The resilience of society to flood risk as a challenge for local government: A case study from Slovakia

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ABSTRACT This paper examines whether local authorities in Slovakia are prepared to manage flood risk in line with resilience principles. The research framework focuses on three dimensions of resilience in local flood risk management: knowledge, policies and actions, and governance. Data were collected through a web-based questionnaire distributed to mayors of Slovak municipalities with previous flood experience. The analysis is based on 499 completed questionnaires. The findings reveal that current local-level flood risk management is inadequate from a resilience perspective. The main shortcomings are the lack of diversified management strategies and highly centralized governance. Three key challenges for enhancing resilience were identified: i) modifying the approach to preliminary flood risk assessments to identify areas of potentially significant flood risk, ii) implementing diversified flood risk management strategies at the river basin scale, and iii) decentralizing flood risk governance. The results highlight the main barriers and challenges that need to be addressed to strengthen resilience in local flood risk management.

KEY WORDS flood risk management – legislative framework – local government competence – social resilience – Slovakia

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1. Introduction

Social resilience to flood risk can only be truly multi-dimensional if it is applied in everyday practice. Local-level flood risk management plays an important role in this respect (Tobin 1999; Norris et al. 2008; Cutter, Ash, Emrich 2014; McDermott et al. 2018). At this level, in addition to the individual responsibility of community members for mitigating the negative consequences of floods, local government authorities play a key role (Gersonius et al. 2016). Local governments should actively support the implementation of diverse measures to mitigate the impact of local factors contributing to flood hazard and vulnerability. From this perspective, flood risk governance is crucial for the implementation of diverse flood risk management strategies (Driessen et al. 2016; Hegger, Driessen, Bakker 2016). Hegger, Driessen, Bakker (2016) note that diversification of flood risk management strategies is indeed necessary to enhance a society's capacity to withstand and cope with negative flood impacts (resilience); however, diversification alone does not guarantee resilience. Therefore, they emphasize that achieving societal resilience to floods through a diversified strategy also requires decentralization of flood risk governance. For instance, in countries like the Netherlands and Poland (Kaufmann 2018, Matczak et al. 2018), where flood risk governance is centralized at the national level, flood risk management is dominated by a uniform, infrastructure-based flood protection strategy. In contrast, clear diversification in flood risk management strategies is evident in countries such as England, Belgium, France, and Sweden (Fournier, Laurrue, Schellenberger 2017; Johnson, Tunstal, Penning-Rowsell 2005; Mees, Crabbé, Suykens 2018), where governance exhibits decentralization characteristics (Hegger, Driessen, Bakker 2016).

An essential component of diversified flood risk management is the adoption of flood risk reduction strategies that regulate economic activities and settlement patterns through spatial planning at the municipal level. Several authors, including Neuvel and Van der Knaap (2010), Dawson et al. (2011), and Begg, Walker, Kuhlicke (2015), consider municipal spatial plans to be one of the key non-structural tools for flood risk management. Burby et al. (2000) argue that local spatial plans integrate technical analysis with community participation, enabling informed decisions among alternative land-use strategies. However, Ran and Nedovic-Budic (2017) point out that there are several obstacles to making it work in practice.

The aim of this paper is to answer the question of whether the local self-government authorities of Slovakia are ready to accept and actively engage in flood risk resilience management; in other words, to adopt a diverse approach to eliminating local flood risk factors and enhancing transformational and adaptive capacity when dealing with the negative effects of flooding. The achievement of this objective is based on data obtained through a web-based questionnaire. We contacted the mayors of 1,867 municipalities with experience of flooding and

cooperation with state authorities responsible for flood protection. A total of 499 mayors responded to the survey.

The paper is structured as follows: Section 2 introduces the concept of societal resilience. Section 3 provides a brief overview of the legislative framework for flood risk governance in Slovakia. Section 4 outlines the research design, including the administration of the questionnaire, processing of responses, and evaluation. Section 5 presents the results. Section 6 discusses these findings and identifies the challenges of resilient flood risk management. Finally, Section 7 provides concluding remarks.

2. The concept of resilience

Several authors, such as Davoudi, Brooks, Mehmood (2013); Alexander (2013); Pizzo (2015) and Abdulkareem, Elkadi (2018), point out that the concept of resilience is not clearly defined and has different meanings in various contexts, each of which is rooted in different scientific traditions. Within the context of resilience, three main approaches are typically identified (Davoudi, Brooks, Mehmood 2013): engineering resilience, ecological resilience, socio-ecological or evolutionary resilience. The term engineering resilience refers to the functional stability of technological systems. It refers to a system's ability to return to a steady state following a disturbance. According to Abdulkareem and Elkadi (2018), the faster a system recovers, the more resilient it is. Ecological resilience is defined as the ability of a system to withstand disturbances while continuing to function (Holling 1973; Zevenbergen, Berry, Mohan 2020). It acknowledges the possibility of multiple stable states (or equilibria), rather than a single fixed one. Socio-ecological or evolutionary resilience is conceived as a broader system characteristic, involving the interaction between natural and human systems (Zevenbergen, Berry, Mohan 2020). The term evolutionary or adaptive refers to the adjustment of a strategy in response to new insights (Bloemen et al. 2017). As noted by Kinzig et al. (2006), evolutionary resilience is based on the recognition that a seemingly stable state can suddenly change and become something radically new, with characteristics profoundly different from those of the original state.

In the context of extreme natural events, the United Nations International Strategy for Disaster Reduction (UNISDR 2009, p. 10) defines resilience as follows: "The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions."

