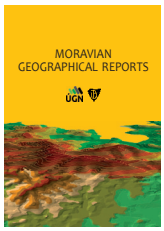

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Spatial planning as a tool of flood risk management in rural landscapes? Position, limitations, and other findings: The case of Myjava Region (Slovakia)

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Abstract

In the context of flood risk management, the application of spatial planning is challenging. This article specifies the position of spatial planning in the context of flood risk management in Slovakia. Through a case study, it assesses the potential of municipal spatial plans to reduce flood risk in rural landscapes. The analysis of municipal spatial plans includes the following aspects: the legislative framework, the actionability of spatial plans and the competences of municipalities. The results showed that in terms of key aspects of flood risk management in the rural landscape, i.e. reducing flood risk through the application of eco-stabilisation measures and reducing the negative consequences of floods through the functional and spatial arrangement of the rural landscape, spatial plans have the status of a formal document. There are several reasons for this. The first one is centralised governance of flood risk. The second reason is the flood risk policy where protection by the technical infrastructure is dominant. The third reason is inconsistent use of municipal powers to reduce flood risk based on a spatial plan. The expectation that the municipalities' spatial plans could contribute to effective flood risk management in the rural landscape thus remains a challenge.

Key words: *Spatial planning, flood risk, rural landscape, municipality, environment and ecological stability, Slovakia*

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1. Introduction

The increased incidence of floods in recent decades and their negative consequences indicate that tackling floods solely based on flood protection through technical infrastructure is no longer sufficient (Di Baldassarre, 2018). Therefore, the flood paradigm is changing and the strategy for flood protection is gradually moving towards integrated flood risk management focused on the reduction of potential flood risk through the application of a diversified set of strategies and measures. These aim not only to reduce flood hazard but also to reduce the social vulnerability and increase the resilience of society to floods (APFM, 2004; ISDR/UN, 2007; Sapoutzaki, 2012; Hegger et al., 2016; Priest et al., 2016; McEwena et al., 2018). According to Ran and Nedovic-Budic (2016), the implementation of such an integrated approach in practical activities requires the harmonisation of territorial units, the interconnection of public policies and cooperation between actors.

The regulation of economic activity and settlement in flood-prone areas is generally considered to be one of the key strategies for reducing flood risk potential. The conditions for the location and spatial arrangement of buildings, as well as the regulations of the functional use of the land are set out in spatial planning. According to Neuvel and Van der Knaap (2010) and Dawson et al. (2011), the spatial plan can therefore be considered one of the key non-structural tools of flood risk management. Spatial plans can be developed at the national, regional, or local levels. There is general agreement, however, that community-level spatial planning is crucial in terms of effective flood risk reduction (Begg et al., 2015). Spatial plans at the local level allow the combination of 'technical analysis with community participation to make wise choices among alternative strategies of land use changes' (Burby et al., 2000).

Although spatial planning is generally appreciated for flood risk management, there are several obstacles to its practical implementation. According to Ran and Nedovic-Budic (2017), important obstacles that prevent spatial planning from becoming an effective tool for flood risk management include, for example, a lack of communication and coordinated action between spatial planning and flood risk management authorities. In addition, planners and flood risk managers tend to have different views of the role that spatial planning has in flood risk management. In this context, Burby et al. (2000) emphasise that spatial plans will have little effect if 'they do not result in a program of action that leads to a more hazard-resilient community'.

Spatial plans are a comprehensive document in which several factors, such as factors of demographic, social, economic, and sustainable development, nature protection or biodiversity of the territory, play an important role in connection with the development of the territory and its spatial arrangement and

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functional use. Therefore, it is not surprising that in spatial plans in many countries, the issue of flood risk 'often takes a back seat' relative to economic development (Begg et al., 2015).

Another important factor influencing the relevance of spatial planning in the context of flood risk management is flood risk governance (Fournier et al., 2018; Kaufmann, 2018; Lifferink et al., 2018; Mees et al., 2018; Matczak et al., 2018; Wiering et al., 2018; Dordi et al., 2020). Flood risk governance is understood as an arrangement of actors, rules, resources, and discourses linked by a common goal of flood risk management (Hegger et al., 2016). In countries such as the Netherlands, where flood risk governance is centralised, i.e. the state is the dominant actor and flood risk reduction is carried out exclusively by technical infrastructure (Kaufmann, 2018), spatial planning is not considered a flood mitigation measure (Neuvel & Van den Brink, 2009). On the other hand, significantly decentralised flood risk governance, together with the application of diversified flood risk management strategies in spatial planning (Böhm et al., 2004), occurs in England (Priest et al., 2016), where flooding issues must be taken into spatial planning (Begg et al., 2015; Green, 2017).

The main objective of this research is to answer the question of whether spatial plans in Slovakia are an effective tool for flood risk management at the local level. Slovakia is a mountainous country and, for the most part, has a rural character; therefore, it is appropriate to analyse the importance of municipal spatial plans in the context of flood risk management in rural landscapes. The region of Myjava in the western part of Slovakia was therefore selected as a case study. In the context of flood risk management in rural landscapes, Rouillard et al. (2015) emphasise the application of measures to increase the retention capacity of the rural landscape by regulating agricultural production and forestry while increasing biodiversity in rural areas. Achieving this is therefore something of a further challenge for municipal planning: the question is whether this challenge will be met. The mere existence of spatial plans at the municipal level does not guarantee that they will function as a real flood risk management tool. By analysing municipal spatial planning within the legislative framework of flood risk management and spatial planning, flood risk governance and the powers and resources of local authorities, we sought to assess whether municipal spatial plans are an effective tool for flood risk management.

2. Case study area: selection of municipalities in a rural landscape

The case study area is represented by the Myjava region in the western part of Slovakia, extending to the Myjava Hills, the Little Carpathians and the White Carpathians. The region includes the cadastral area of 20 municipalities (Fig. 1). The use of municipal spatial plans as a tool for flood risk management in a rural landscape is topical, especially in municipalities with a high flood risk potential. Within the framework of the Preliminary Flood Risk Assessment of the SR (MoE SR, 2011) 27 critical river sections with a potentially significant flood risk located in 15 municipality districts were identified (Fig. 1). Based on a systematic evaluation of the attributes of cadastral areas in terms of their impact on flood risk, Solín and Rusnák (2020) identified eight municipalities with potentially significant flood risk in the Myjava region: Brezová pod Bradlom, Kostolné, Krajné, Myjava, Podbranč, Sobotište, Stará Myjava and Vrbovce (Fig. 2). Of these municipalities Kostolné and Stará Myjava do not have a spatial plan. The remaining six municipalities have a spatial plan, and these are the subject of our analysis. Brezová pod Bradlom (Architektonický atelier BP, 2015) and Myjava (Aurex, s.r.o., 2006; 2020) are obliged to prepare a spatial plan because they have more than 2,000 inhabitants. Municipalities with less than 2,000 inhabitants, namely Krajné (Krušinský, 2014), Podbranč (Mikluš & Halinár, 2019), Sobotište (AŽ Project, s.r.o., 2013) and Vrbovce (Maro SK, s.r.o., 2008; AŽ Project, s.r.o., 2020) have developed spatial plans for various other reasons.

