P. (2017). Detection of future changes in seasonality in extreme short-term rainfall in selected stations of Slovakia. Contributions to Geophysics and Geodesy. Vol. 47, no. 2 (2017), DOI: 10.1515/congeo-2017-0009.

Výleta, R., Valent, P., Németová, Z., Hlavčová, K. (2019). An assessment of changes in ecological stability and landscape management practices over the last centuries: a case study from Vrbovce, Slovakia. WMCAUS 2019, Prague, Czech Republic. IOP Publishing, ISSN 1757-8981.

Acknowledgement

This research was jointly funded by the Slovak Scientific Grant Agency, grant No. VEGA 1/0068/19, and the Slovak Research and Development Agency, grant No. APVV-18-0347 and APVV-20-0374.

Souhrn

Studie je zaměřena na zvýšení rekreačního a turistického potenciálu zastavěné části západoslovenské obce Vrbovce. Řeka Teplica protékající intravilánem byla v minulosti z přírodního a estetického hlediska nevhodně upravena a v současnosti poskytuje jen málo příležitostí k rekreačnímu využití. Článek popisuje navrhovaný scénář, který může dosáhnout vysoce pozitivního efektu z hlediska rekreačního využití, ale také z hlediska zlepšení ekologického stavu lokality realizací revitalizačních opatření za relativně nízké náklady. V lokalitě se nachází starý nepoužívaný mlýnský násep, který je zanedbaný, plný odpadního materiálu a stojatá voda v něm je eutrofizovaná. Jeho napojení na upravené koryto Teplice vytvoří levobřežní rameno a poskytne cenný variabilní mikrostanoviště ve vodním prostředí jako protiváhu monotónnímu upravenému úseku. Propojení nábřeží bude prvním krokem k revitalizaci celého území, kde se očekává, že propojení oživí celou lokalitu a součástí opatření je využití potenciálu potoka pro estetické dotvoření veřejného prostoru a zvýšení atraktivity území pro rozvoj rekreace a cestovního ruchu.

Contact

doc. Ing. Andrej Škrinár, PhD.
E-mail: andrej.skrinar@stuba.sk

Open Access. This article is licensed under the terms of the Creative Commons Attribution 4.0 International License, CC-BY 4.0 (https://creativecommons.org/licenses/by/4.0/)