The key question in this context is how resilience can be measured. Several authors (e.g., Alexander, Priest, Mees 2016; Hegger, Driessen, Bakker 2016) have

stated that resilience can be measured in terms of the capacity for resistance, absorption, recovery, transformation, and adaptation. Hegger, Hegger, Driessen, Bakker (2016) conceptualised these capacities as follows: The capacity to resist refers to a system's ability to withstand external pressures, especially negative ones, without being affected. Examples of resistance-like measures include dikes, dams, embankments, water retention structures, and the implementation of rescue and safety measures. The capacity to absorb and recover refers to situations in which the system is affected but can still respond and return to its original or functional state. It is associated with the implementation of flood preparedness strategies aimed at reducing vulnerability, enhancing recovery capacity, and using more natural ways to reduce flood hazards. The capacity to transform and adapt refers to a system's ability to adjust in order to take advantage of opportunities, moderate potential damages, or cope with consequences. Transformation and adaptation measures are primarily related to flood risk governance, as defined by the legislative framework.

The more extensive methodological elements of resilience assessment are analysed by Gal (2013). He points to the existence of four methodological approaches to the assessment of resilience, which are as follows: (i) outcome-driven approaches, which focus on estimating and/or modelling losses, recovery times and similar; (ii) input-driven approaches, which identify underlying factors that influence resilience, including vulnerability; (iii) scenario-driven approaches, which document past or future system responses to a specific risk; and (iv) complex system approaches, which inventory independent elements of resilience with unknown feedback loops. Other authors, such as Norris et al. (2008), distinguish between two approaches to resilience research. The first approach focuses on community resilience in terms of preventing disaster-related health or mental health problems among community members. The second approach views community resilience as a descriptor of effective organisational behaviour and disaster management. A concept closely related to the first approach is *inherent resilience*, as defined by Cutter, Ash, Emrich (2014). This refers to the qualities of a community that arise from everyday processes, which may either enhance or reduce its ability to prepare for, respond to, recover from, and mitigate environmental hazard events. In this context, social, economic, community, institutional, environmental, and housing/infrastructure capital are usually considered key contributing factors (Cutter, Burton, Emrich 2010; Cutter, Ash, Emrich 2014; Esteban 2018). The second approach to resilience research, as outlined by Norris et al. (2008), is reflected in the work on flood risk governance and diversified management by Hegger, Driessen, Bakker (2016), Driessen et al. (2016), and Bergsma (2016).

3. An analysis of the legislative framework for flood risk management

The activities of local governments in the field of flood risk management in Slovakia are regulated by the Flood Protection Act (Act No. 7/2010) and spatial planning legislation (Act No. 237/2000). Act No. 7/2010 establishes a highly centralized state structure for the organization and management of flood risk, in which the Slovak Water Management Company (SVP, š. p.) serves as the key administrative body. Local government has a lower legal and administrative status, and its activities in the area of flood prevention are contingent upon cooperation with SVP, š. p. The responsibilities of municipalities regarding flood prevention are defined as follows under Section 26 of Act No. 7/2010:

- collaborates with SVP, š. p. on the preparation and updating of preliminary flood risk assessments and flood risk maps, as well as the development of flood risk management plans
- participates in the development of proposals for preventive measures within the cadastral area that slow down runoff from the watershed, reduce peak flow, or protect the area from flooding, and, to the extent possible, also in their implementation
- manages and ensures the implementation of flood protection measures within the cadastral area.

An important aspect of local flood risk management is maintaining watercourses. Only the watercourse administrator is authorized to perform maintenance on watercourses (Act No. 7/2010). Currently, more than 62% of the total length of watercourses is managed by SVP, š. p. The second major manager of small watercourses is Lesy SR ("Forests of the Slovak Republic"; 32%). Municipalities manage watercourses only in isolated cases.

The issue of spatial planning is regulated by Act 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 in accordance with the principles of sustainable development. 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 municipal spatial plan when it is necessary to address the concept of their spatial development. The primary task of spatial planning in connection with flood risk management is to ensure territorial claims for the implementation of flood control measures proposed in flood risk management plans and to ensure the regulation of activities on land along the banks and in inundation areas. However, the legislative framework of spatial planning also stipulates that the spatial plan of the municipality includes, in particular:

(i) principles and regulations of spatial arrangement and functional use of the territory of the municipality in relation to the surrounding territory; (ii) permissible, limited and prohibited functional use of areas; (iii) principles and regulations of care for the environment, the territorial system of ecological stability and landscape creation, including green areas; (iv) principles and regulations of protection and use of natural resources, cultural and historical values and important landscape elements; (v) the boundary between the continuously built-up area and the other territory of the municipality; vi) principles and regulations of public transport and technical equipment and civic equipment; and (vii) areas for public works, for remediation and for protected parts of the landscape. The development of the legislative framework is discussed in greater detail in Solín (2020).

4. Research design

To answer whether local authorities are ready to accept and actively manage flood risk in a resilient manner, we conducted a web-based questionnaire among municipalities that experienced at least one flood event from 1996 to 2020. A flood situation was defined as a condition on a watercourse or in a cadastral area that required the declaration of a level III flood activity by the mayor of a municipality. This level is declared when water overflows from the riverbed during extremely heavy or prolonged rainfall or sudden snowmel. Of the 2,890 municipalities in Slovakia, a flood occurred at least once in 1,867 municipalities during the monitored period. The mayors of the municipalities concerned were contacted by email in October 2022 and completed the questionnaire via a Google Form, allowing them the time and flexibility to revisit individual questions if necessary.