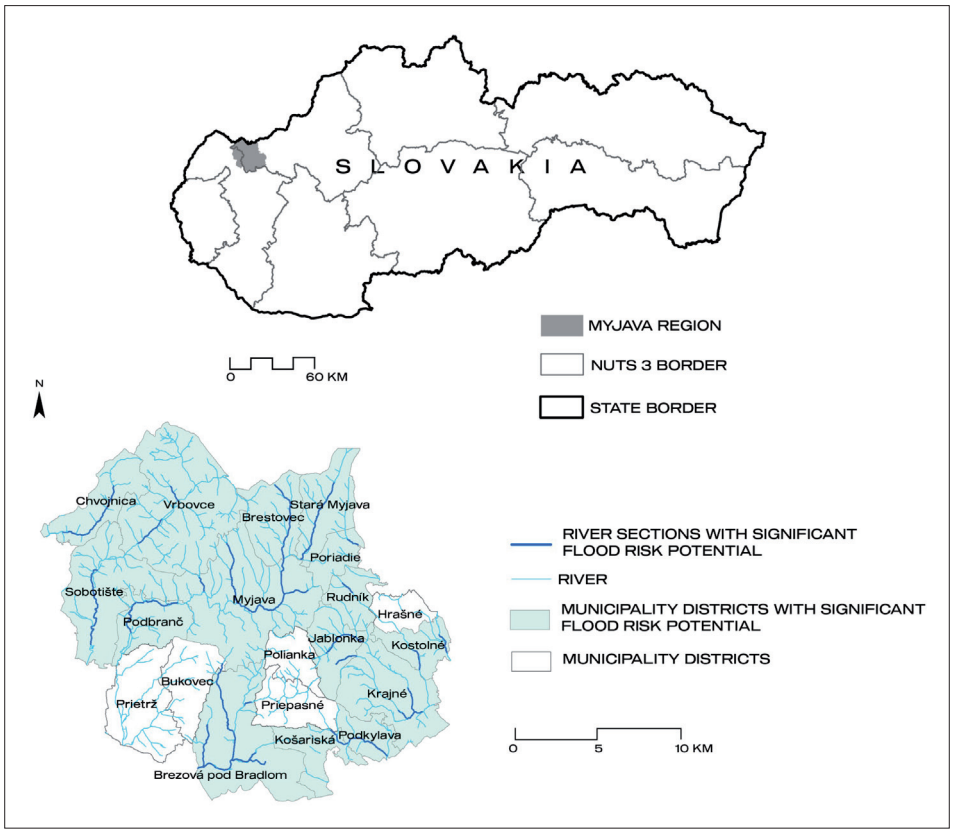

Fig. 1: The Myjava region and river sections with a potentially significant flood risk
Source: authors' elaboration based on MoE SR (2011)

3. Research design

In order to assess whether municipal spatial plans are an effective tool for flood risk management in rural landscapes, we consider it important to answer to the following questions:

i. Whether the flood risk issues are included in municipal spatial plans and, if so, in what context;

ii. Whether application schemes for the implementation of flood protection measures in the cadastral area are developed in the spatial plans; and

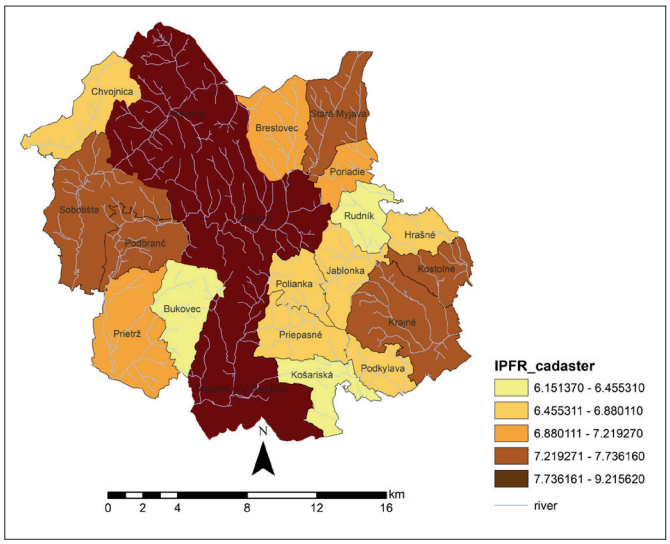

Fig. 2: Spatial differentiation of the municipalities of the Myjava region in terms of flood risk potential index (IPFR)
Source: Solín and Rusnák (2020)

iii. Whether the development of the municipalities is harmonised with the expectations of reducing the flood risk.

To answer these questions, we used a research design including the following aspects: the legislative framework, the action ability of the spatial plan and the competences of the municipalities. A flow chart of the research design is shown in Figure 3.

The starting point of the analytical framework is the analysis of the legislative framework of flood risk and spatial planning. The legislative framework of flood risk management was established by the Flood Protection Act (Act No. 7/2010). The issue of spatial planning is regulated by the Act on Spatial Planning and Building Regulations (Act No. 237/2000).

In assessing the actionability of the municipality's spatial plan in the context of flood risk issues, the analysis focused on:

- How the issue of flood risk is reflected in the objectives of the spatial plans;
- How the required tasks related to the reduction of flood hazard from the superior documents are implemented in the spatial plans of municipalities;
- Whether municipalities formulate their proposals in spatial plans for measures to reduce flood risk at the local level; and
- How landscaping measures, care for the environment and ecological stability are postulated.

In connection with the possible implementation of the flood risk measures, we considered what the real powers and resources (financial, informational) of the municipality were. The overall goal of spatial planning is to ensure sustainable economic and social development of the municipality. In this context it is important to know whether development is in line with the expectations of reducing flood risk. Thus, we assess the spatial and functional