The key to designing the questionnaire and formulating its questions lies in establishing a conceptual framework of resilience and an appropriate approach for assessing it. The conceptual framework is based on the UNISDR (2009) definition of resilience.

The assessment of community resilience draws on the concept of effective organisational behaviour and disaster management, as outlined by Norris et al. (2008). The approach to evaluating a municipality's capacity to withstand, absorb, and cope with the negative impacts of floods does not focus on the attributes of individual community members but instead relies on an analysis of resilience indicators affecting the local government's ability to effectively manage and respond to flood risk. Three sets of indicators are considered essential for influencing flood risk management resilience: (i) knowledge indicators, (ii) strategy and measure indicators, and (iii) governance indicators. The questionnaire items were developed in accordance with these indicator groups. The questionnaire was distributed electronically via e-mail to mayors and municipal leaders of

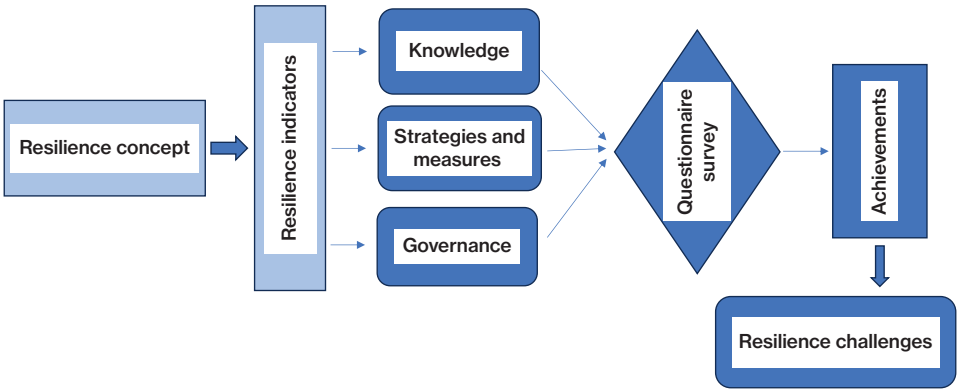

Fig. 1 – Flow chart of the research design. Source: Authors' elaboration.

municipalities that experienced at least one recorded flood event during the study period. The original Slovak-language version of the questionnaire is available online via Google Forms (https://forms.gle/e2cUn2fAQYQsBuWAA). To ensure transparency and accessibility for international readers, an English translation of the survey instrument has been deposited in the Zenodo repository and is openly available under a persistent DOI (Sládeková Madajová, Solín, Výbošťok 2026).

Based on the questionnaire results, the current state of local flood risk management was assessed, and key challenges for achieving resilient management were identified. A flowchart illustrating the research design is presented in Figure 1.

Knowledge Indicator. Knowledge of flood risk provides a rational basis for effective management. The questions primarily concern awareness of the types of flood hazards that occur within the municipality's cadastral area and their causes.

Strategies and Measures Indicator. Diversified flood risk management is a key prerequisite for the concept of resilience-based management. The questions focus on the flood protection measures implemented to date and the assessment of their adequacy, the maintenance of watercourses, the role of spatial planning, and the potential for implementing eco-stabilisation and anti-erosion measures to reduce flood hazards. This section also includes questions related to flood early warning systems and flood preparedness.

Governance Indicator. Effective, diversified flood risk management is closely linked to governance. The questions address the effectiveness of centralised flood risk management and examine the level of cooperation between local authorities and water management bodies in maintaining watercourses and developing preliminary flood risk assessments, flood hazard maps, flood risk maps, and flood risk management plans.

5. Results

The questionnaire data were integrated into an existing GIS database of Slovak municipalities and processed in ArcGIS 10.5.1. Out of a total of 1,867 questionnaires sent the mayors, 499 mayors (i.e., 27%) responded to the questionnaire. The municipalities whose mayors responded to the questionnaire are shown in Figure 2, which presents their spatial distribution by municipality size category. The size categories are determined based on the methodology of the Statistical Office of the Slovak Republic. The number of municipalities in each size category is listed in Table 1. The results are presented in aggregate form within the context of three indicators of resilience-building in flood risk management. Mayors of towns with populations of more than 5,000 account for only 10% of the total respondents. Most respondents come from small and medium-sized municipalities.

5.1. Flood hazard knowledge indicator

The respondents' answers show a wide spectrum of flood hazards across the municipalities (Fig. 3). The occurrence of fluvial flood hazard is considered the most significant (48% of respondents). The incidence of pluvial flood hazards caused by water flowing from slopes and fields is also significant (37%). Third in order of significance is the occurrence of flood hazards due to blockage of bridges and local drainage channels (12%).

The most significant local factor for a flood hazard was considered by 32% of respondents to be overgrown and silted watercourses. Furthermore, 11% of respondents reported high deforestation in the area, and 11% also reported an improper crop mix on arable land. Various obstructions and debris in watercourses, primarily consisting of construction and other solid waste, wood, branches, or

Table 1 – Number of municipalities by size category whose mayors responded to the questionnaire survey

Municipal size categories	Population	Number of municipalities
Very small village	up to 199	39
Small village	200–499	116
Medium-sized municipality	500–999	144
Larger municipality	1 000–1 999	90
Large municipality	2 000–4 999	59
Large municipality / small town	5 000–9 999	20
Smaller town	10 000–19 999	10
Medium-sized city	20 000–49 999	13
Big city	50 000 +	8

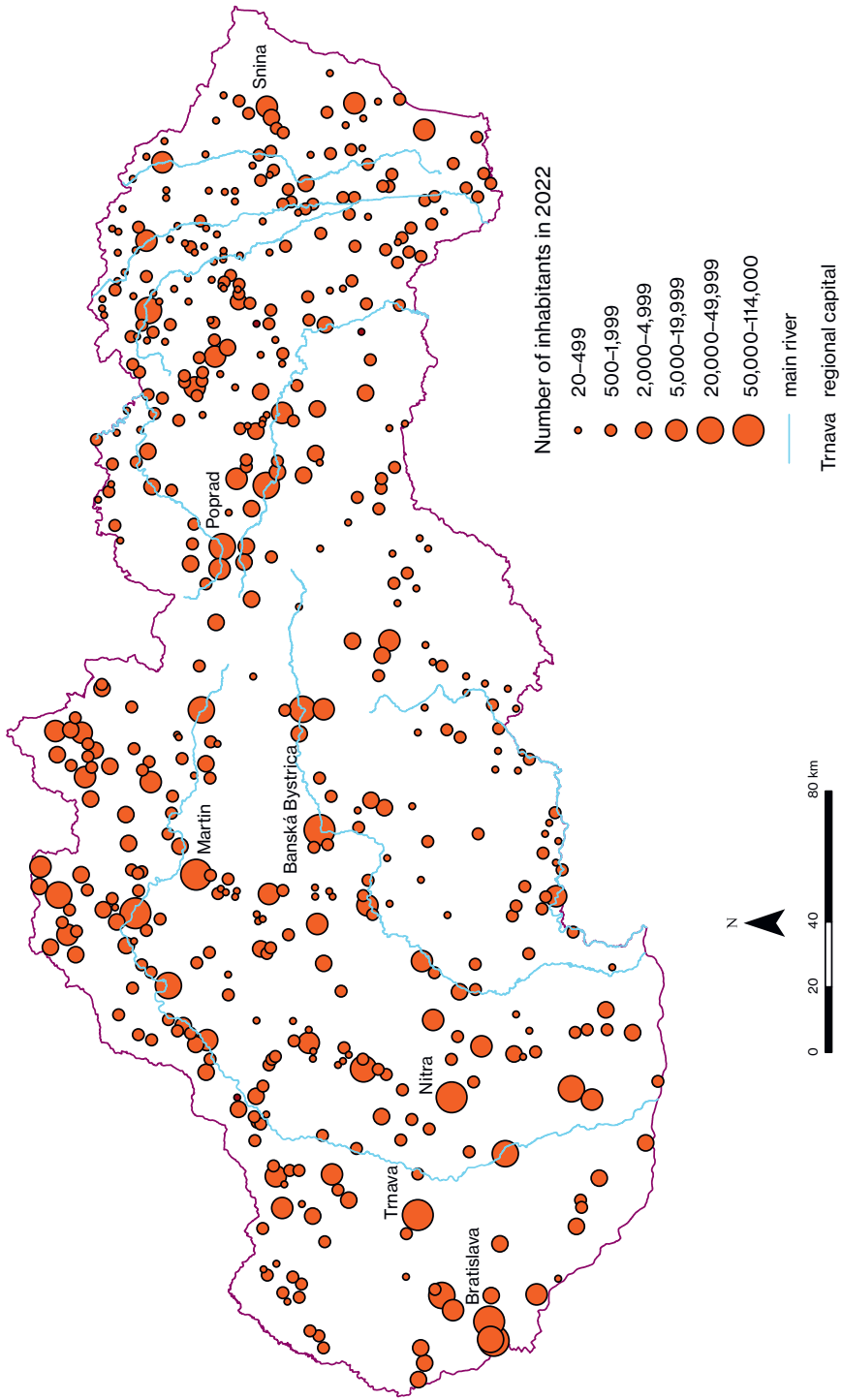

Fig. 2 – Population of the municipalities whose mayors responded to the questionnaire