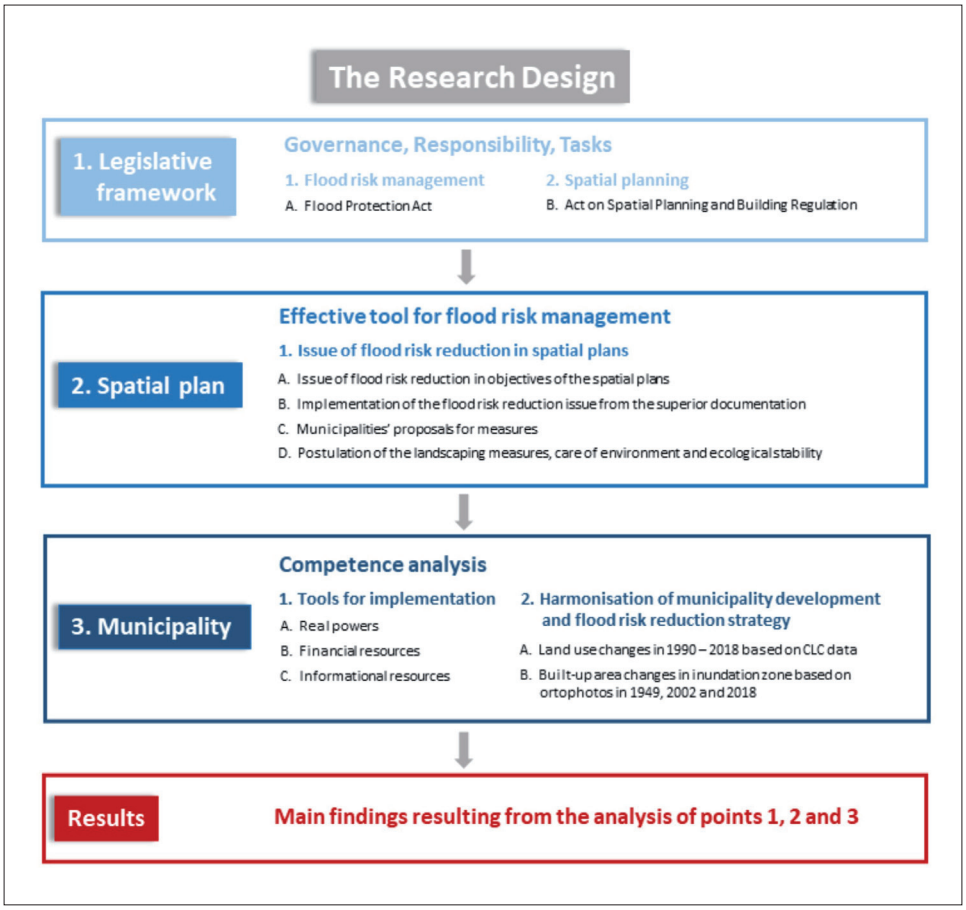

Fig. 3: Flow chart of research design
Source: authors' elaboration

organisation of municipalities in the period 1990–2018. The changes were identified based on CORINE Land Cover (CLC) data from the European Environmental Agency (https://land.copernicus.eu/pan-european/corine-land-cover), which identified the state of land use in 1990, 2000, 2006, 2012 and 2018. The monitoring of changes in cadastral areas was based on an examination of the area of 13 land cover classes of the third hierarchical level of the CORINE Land Cover Nomenclature (Feranec et al., 1996) in the period 1990–2018. Overlaying the land cover allows stable and changed areas to be identified. The CLC data layer, however, has a spatial resolution of 25 ha. Such a distinction greatly limits the mapping of built-up areas, especially in areas where scattered buildings often do not form uniform areas. That is why we decided to map the development of the built-up area in the inundation area of floods with a return period of 100 years on average (MŽP SR, 2015), using black and white aerial photographs from 1949 and orthophotos from 2002 and 2017, with a high spatial resolution of 50cm × 50cm per pixel (years 1949 and 2002), and 20cm × 20cm per pixel (year 2017) (TOPÚ; GKÚ, 2002; GKÚ and NLC, 2017).

4. Results

4.1 Analysis of the legislative framework

4.1.1 Flood legislation

The current legislative framework (Act No. 7/2010) creates a strongly centralised state governance of flood risk. The decisive state authority responsible for the management of flood risk is the Slovak Water Management Enterprise (SVP, state-owned enterprise (hereinafter s-o-p). Other authorities responsible for preventive flood protection, namely state administration authorities (regional district offices, district offices), and self-government authorities (municipalities, higher territorial units/NUTS 3) are legally and professionally lower and their activities in the field of preventive flood protection are tied to cooperation with SVP, s-o-p. The basic documents of the flood protection policy elaborated by SVP, s-o-p. are the Preliminary Flood Risk Assessment (PFRA), Flood Hazard Maps (FHM), Flood Risk Maps (FRM) and Flood Risk Management Plans (FRMP). The concept of flood protection with technical infrastructure is still dominant in FRMP.

According to Act No. 7/2010, the municipalities: i) provide to the SVP, s-o-p, information from spatial planning documentation, which can contribute to the elaboration and updating of PFRA and FRM: ii) coordinate building permits and the regulations of the spatial and functional use of the land in the spatial plan with the measures set out in the FRMP; and iii) ensure the marking of all flood lines shown on the FHM in the spatial plan, taking into account the implementation of prohibited activities across the entire extent of the inundation area determined by the flood lines. Furthermore, the municipalities must respect the protection of the land along the banks of the watercourse to a width of 10 m from the riverbank for the water management of significant streams and 5 m in the case of small watercourses.

Act No. 7/2010 also stipulates that to achieve optimal flood protection, the FRMP as well as the River Basin Management Plan (RSV 2000/60/ES) must be coordinated with other land use planning tools, in particular landscaping projects, spatial planning, and forest plans, with which they will jointly form an integrated landscape management tool.

4.1.2 Spatial planning legislation

The issue of spatial planning is regulated by Act No. 237/2000 according to which spatial planning continuously addresses the spatial arrangement and functional use of the territory, determines its principles, proposes the coordination of activities affecting the environment, ecological stability, cultural and historical values of the territory, territorial development, and landscape creation following with the principles of sustainable development. Spatial plans are developed for different spatial levels. The strategy of territorial development in the state is prepared by the ministry; higher territorial units perform this activity for the territory of regions, and municipalities provide spatial plans of municipalities and act as building permit authorities.

Cities and rural municipalities with more than 2,000 inhabitants are obliged to draw up a spatial plan. Other municipalities are obliged to have a spatial plan when it is necessary to address the concept of their spatial development, carry out large-scale new construction and reconstruction in the municipality or site public works or follow the binding part of the spatial plan of a region, especially to meet international obligations or regarding the location of public transport and technical equipment of the territory of national importance.

The spatial plan of the municipality includes, in particular:

a. Principles and regulations of spatial arrangement and functional use of the territory of the municipality relative to the surrounding territory;
b. Permissible, limited and prohibited functional use of areas;
c. Principles and regulations of care for the environment, the territorial system of ecological stability and landscape creation, including green areas;
d. Principles and regulations of protection and use of natural resources, cultural and historical values and important landscape elements;
e. The boundary between the continuously built-up area and the other territory of the municipality;
f. Principles and regulations of public transport, technical equipment, and civic equipment; and
g. Areas for public works, remediation and for protected parts of the landscape.

The municipality's spatial plan comes into validity after approval by the district office. The condition of approval is the compliance of the municipality's spatial plan with the binding part of the zoning plan of the higher territorial unit. The legislative framework of spatial planning concerning flood risk management shows that through spatial planning (items b, g), the spatial requirements for the implementation of flood protection measures proposed in the PRMP and the regulation of activities in the inundation zone are ensured. The legislative framework of spatial planning, however, also stipulates that municipalities pay attention to the care of the environment and ecological stability of the territory (item c). This is an aspect that can quite significantly affect flood risk in a rural landscape.

4.2 Spatial plan as effective tool for flood risk management

4.2.1 Issue of flood risk reflected in the objectives of the spatial plans

The spatial plans of municipalities set various specific objectives, which relate to ensuring the development of business activities, housing, services, recreation and tourism, preservation of cultural and historical monuments and nature reserves and improving the quality of the environment, among others. Even though the municipalities in question are characterised by a high potential of flood risk and the occurrence of floods in some way limits economic development and causes property, physical and psychological damage, with one exception (municipality Podbranč), no attention is paid to the issue of floods in the specific objectives of the spatial plans.