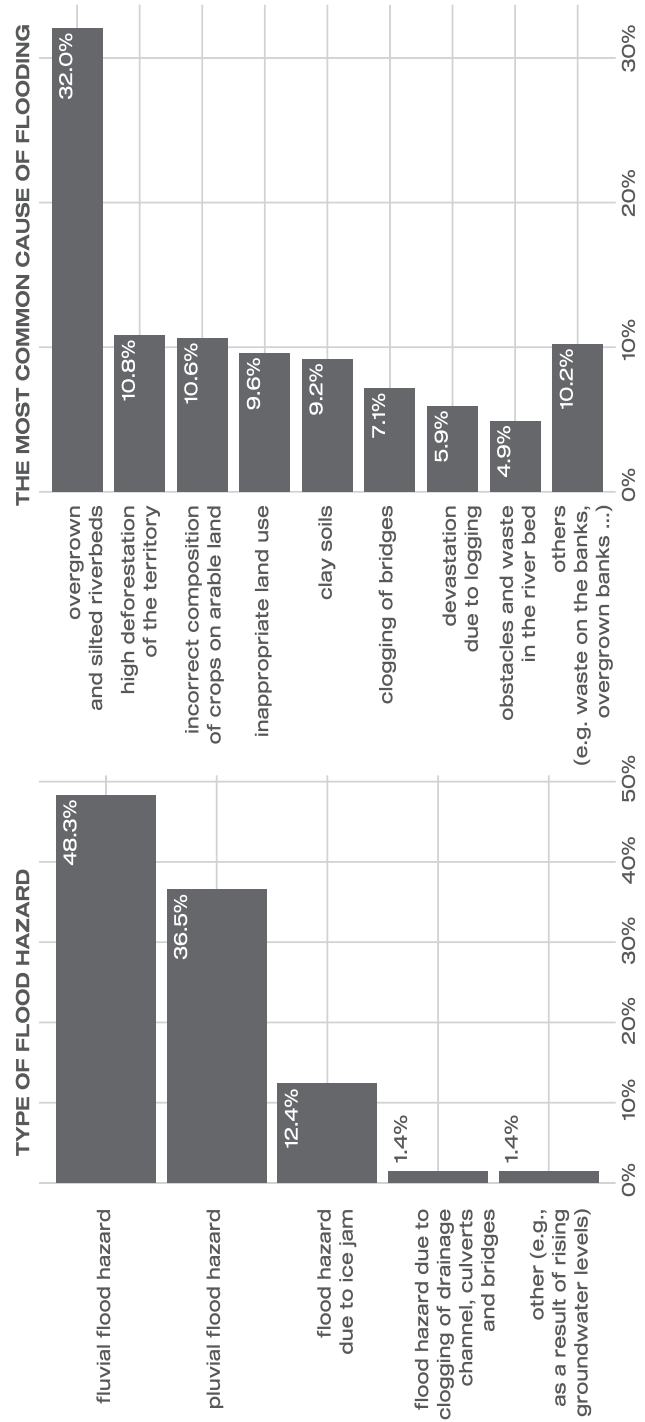

Fig. 3 – Types of flood hazards occurring in municipalities and their causes. Source: Author's calculations.

grass clippings, also contributed to the acceleration of flood hazards, according to the mayors of individual municipalities. More than 41% of respondents reported their presence in the channel.

Inspections of watercourses are an essential activity to assess the condition of watercourses. Up to 72% of respondents reported conducting inspections. The mayors' answers showed that inspections were carried out at varying intervals, most often more than once a year.

The majority of mayors (52%) indicated that they could identify the river sections in the cadastral area where water overflowed from the channel. However, up to 56% could not identify locations in the cadastral area that were susceptible to flooding or subsidence due to blocked bridges, ice barriers or rising groundwater.

Only 8% of respondents indicated that they had developed a flood hazard potential assessment based on a systematic evaluation of the influence of the physical-geographical characteristics of the cadastral area on flood hazard. Effective use of flood hazard knowledge requires that it be processed and presented in a GIS environment. However, regarding GIS software, 79% of respondents reported that the municipality has none.

5.2. Strategy and measures indicator

5.2.1. Management intervention options

The majority of mayors (66%) believed that technical flood-prevention infrastructure was sufficient to reduce flood hazards. However, 34% of respondents did not think so. Furthermore, more than 62% of mayors carried out other activities related to preventive flood protection on their own initiative (Fig. 4). A total of 56% of respondents also had specific proposals to be implemented by watercourse administrators to reduce flood hazards within the municipality's cadastral area. In particular, regular maintenance of watercourses was required, as well as the construction of additional polders, dikes, dams, and channel modifications. To a lesser extent, mayors also called for comprehensive watershed-wide water conservation measures.

The mayors of the municipalities occasionally carried out the maintenance of watercourses and the cleaning of drainage channels and ditches on their own initiative.

However, it should be stressed that the responsibility for the maintenance of watercourses lies with the watercourse administrator. Therefore, if municipalities decide to maintain the watercourse, they must finance it from their own resources. However, most municipalities lack the resources to do so.

An important part of flood risk management is the maintenance by owners of riparian land along the watercourse up to 10m from the bank for major

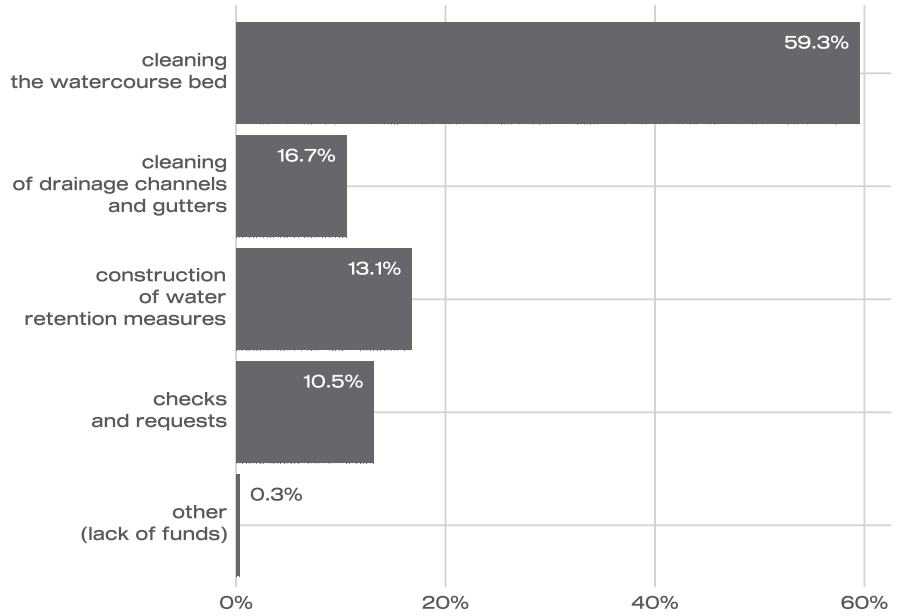

Fig. 4 – Preventive flood protection activities of municipal mayors. Source: Author's calculations.

watercourses and up to 5m for minor watercourses. The responses showed that when there were multiple dumps of material or waste on the riverbanks, the mayors usually dealt with them by contacting the owners. Only 14% of those surveyed mentioned charging a fine for polluting waterways with various solid wastes or organic materials. However, a relatively large group of mayors (more than 20%) did not respond or felt it was the responsibility of the water authority to oversee the maintenance of the riparian areas. The situation is similar to that of waste in watercourses. In this context, local government activities aimed at raising public awareness of flood risk and strengthening individual responsibility for reducing flooding are particularly important. The implementation of such activities (e.g., announcements on the local public address system and the municipality's website, reminding residents to keep stream beds clean, and prohibiting the disposal of biodegradable waste in stream beds, etc.) was reported only by 34% of respondents.

For effective flood risk management, early warning to prepare for a flood are important. 79% of mayors issued flood warnings. However, the warnings did not come in sufficient time. Up to 76% of respondents said they did not have enough time to prepare for a flood event.

5.2.2. Spatial planning

The respondents' answers showed that 62% of municipalities have a municipal spatial plan. The spatial planning framework established by Act 237/2000 requires municipalities to take ecological stability and environmental protection into account in their spatial plans. However, having mapped sites where eco-stabilisation and erosion control measures would be needed was reported by only 36% of respondents. At the same time, if the owners or tenants of the land do not implement eco-stabilisation and anti-erosion measures, only 8% of the respondents said that the local council would complain to the district authority, which has the right to force the land users to implement the required measures. However, action has been taken on complaints only in isolated cases.

From the perspective of effective control of construction in the floodplain, the delineation of the inundation area in the land-use plan is important. However, only 48% of respondents indicated that the floodplain boundaries are shown on the spatial plan. The requirement to build in the inundation area is quite common. This was reported by 42% of respondents. However, only 9% of respondents reported a refusal to build in the inundation area.

5.3. Governance indicator

5.3.1. Competences of municipalities in preventive flood management

A significant proportion of respondents (44%) were unable to comment on the legal framework of local government competence in the field of flood risk assessment and management as defined by Act No. 7/2010. 11% of respondents expressed satisfaction with the current regulatory framework. A further 26% of respondents considered the legal framework adequate but pointed out that its practical implementation was very limited because municipalities lacked sufficient financial, human and material resources to carry out the responsibilities set out in the legislation. 19% of respondents considered the legislative framework insufficient and ineffective.

When mayors were asked to give an overall opinion on their powers to reduce flood risk in the municipality, 68% of respondents did not think they were sufficient (Fig. 5). The main reasons that limited the active participation of the municipality in preventive flood protection were: (i) lack of financial resources, (ii) lack of real/legal powers, and (iii) lack of scientific information on the flood hazard in the municipality's cadastral area (Fig. 5).

Following the implementation of the EU Directive on the assessment and management of flood risks (European Union 2007) into Slovakia legislative system, the

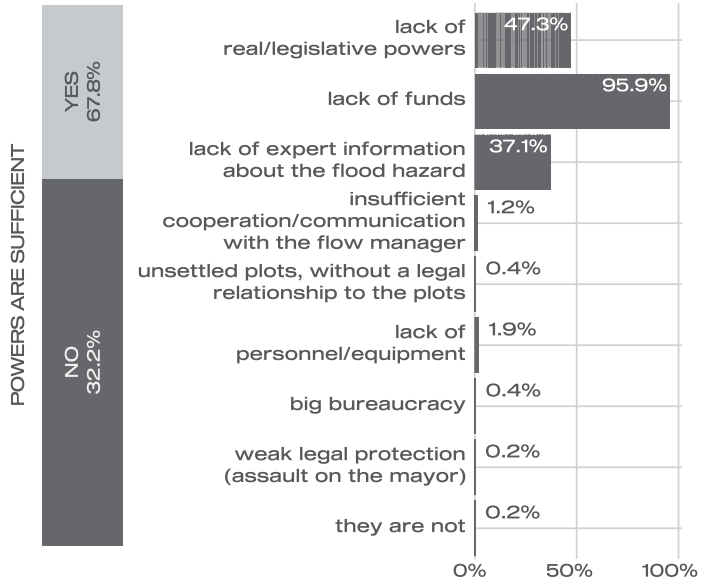

Fig. 5 – Mayors' views on the powers provided by the legislation. Source: Author's calculations.

Flood Risk Management Plans (MOE SR 2015) have become the basic tool for flood risk management. These have been developed for areas with potentially significant flood risk under the responsibility of SVP, š. p. In relation to the identification of significant flood risk areas (MOE SR 2011), the majority of mayors (62%) stated that they had not been approached by SVP, š. p. for cooperation. Almost 70% of respondents reported that their municipality was not included in the list of potentially significant flood risk areas. However, a comparison of these responses with the official list of municipalities classified as areas with potentially significant flood risk revealed several discrepancies. Of the 331 mayors who stated that their municipality had not been classified as an area with a significant flood risk, 52 mayors (16%) provided an incorrect answer. Similarly, of the 146 mayors who stated that their municipality had been classified as an area with a significant flood risk, 79 mayors (54%) provided an incorrect answer. These discrepancies suggest that a substantial proportion of mayors and municipal leaders may not be fully familiar with the official classification of municipalities as areas with potentially significant flood risk.

A significant percentage of respondents (58%) indicated that they had not even been asked to participate in the preparation of the Flood Risk Management Plans. In cases where the SVP, š,p. cooperated with the municipality, only 23% of respondents assessed the cooperation with the SVP positively, while 19% assessed it negatively and 58% gave a neutral assessment.