4.2.2 Required tasks from superior documents

According to the legislative framework, the spatial plans of the municipalities must follow the spatial plan of the higher territorial units (NUTS 3, further as the region). Therefore, they should

consider issues relating to flood protection and environmental policy from the superior documentation. The relevant tasks in the regional authorities' spatial plans (superior documentation) in terms of flood risk reduction are set out in two parts. The first is focused on the arrangement of the land in terms of ecology, nature and landscape protection, as well as the protection of agricultural and forest land. The second deals with the development of the technical infrastructure of water management. They are specified in Table 1. It is important to note that the general tasks of the spatial plans of the regions are formally implemented into the spatial plans of municipalities. They are not elaborated in more details either in terms of specifying their spatial application or listing specific measures or entities responsible for their implementation.

The municipalities' spatial plans must also be harmonised with the FRMP (MoE SR, 2015). Proposed measures are listed in Table 2. Technical flood protection measures for river sections with significant flood risk are precisely specified and their location is stated (see columns 2–3 in Tab. 2). Their implementation is ensured by the creation of a territorial guarantee in the spatial plans. On the other hand, the maintenance measures for watercourses that ensure the flow capacity of the channels are slightly less targetted. In contrast, measures that slow down the outflow of water from a river basin and increase its retention capacity are listed in the FRMP only in a general declarative form. Their provision and implementation are not elaborated in detail in the municipalities' spatial plans either.

Another mandatory regulation resulting from the legislation relates to a 5 m wide area along the banks of a watercourse and the designation of flood lines for low, medium, and high probability floods in the spatial plan. In the case of area along watercourses, it is only generally stated in spatial plans that it must be maintained in such a way that obstructions to runoff make access to the watercourse difficult or impossible or do not encourage sediment deposition. The flood lines for floods with low, medium, and high probability of occurrence, which are shown on FHM must be drawn in the municipal spatial plan at the next update of the approved spatial plan. Apart from Sobotište, other municipalities have already updated their spatial plans between 2014 and 2020, but only Brezová pod Bradlom and Myjava had flood lines drawn in the spatial plan.

4.2.3 Measures for the environment and ecological stability

Measures related to landscaping and environmental care (eco-stabilisation measures) in the spatial plans can be divided into two basic groups, namely measures in the river landscape (watercourses and their riverine zone) and measures in forest and agricultural land. Although eco-stabilisation measures are not explicitly mentioned in the spatial plans in the context of flood risk management, there are measures that could make a significant contribution to reducing flood risk in the rural landscape. A wide range of general principles of watercourse, agricultural and forestry management (Tab. 3) is listed in several variations in the spatial plan of each municipality. In connection with watercourses, the spatial plans of municipalities mention the revitalisation through the maintenance of their channels and riparian vegetation and the preservation of their natural meandering. In the case of agricultural and forest land the application against erosive farming practices on agricultural land and logging in the forest is reported. The general principles of landscaping and environmental care and the application of eco-stabilisation measures in municipal spatial plans in terms of the potential reduction of flood risk in rural landscapes cannot be questioned. The spatial plans of

SECTION	
Land organisation in terms of ecology, nature, and landscape protection and protection of agriculture and forest land	**Water management and flood protection**
• -up areas, especially in public spaces; to develop landscape greenery in implement systems for the proper use of agricultural land and their protection against erosion, weeds, excessive urbanisation, insensitive transport network solutions and all types of waste	• perform maintenance on modified watercourses to maintain the built capacities
• support the solution of erosion problems, which is proposed in the framework of landscaping and within the projects of the local territorial system of ecological stability, through draws, erosion belts and windbreaks	• improve water management conditions on small watercourses and in the river basin by interventions aimed at stabilising conditions in extreme situations, both floods and droughts
• create conditions for stopping the process of reducing biodiversity in the whole territory of the region	• ensure, on the unmodified sections of watercourses, particularly, the protection of urban areas of municipalities and subsequently comprehensively solve run-off conditions following development programmes
• gradually address the issue of building paved and unpaved forest roads so that soil erosion on slopes does not occur	• provide preventive anti-erosion measures, especially on the sloping parts of the Chvojnica and Myjava river basins, pay attention to the observance of correct agrotechnical procedures, planting and maintenance of protective vegetation belts in the vicinity of agricultural areas and the establishment of infiltration areas
• pay attention to the revitalisation of existing streams, complete the accompanying vegetation by planting a belt of domestic tree species and shrubs along the streams and by increasing the share of grasslands in the surrounding microdepressions	• create conditions for timely preparation and implementation of flood control measures
• respect the inundation areas of watercourses in municipalities in the region and define them as inadmissible from the point of view of placement of new buildings	• implement constructions connected with anti-flood measures in the Váh, Nitra and Myjava sub-basins for the protection of urban areas of municipalities following the Flood Protection Programme of the Slovak Republic and for other watercourses in the Váh, Nitra and Myjava sub-basins following the investment development programme of Slovak Water Management Enterprise and water management concept
• supplement the accompanying vegetation by planting strips of native domestic tree species and shrubs along watercourses; build shading strips of greenery along exposed watercourses	• respect the flood lines resulting from flood hazard and flood risk maps, especially in areas where significant flood risk is likely to occur
• increase the level of representation of natural elements in builtbuilt-up areas and the open country	• prevent the formation of stormwater in the area, e.g. designing systems of polders, ditches and retention reservoirs in the country, along with suitable landscaping systems
• minimise the construction of impermeable surfaces in the country	• support the retention of rainwater in the area, in the form of natural retention reservoirs, ponds, building occasional water areas filled only with precipitation or replenishment of green areas
• promote the implementation of adaptation measures to climate change in built-up areas of municipalities through spatial planning tools	• respect the protection zones of watercourses, dikes and inundation areas, where, depending on the circumstances, mainly grass, grass-herbaceous vegetation is applied

Tab. 1: Binding tasks for spatial plans of municipalities related to flood risk resulting from the spatial plans of the regions (Trenčín and Trnava self-governing region)
Source: authors' compilation

MEASURES PROPOSED IN FLOOD RISK MANAGEMENT PLANS			
Measures slowing down the outflow of water in the river basin and increasing its retention capacity	**Measures reducing the maximum flow**	**Measures protecting the area from flooding by water from a watercourse**	**Measures ensuring the flow capacity of the watercourse**
• measures in normally managed forest stands	*Brezová pod Bradlom:* • regulation of the Brezová pod Bradlom water reservoir • area suitable for natural transformation of flood waves in 17.2–18.0 km of Brezovský brook	*Kostolné:* • modification of the riverbed from natural materials to the flow Q100 in km 1.370–1.89 • Dubník water reservoir to build a supporting concrete wall (520 m)	*Brezová pod Bradlom:* • watercourse maintenance (mowing, removal of airborne trees, sediments from the stream and remediation of bank reservoirs)
• comprehensive measures that slow down run-off from the basin, such as adjustments on agricultural land (change of cultivated crops), ploughing along contours, anti-erosion sowing procedures, construction of draws to eliminate soil flushing, construction of infiltration belts	*Podbranč:* • polder Malejov in km 64,434	*Podbranč:* • modification of watercourse in km 64.404 – 64.484 (part of construction ‚Malejov Polder') • modification of the watercourse in km 58.032 –58.555 with the construction of protective dams	*Krajné:* • necessary maintenance of the old modification (Jablonka) • elimination of raids on slopes (Rudník km 2.4–4.0) • maintenance of the Matejovský brook (km 0.900, removal of inadequate culvert)
	Myjava: • polder Cengelka in km 2.10 • polder Padelky on the right-hand tributary of Myjava (Hukov brook) in km 1.20 • polder Smíchov in km 0.605	*Myjava:* • modification of watercourse in km 2.05–2.13 (part of construction Cengelka Polder' • modification of watercourse in km 1.13–1.29 ((part of construction Padelky Polder')	*Kostolné:* • necessary cleaning and removal of sediments (Kostolník km 1.89–2.3)
	Sobotište: • Sobotište water reservoir		

Tab. 2: Summary of proposed measures in FRMP
Source: authors' elaboration

municipalities, however, lack the elaboration of implementation schemes of general ecostabilisation principles with an indication of specific measures and localities within the cadastral area where they are to be implemented and the subject that is to ensure the implementation.

4.2.4 Municipalities' proposals for measures to reduce flood risk at the local level

The legislative framework itself does not explicitly stipulate that the municipalities perceive the spatial plan as a flood risk management tool, which would specify their own proposals for measures to reduce flood risk. Also, the local authorities propose almost no flood risk reduction measures in their spatial plans by their own initiative.

4.3 Competence analysis

4.3.1 Tools for implementation

When considering why municipalities are not motivated to exert more effort and initiative in flood risk management at the local level and develop local application schemes for specific eco-stabilisation measures, three factors come to the fore: a) very weak legislative powers; b) lack of financial resources; and c) insufficient systematic assessment of flood risk with attributes of the cadastral area.

Regarding the implementation of measures on watercourses, according to Act No. 7/2010 the maintenance of watercourses can only be performed by the administrator of watercourses. Municipalities are usually not administrators of watercourses (only about 1% of watercourses are managed by municipalities). So, municipalities cannot perform activities related to the care of watercourses. The mayors of municipalities may submit a request for the maintenance of small watercourses at the time of the flood inspection organised by the district office once every two years. The district office may, by its decision, impose on the watercourse administrator the obligation to eliminate the identified deficiencies, but this process is very inefficient.

The legislative competence of the municipality is limited even in the case of the implementation of ecostabilisation measures on agricultural land. The decisive owners of agricultural land (physical persons) usually lease the land for use to agricultural cooperatives or various agribusinesses. The act on the conservation and use of agricultural land (Act No. 220/2004) stipulates that the owner or tenant is obliged to implement protective agrotechnical measures for erosion protection of agricultural land, such as planting of agricultural and protective greenery; contour agrotechnics; crop rotation with protective effect; mulching intermediate crop combined with no-till technology; and other measures to be determined by the soil service according to the degree of soil erosion. If such protective measures are not applied to eroded soils, the competent authority, which is obliged to request their implementation, is the District Land Office.

Another legislative regulation, which includes the implementation of anti-erosion adjustments on agricultural land, is the Act on Land Arrangements, Land Ownership Arrangements, Land Offices, Land Fund and Land Communities (Act No. 330/1991). According to that law, if it is necessary to restore or improve the functions of ecological stability and the overall character of the agricultural landscape, to reduce agricultural or forestry production due to the declaration of protection zones or to address the consequences of natural disasters, the District Office may order land readjustments. Land improvements include measures to protect the soil from erosion and water erosion (grassing, afforestation, windbreaks, infiltration belts, terraces, dams and canals), measures to protect the environment and create ecological stability of the country's biodiversity (biocorridors, biocentres, interaction elements and accompanying greenery) and water management measures to ensure protection against flash floods, waterlogging and water supply to cover moisture deficit (polder tanks, drainage and irrigation). Landowners may claim some compensation (money or other land) from the state for land subject to adjustment. The agreement on the amount of compensation between the landowner and the state, however, is a critical point of land readjustment.

Municipality	Watercourses	Agricultural And Forest Landscape
Brezová pod Bradlom	• further straightening of streams, strengthening of banks and removal of riparian vegetation in the area and inappropriate regulation of watercourses are not recommended • it is necessary to observe the protection zones of watercourses • it is recommended to extend the already modified riverbeds again	• improvement of physical properties of soils, change of management method and types of crops, ploughing along the contour, creation of catch ditches, planting of protective greenery • division of land, crop rotation, boundaries, draws, seepage ditches • restoration of wetlands, small polders in valleys, small reservoirs, and ponds) • controlled flooding to selected localities in territorial floodplains (based on flood hazard and flood risk maps – not yet processed)
Krajné	• revitalisation of the Jablonka stream in the built-up area of the village • revitalisation and reconstruction of the original riparian vegetation of all streams in the cadastral area • removal of erosive deposits, alluvium, dead wood, various waste, etc. • strengthening of erosion-affected riparian parts of streams	• unequivocally preserve the current spatial organisation of elements of the landscape structure (especially the area with beds, gardens, orchards, permanent grassland, and scattered vegetation in the country) • to preserve the current use of the agricultural part of the country, permanent grassland intensively mown and grazed • prevention of unnatural land formation (uncontrolled overgrowth) • in localities with a slope greater than 12° consider growing broad crops (maize, sunflower) due to high soil flushing, water erosion, etc. • not to plant new areas in the land of the cadastre, to understand the lines of non-forest vegetation in the country as anti-erosion or anti-flood natural elements
Podbranč	• conversion of agricultural crops to permanent grassland on areas of arable land that directly touches the banks of watercourses or is in the meanders of the Morava River	• change of agricultural crops to non-forest woody vegetation in localities where water erosion occurs • network of field roads with vegetation • heavily wetted parts overgrow with moisture-loving vegetation or change to permanent grassland • to improve the technical condition of areas with a built drainage system • increase the share of non-forest woody vegetation along streams and canals, roads and create areas of so-called draws
Sobotište	• completion of vegetation support along water canals and streams	• inappropriate and inadmissible are activities that conflict with the protection and enjoyment of agricultural land, with integrated prevention and control of environmental pollution, with the protection of forest land in spatial planning activities
Vrbovce	• revitalisation of modified sections of the Teplica (Vrbovčianka) stream	• leave non-forest woody vegetation to natural successive development • divide blocks of agricultural land into smaller units by planting landscape greenery • grass important water management areas • maintain the mowing of meadows and orchards, meadows, and pastures in the vicinity of the farmsteads
Myjava	• modification of the Myjava riverbed and adjacent watercourses • retention of original trees of riparian vegetation and their thickening by geographically original species revitalization of watercourses (e.g. Svacenický spring) • Ţriedlovský brook, Brezovský brook, Smíchov polder, Cengelka polder)	• anti-erosion grassing of slopes on which water erosion occurs • exclusion of logging from commercial forests • in the hilly area, leave or create a mosaic-like representation of permanent grassland and arable land • increasing the share of non-forest greenery by planting drawbridges and smaller woods in the open countryside in connection with local landscaping • anti-erosion line elements of greenery – artificially created – elements of tree and shrub vegetation, original tree species planted on agriculturally cultivated soils in the open country, connected to urban greenery

Tab. 3: Landscaping and environmental principles affecting the flood hazard in spatial plans of municipalities
Source: authors' elaboration

4.3.2 Harmonisation of municipalities' development and flood risk reduction strategy

In terms of function, the cadastral territory of the municipality is usually divided into several basic blocks (Tab. 4). For each block, a main function of its use is defined, which can be supplemented by a set of functions of additional functional use as required. For each block, the non-allowable functions of its use are also exhaustively listed.