5.3.2. Watercourse administration

An important aspect of flood risk management at the local level is the maintenance of watercourses. Under ACT 7/2010, the watercourse administrator is responsible for maintaining watercourses. The dominant administrator of watercourses is the Slovak Water Management Enterprise (SVP, š. p.), which manages 62% of the total length of watercourses in Slovakia (61,147 km). In addition to SVP, š. p., another important administrator is the State Forestry Organisation, which manages 32% of the total length of the watercourses. Municipalities are scarce administrators of watercourses and manage only 1% of the total length.

The watercourse manager is authorised to carry out management activities (sediment, vegetation, and debris interventions). The mayors expressed strong dissatisfaction with the authorities' maintenance of watercourses. Up to 79% of the respondents reported dissatisfaction with vegetation management (cutting of riparian vegetation, selective removal of riparian vegetation, maintaining the possibility of riparian areas, etc.). Similarly, a high percentage of respondents (74%) are dissatisfied with the way administrators carry out sediment and debris management (management of in-channel deposition and erosion, removal of fallen branches and trees, removal of organic and other debris from the channel bed or banks). Furthermore, 65% of respondents indicated that administrators undertake maintenance only upon explicit request, and that significant delays (sometimes lasting several years) often occur between the submission of a maintenance request and its implementation.

Given these circumstances, it is not surprising that almost 76% of respondents consider centralized watercourse management by state organizations – established by Act No. 7/2010 – to be ineffective. The main negative aspects of centralised state management of watercourses were seen by the respondents as: insufficient material, technical, financial, and human resources, excessive bureaucracy, and inflexibility. Only flood emergencies are dealt with, and there is no preventive maintenance. On the other hand, the possession of suitable equipment for the maintenance of watercourses, the professionalism of the SVP staff and the fact that the municipality does not have to take care of the watercourses were seen as positive aspects of centralised watercourse management.

Despite the high level of dissatisfaction with the way in which watercourses are managed, only 32% of respondents were in favour of municipalities becoming watercourse administrators. For respondents, the management of watercourses was primarily dependent on the state providing adequate funding for municipalities to maintain watercourses.

6. Discussion

An analysis of the questionnaire responses using the three resilience indicators shows that current flood risk management at the local level is unsatisfactory from a resilience perspective, particularly with regard to the strategy and measures indicator and the governance indicator. These indicators point primarily to a lack of diversified management approaches and highly centralized flood risk governance. The findings from the questionnaire are consistent with the conclusions of the study by Hegger, Driessen, Bakker (2016) regarding the necessity of decentralizing flood risk governance to achieve societal resilience to floods through diversified strategies. Consequently, the existing legislative framework in Slovakia – characterized by centralized state governance emphasizing technical flood protection infrastructure – constitutes a primary limiting factor for resilient flood risk management at the local level.

One of the key tools for flood risk management at the local level should be spatial plans of municipality Despite the fact that as many as 62% of respondents stated that they have an approved municipal spatial plan, however as showed Solín, Sládekova Madajová (2023), spatial plans currently play only a formal role in flood risk management and representing another limiting factor for achieving resilient flood risk management. Local authorities lack sufficient powers to actively pursue local flood risk policies such as enhancing retention capacities through eco-stabilization measures, maintaining watercourse capacities, and reducing flood impacts through functional spatial arrangements and integrated flood risk management at the catchment level is largely overlooked.

The results presented above suggest that flood risk management at the local level is currently unsatisfactory in terms of resilience-oriented management. Several key challenges hinder its effective implementation:

1. In the context of the Flood Hazards Knowledge indicator, a key challenge is to revise the current approach to preliminary flood risk assessment so that areas of potentially significant flood risk are identified. Instead of the previously used preliminary assessment of flood risk based on the identification of critical river sections in terms of overtopping, it is desirable to proceed to an assessment based on a systematic evaluation of the physical-geographical characteristics of cadastral areas and watercourses in terms of their impact on flood hazard (Solín, Rusnák 2020; Solín, Sládekova Madajová, Michaleje 2024). Such an approach would replace the existing binary risk assessment with a more detailed, multi-scale evaluation, providing a rational basis for applying flood risk management across all municipalities, differentiated by flood risk level. Additionally, it is essential to address the inadequate availability of GIS software, which currently limits municipalities' ability to effectively process and spatially visualize flood risk knowledge.

2. In the context of the Strategy and Actions indicator, *increasing resilience* requires adopting diversified flood risk management at the river basin scale rather than focusing exclusively on technical flood protection measures for isolated river sections. It is neither feasible nor environmentally desirable to install technical flood protection infrastructure on every watercourse that floods. The dominant strategy of relying solely on constructing technical infrastructure also faces significant financial constraints, as the state budget has long struggled to provide adequate resources to maintain existing flood protection measures, let alone build new ones. Consequently, creating a legislative framework that enhances the role of municipal spatial plans as effective local flood risk management tools is crucial. However, achieving diversified flood risk management is closely interconnected with improvements in flood risk governance.
3. A critical step toward greater resilience involves transitioning to decentralized flood risk management characterized by a clearly defined hierarchical structure. This requires legally specifying flood risk management actors at national, regional, and local levels, clearly delineating their responsibilities, securing adequate financial resources, and establishing effective communication channels to ensure alignment of management objectives across different hierarchical levels. Decentralization would strengthen the capacities and powers of local governments, enabling them to proactively undertake systematic watercourse maintenance and implement eco-stabilization and erosion-control measures on forest and agricultural lands, as outlined in spatial plans. Such measures would significantly contribute to flood risk reduction at the local level.