Development impulses of the municipality, such as population growth, business plans and new investments, among others, exert pressure on the expansion of built-up areas or the change of functional use of the areas as such. The evolution of land cover changes within cadastral areas for the 1990–2018 period, observed based on CLC data, is presented in Figure 4. Then Table 5 summarises the percentage change (increase/decrease) in land cover classes CLC 112 and CLC 121 in individual years. The number of inhabitants in the municipalities has been slowly decreasing over the last 30 years, only Stará Myjava has been growing since 2006 and Podbranč since 2012. The population is related to the housing stock, which is represented by the land

BLOCKS OF TERRITORY
Housing areas – family houses, residential houses
Areas of civic amenities – non-commercial, commercial, school
Multifunctional areas of trade and services
Multifunctional areas of production and services
Industrial production areas
Agricultural production areas
Recreation areas
Sports area
Areas of technical equipment
Areas of orchards and gardens
Meadow areas
Forest areas
Arable land areas
Areas of non-forest vegetation

Tab. 4: Functional blocks of cadastral territory
Source: authors' elaboration

Municipality	Period									
	1990–2000		2000–2006		2006–2012		2012–2018		1990–2018	
	CLC 112	CLC 121	CLC 112	CLC 121	CLC 112	CLC 121	CLC 112	CLC 121	CLC 112	CLC 121
Brezová pod Bradlom	4.80	0.00	9.21	– 2.52	– 0.03	0.00	7.16	43.02	22.61	39.41
Kostolné	0.00	–	– 1.15	–	0.00	–	0.28	–	– 0.87	–
Krajné	0.00	–	– 2.69	–	7.35	–	22.48	–	27.95	–
Myjava	1.92	0.00	– 14.96	– 0.41	12.60	21.18	– 7.61	3.67	– 9.84	25.11
Podbranč	0.00	–	– 41.41	–	24.95	–	– 30.39	–	– 49.04	–
Sobotište	4.76	–	9.64	–	– 2.98	–	– 0.05	–	11.39	–
Stará Myjava	0.00	–	5.78	–	0.30	–	2.78	–	9.05	–
Vrbovce	0.00	0.00	1.31	0.30	– 7.29	0.00	22.72	0.00	15.27	0.30

Tab. 5: Percentage changes in land cover classes CLC112 and CLC121 in the cadastral territory of municipalities in the Myjava region in the years 1990–2018. Source: recalculated EEA

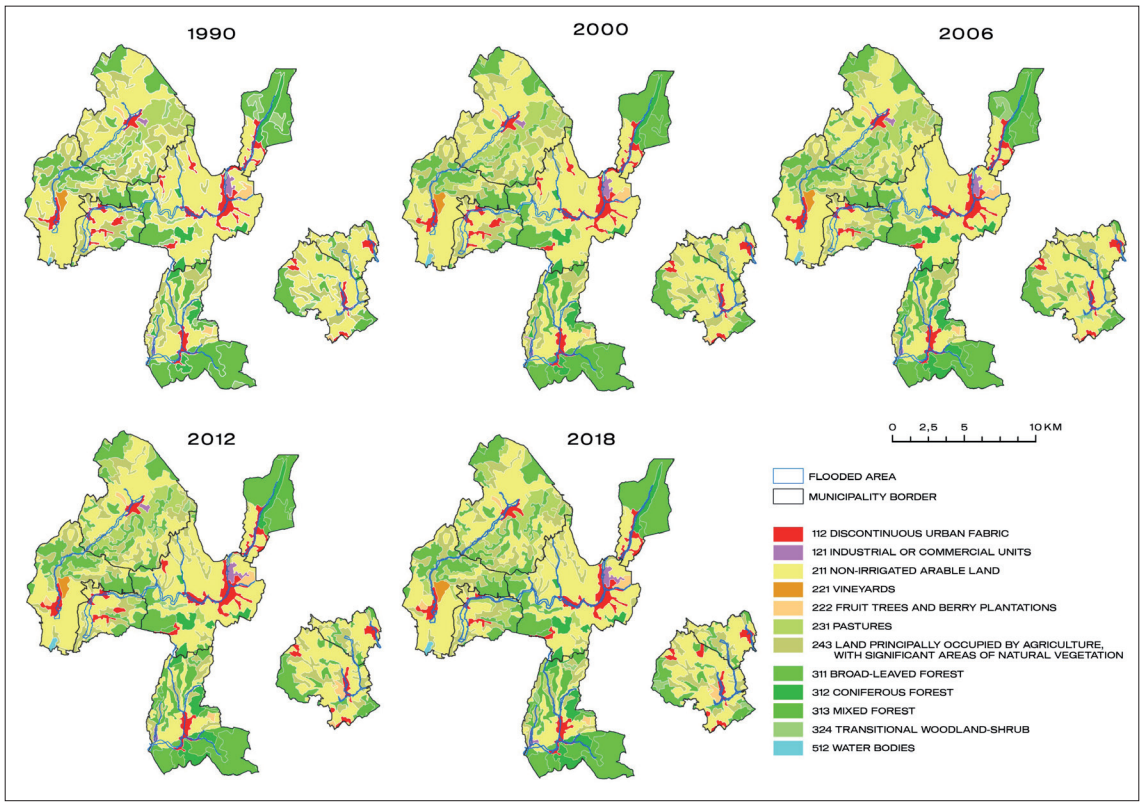

Fig. 4: Changes in landscape cover in the cadastral territory of municipalities in the Myjava region in the years 1990–2018 Source: EEA

cover class CLC 112, discontinuous urban fabric. The analysis of the development of this class shows a slight increase in its area in the cadastral territories in 2018 compared to 1990, except for the municipalities of Myjava, Podbranč and Kostolné, where a decrease in housing construction was observed (Tab. 5). A more significant increase in built-up areas due to the increase in industrial and commercial areas (CLC 121) was observed in 2018 in the municipalities of Brezová pod Bradlom and Myjava.

As mentioned in Section 3, much more accurate information on the development of the built-up area is provided by the analysis of aerial black-and-white images from 1949 and orthophotos from 2002 and 2017 in higher spatial resolution (Fig. 5). A more detailed analysis of the built-up area in the inundation zone delineated by the flood with a return period on average once in 100 years in the municipalities of interest in 1950, 2002 and 2017 is presented in Table 7 and Figure 6. The analysis shows a significant increase in the built-up area in the municipalities' inundation zone from the 1950s to the beginning of the 20th century. In four municipalities (Brezová pod Bradlom, Krajné, Sobotište and Stará Myjava) the built-up area increased by more than 200% in 2002

Population	1991	2000	2006	2012	2018
Brezová pod Bradlom	5,551	5,647	5,431	5,092	4,834
Kostolné	729	684	623	628	586
Krajné	1,878	1,725	1,639	1,587	1,507
Myjava	13,135	13,167	12,729	12,185	11,591
Podbranč	751	670	626	609	614
Sobotište	1,693	1,558	1,508	1,490	1,486
Stará Myjava	781	696	738	744	774
Vrbovce	1,663	1,556	1,536	1,551	1,497

Tab. 6: Population development in municipalities Source: Statistical Office of SR

compared to the year 1950. If we focus on the last 15 years (2002–2017), the increase in the built-up area is slower and in the four municipalities with the highest increase (Stará Myjava, Myjava, Kostolné and Vrbovce) the built-up area in the inundation zone increased by more than 20%. On the contrary, it remained almost the same in the village of Podbranč. When comparing the relative increments, it was shown that among all the monitored municipalities, the most building in the inundation zone was in

Fig. 5: Demonstration of development of the built-up area in higher spatial resolution. Example from Brezová pod Bradlom
Source: TOPÚ, GKÚ, NLC

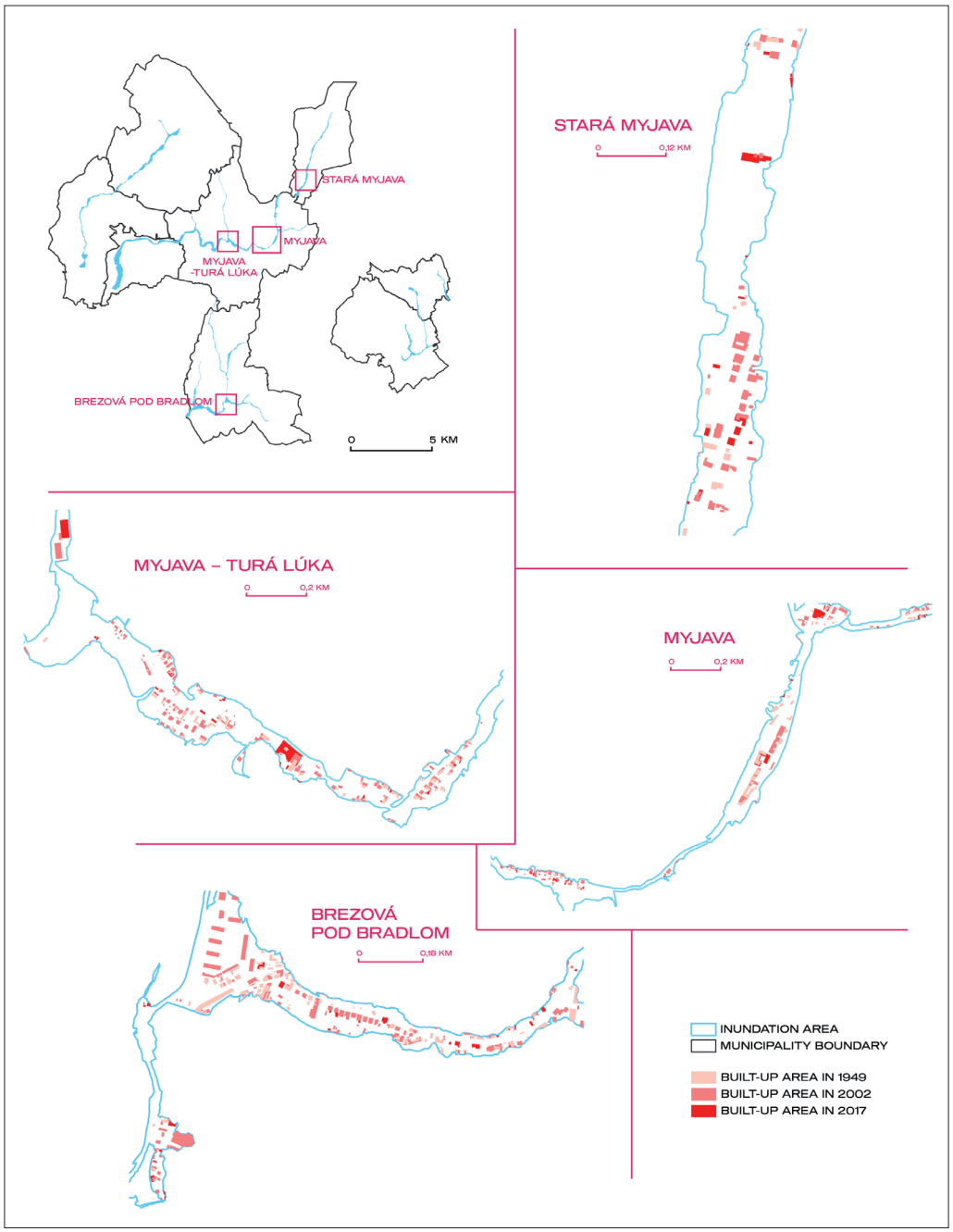

Fig. 6: Increments of built-up area in inundation zone (Q100) of municipalities in different periods
Sources: authors' elaboration based on data from (SVP, š.p., TOPU, GKÚ and NLC)

Municipality	Built –up area (m^2)			Increase* (%)	Relative increase** (%)	Increase* (%)	Relative increase** (%)
	1950	2002	2017	1950–2002	1950–2002	2002–2017	2002–2017
Brezová pod Bradlom	17,239	62,350	66,499	262	43.5	7	17.8
Kostolné	405	685	858	69	0.3	25	0.7
Krajné	8,586	28,307	31,528	230	19.0	11	13.8
Myjava	17,225	33,933	43,263	97	16.1	27	40.0
Podbranč	1,859	2,760	2,776	48	0.9	1	0.1
Sobotište	3,109	10,910	11,626	251	7.5	7	3.1
Stará Myjava	5,077	15,237	19,443	200	9.8	28	18.0
Vrbovce	3,282	6,363	7,877	94	3.0	24	6.5

Tab. 7: Development of built-up areas in the inundation zone of municipalities. Source: authors' calculations
** Percentage increase of built-up area in the municipality's inundation zone for the 1950–2002 and 2002–2017 periods, respectively*
*** Percentage share of the built-up area in the municipality's inundation zone of the total increase in the built-up area in the inundation zone of all municipalities for the 1950–2002 and 2002–2017 periods, respectively*

Myjava, Stará Myjava, Brezová pod Bradlom and Krajné, while occurring almost not at all in Podbranč and Kostolné. This is mainly the construction of family houses or the construction of smaller buildings (garages, garden houses), and to a lesser extent industrial and commercial areas. An example case is the village of Podbranč, in which, despite the increase in population, there has been almost no significant construction in the inundation area in the last almost 70 years.

5. Discussion

The analysis of the spatial plans of the municipalities of the Myjava region showed that the spatial plans have the status of a formal document in terms of the key aspects of flood risk management in the rural country, i.e. increasing the retention capacity of the cadastral area and the maintenance flow capacity of watercourses. There are several reasons why this is the case.