In conclusion, it is important to emphasize that resilient management – which is primarily associated with decentralized management and the implementation of a diversified set of measures (integrated management) to reduce flood risk – is particularly effective in mountainous countries. In these countries, which include Slovakia, management efforts focus primarily on eliminating local factors contributing to both fluvial and pluvial flood hazard in small watersheds. Flood management in small mountainous, foothill, and hilly watersheds is essential for reducing flood risk in the lower reaches of lowland watercourses. Local and regional government bodies play a crucial role in this regard. And the research presented in the article is fully justified. This is somewhat less relevant in the case of lowland countries already crossed by major waterways, or countries at risk of flooding from the sea. In these countries, a centralised governance of flood risk – based exclusively on the development of costly technical infrastructure – has proven to be more effective (Liefferink et al. 2018).

The results of this study should be interpreted in light of several limitations. First, the analysis is based on questionnaire responses from 499 mayors, representing a subset of the 1,867 municipalities that were contacted. Although the number

of responses is sufficient to identify major trends and challenges in local flood risk management, the possibility of non-response bias cannot be entirely excluded. Second, the results rely on the perceptions and self-assessments of mayors and municipal leaders. Consequently, some responses may reflect subjective evaluations rather than the actual state of flood risk management. This is illustrated, for example, by discrepancies between respondents' answers and the official classification of municipalities in areas with potentially significant flood risk.

Another limitation relates to the heterogeneity of the respondent municipalities. The survey included municipalities of different population sizes, and it is possible that local capacities, financial resources, staffing levels, and experience with flood risk management vary according to municipality size. From a methodological perspective, this raises the question of whether the size of the municipality influences the nature of the responses provided. However, Act No. 7/2010 defines the responsibilities of municipalities regarding flood protection irrespective of their size. For this reason, the present analysis focuses on the substantive content of the responses rather than on differences among municipality size categories. While a more detailed analysis based on municipality size could provide valuable insights into the variability of local flood risk management capacities and perceptions, such an analysis falls beyond the scope of the present study and may represent an interesting avenue for future research. Nevertheless, it is unlikely that it would substantially alter the main conclusions regarding the capabilities and limitations of local governments within the current legislative framework for flood risk management.

Third, the study focuses exclusively on the perspective of local governments. Other important stakeholders involved in flood risk management, such as watercourse administrators, regional authorities, landowners, and local residents, were not included in the survey. This limitation is particularly relevant because resilient flood risk management depends not only on the capacities of local authorities but also on the active involvement of the public in flood risk reduction (APFM 2006). Public participation includes engagement in decision-making processes related to the selection of flood risk mitigation measures (e.g., Raška et al. 2020), as well as individual responsibility for protecting property and enhancing the capacity to cope with flood impacts. However, this aspect was not addressed in detail in the present study because it requires a different target group of respondents and a different survey design. Moreover, the issue of household vulnerability and social resilience has already been examined in detail in our previous research (Solín, Sládeková Madajová, Michaleje 2018). In that study, three key dimensions of household social resilience were assessed: (i) the susceptibility of household property to damage, (ii) the propensity of household members to suffer physical and psychological harm, and (iii) the household's ability to cope with the negative impacts of floods.

7. Conclusion

Local-level management plays a crucial role in achieving resilient flood risk management. In this context, the key question is whether local authorities are adequately prepared to implement resilient approaches. The answer to this question is based on empirical insights obtained from mayors via a web-based questionnaire evaluating three basic indicators of resilience-oriented management: (i) knowledge indicators, (ii) policies and measures indicators, and (iii) flood risk governance indicators.

The obtained results indicate that current flood risk management at the local level is not satisfactory in terms of resilience. The primary obstacles include centralized flood risk management dominated by uniform technical flood protection measures, as well as the limited, largely formal role of local spatial plans in this context.

Most mayors considered centralized, state-managed watercourse maintenance ineffective. Despite this dissatisfaction, the majority did not support transferring watercourse management responsibilities directly to municipalities. Mayors also reported rarely being approached by the primary water management authority (SVP, š. p.) to collaborate in developing preliminary flood risk assessments or flood risk management plans. Furthermore, most mayors viewed their current powers to reduce flood risk at the local level as insufficient. The main factors limiting active municipal involvement in preventive flood hazard management include inadequate financial resources, insufficient legal authority, and the lack of systematic flood hazard assessment within municipal cadastral areas.

Although most mayors considered existing technical flood protection infrastructure sufficient, they called for the implementation of comprehensive basin-wide water retention measures. They also expressed significant dissatisfaction with watercourse administrators neglecting the maintenance of smaller watercourses, thereby failing to eliminate local factors accelerating flood occurrences.

Several challenges must be addressed to achieve resilient management. Regarding flood hazard knowledge indicators, it is essential to change the current approach to preliminary flood risk assessments. In terms of strategies and measures, the challenge of enhancing resilience lies in adopting diversified flood risk management strategies that cover the entire cadastral area. Establishing a clear legal framework for municipal spatial plans to serve as effective local flood risk management tools is particularly critical.

Concerning the governance indicator, there is a need to move toward decentralized flood risk management. At its core, decentralized flood risk management requires clearly defined responsibilities, sufficient financial resources, and effective communication channels among national, regional, and local actors to ensure coordinated objectives across hierarchical levels.

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