The first one is the governance of flood risk. Although flood risk legislation on flood protection has been progressively clarified, the state's sole responsibility for flood protection has been maintained. The decisive authority responsible for flood risk management is the government organisation SVP, s-o-e, which is responsible for the preparation of all the basic documents for flood protection. Given the centralised way of flood risk governance, it is therefore not surprising that the municipality's ideas on flood risk reduction at the local level are not presented in the municipality's spatial plan, and the spatial plan is not explicitly declared as a flood risk management tool. A spatial plan is considered a tool for creating territorial conditions for the implementation of flood control measures proposed by the flood risk management authority and for an incorporation of general regulation tasks from the superior documentation. The results obtained confirm the conclusions reached by Neuvel and Van den Brink (2009) and Kaufmann (2018) that where flood risk governance is centrally managed, spatial planning is not considered a flood mitigation measure. The other reason is the nature of the flood risk policy. If the concept of flood protection by technical infrastructure is still the dominant food risk management strategy, the measures to increase the infiltration and retention capacity in the rural landscape are considered only complementary and are not financially supported by the State. Their presentation in spatial plans has only a declarative character. Encouraging a more detailed elaboration of eco-stabilisation measures in municipal spatial plans requires decentralisation of flood risk management and a change in flood risk policy, with an emphasis on the application of diversified flood risk management strategies. This aspect of increasing the role of municipal spatial plans in flood risk management is emphasized by Priest et al. (2016), Begg et al. (2015), Green (2017) and Rauter et al. (2020).

The third reason is insufficient flood risk assessment. In terms of diversified flood risk management in the rural landscape, it is not sufficient to identify areas of potentially significant flood risk only based on river reaches that are critical in terms of flooding (*cf*. Adamson, 2018). To proceed with flood risk assessment, systematic processing of data on the attributes of watercourse, riparian zone, physical-geographical attributes and the land use of the cadastral area and their impact on flood hazard and social vulnerability needs improvement. The fact that municipal self-governing authorities do not have systematically processed information on the flood risk of cadastral areas also weakens the elaboration of the implementation schemes of ecostabilisation measures.

The fourth reason is the lack of consistency in the use of municipal powers in the context of the spatial and functional arrangement of the cadastral territory. Alignment of the spatial plans with the development requirements of the municipalities is the main mission of the spatial plan. The municipalities have the power to change the spatial and functional arrangement of the cadastral area, and the power to issue permits for the construction of residential houses, buildings for business purposes, or civic amenities. The development of built-up areas in the floodplain, as well as changes in land cover in the cadastral area in recent decades, indicate that the powers of municipalities in guiding the spatial and functional layout of the area are not consistently being applied to reduce flood risk. Self-governing authorities as well as building offices of municipalities are under pressure to permit the construction of residential houses and buildings for economic activities in areas at risk for floods. This situation is the result of ambiguity associated with the delimitation of the inundation area and giving the decision to not permit building construction. The boundary of the inundation area was not strictly set until the adoption of Act No. 7/2010 and thus raised doubts as to whether buildings were in the inundation area. This explains the increase in built-up areas in the period 1950–2002. Problems with the delimitation of the inundation area, however, arise even after the adoption of Act No. 7/2010. The reason for the disputes is the accuracy of the determination of the flood line. In controversial situations, the building authority usually finds in favour of giving the builder permission to build.

The research is limited to the analysis of spatial plans of municipalities and small towns in the rural landscape. The emphasis is placed on the rural landscape because it includes basins of small watercourses, in which the occurrence of flood risk is influenced by local factors. Eliminating or limiting their impact is the task of flood risk management at the local level. In this context, spatial plans of municipalities (or municipalities as such) should then play an important role.

The added value of the study lies in the fact that the assessment of whether municipal spatial plans represent an effective tool for flood risk management is carried out not only from the point of view of the analysis of the legislative framework of flood risk and spatial planning, but also the way in which the issue of flood risk is incorporated into spatial planning and in the context of the competence analysis of municipalities to realistically carry out flood risk management at the local level.

The intention of the study was not to assess the effectiveness of each spatial plan separately, but to formulate some general conclusions about the real possibilities of municipalities spatial plans to reduce flood hazard (or exposure to flood hazard) at the local level. We believe that information about the current state in this area will become the basis for further development and, above all, the implementation of a more participatory community-level flood management approach.

6. Conclusions

Spatial planning is generally considered to be one of the important tools of integrated flood risk management. In this study, we dealt with the legislative framework of flood protection and spatial planning to specify the position of spatial planning in flood risk management in Slovakia. We further performed a detailed analysis of the spatial plans of municipalities in the Myjava region to obtain an answer to the question of whether municipal spatial plans are an effective tool for flood risk management in rural landscapes.

The current legislative framework creates a strongly centralised state governance of flood risk. The decisive actor of flood protection is the Slovak Water Management Enterprise (SVP, s-o-p). Other actors of flood protection (district offices, municipalities, and higher territorial units) are legally and professionally lower and their activities in the field of preventive flood protection are tied to cooperation with the SVP, s-o-p. The Preliminary Flood Risk Assessment, Flood Hazard Maps, Flood Risk Maps and Flood Risk Management Plans are the basic documents of flood protection in the SR. They were prepared under the responsibility of SVP, s-o-p. Flood protection policy based on technical infrastructure is dominant in flood risk management.

The role of spatial planning in the context of flood risk management is primarily to ensure territorial requirements for the implementation of flood control measures proposed in the FRMP and to fulfil requirements of other superior documentation. The legislative framework, however, also stipulates that municipalities pay attention to the care of the environment and ecological stability of the territory in spatial plans. Although this aspect is not explicitly mentioned in the context of flood risk management, it may quite significantly affect the flood risk in a rural country.

The analysis of the spatial plans of the municipalities showed that, on the one hand, they include the required tasks from the superior documentation, which relate to flood protection but, on the other hand, they are only a formal document from the point of view of key aspects of flood risk management in rural landscapes (i.e. the reduction of flood hazard by increasing the retention capacity of cadastral areas, maintaining the flow capacity of watercourses and reducing negative consequences of floods through functional and spatial arrangement of cadastral areas).

There are several reasons for the formal nature of municipal spatial plans in terms of flood risk management in a rural landscape. The first reason is centralised state governance of flood risk. The local self-government authorities do not have enough authority for the active performance flood risk policy at the local level. The second reason is that the concept of flood protection by the technical infrastructure is dominated in flood risk management policy and no attention is paid to integrated flood risk management based on the entire river basin. Thirdly, there are some uncertainties regarding the delimitation of the inundation area and the decision not to issue a building permit, which puts municipal building authorities under pressure to permit the building of residential houses and buildings for economic activities, even in flood-prone areas.

Thus, the analysis showed that the expectation that the spatial plans of the municipalities could contribute to effective flood risk management in the rural landscape was not met. Due to the changing climate and the growing flood risk, however, it is necessary to strengthen the importance of municipal spatial plans from the point of view of flood risk management in a rural landscape. The way to this is through the decentralisation of flood risk management in SR and a change the paradigm of flood policy from flood protection to increasing society's resilience to floods.

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