

Impacts of Extreme Weather Events on the Water Sector: Challenges and Preparedness Needs

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Water management and disaster preparedness in Hungary: institutional framework, practice, and lessons learned

Water management in Hungary represents a strategically critical public function due to the country's hydrological characteristics and exposure to climate-related extremes. The majority of Hungary's surface waters originate outside national borders, while extensive lowland areas remain highly vulnerable to floods, inland excess water, and droughts. As a result, water management plays a central role not only in environmental protection and resource management, but also in disaster preparedness, response, and recovery.

The Hungarian water management system operates as a state responsibility, with operational tasks carried out by a national authority and its regional directorates organised on a river basin basis. Core responsibilities include flood protection, inland water management, prevention and mitigation of water damage, operation and maintenance of state-owned water infrastructure, hydrological monitoring, and technical support for local flood defence activities. This institutional structure ensures nationwide operational coverage, from major transboundary rivers to small watercourses affected by flash floods.

A defining feature of the system is the distribution of responsibilities across governance levels. National and regional water authorities are primarily responsible for fluvial flood protection and large-scale infrastructure, while municipalities play a key role in managing local water damage events and flash floods. This division places particular emphasis on preparedness, coordination, and clearly defined institutional roles, especially during rapidly evolving extreme weather events.

Since 2025, the water management sector has been integrated under the Energy Ministry, reflecting an evolving governance approach that increasingly links water management with energy policy, climate adaptation, and infrastructure resilience. This institutional positioning highlights the strategic relevance of water management in addressing interconnected challenges related to climate change, resource security, and sustainable development.

Operational challenges under increasing hydrological extremes

In recent decades, Hungary has experienced a marked increase in the frequency and intensity of hydrological extremes. Record and near-record flood levels, prolonged drought periods, and locally concentrated heavy rainfall events have become recurring phenomena. These processes place simultaneous pressure on flood protection systems, water retention capacities, and water quality management.

Operational experience confirms that water-related risks are no longer confined to large rivers. Local water damage events, flash floods on small catchments, and inland excess water increasingly cause significant impacts at settlement level. Such events often develop rapidly, leaving limited time for ad hoc decision-making and reinforcing the importance of prior preparedness, trained personnel, and tested procedures.

Although the availability of hydrological, meteorological, and spatial data has increased substantially through monitoring networks and digital platforms, operational challenges persist. The primary

constraint is no longer data availability, but rather the integration, interpretation, and timely use of data to support decision-making under pressure. This underscores the importance of institutional capacity, experience, and training alongside technical solutions.

Preparedness, training, and practical experience

Hungarian water management practice emphasises preparedness as a continuous process encompassing prevention, preparedness, response, and recovery. Flood risk management planning, river basin-scale assessments, and infrastructure maintenance provide the preventive foundation of the system. However, experience from extreme events demonstrates that operational effectiveness depends largely on human capacities, institutional coordination, and practical preparedness.

Training programmes, exercises, and simulation-based activities play a decisive role in translating plans into action. Practice-oriented preparedness enables professionals to rehearse coordination mechanisms, clarify roles and responsibilities, and identify operational gaps before real emergencies occur. Such activities strengthen decision-making, communication, and cooperation under time pressure, thereby increasing overall system resilience.

Volunteer involvement constitutes an additional pillar of effective preparedness. During major flood events and local water damage incidents, volunteers frequently support professional water management and disaster response organisations, particularly when institutional capacities are temporarily overstretched. Their effective contribution depends on prior training, clear integration into response frameworks, and mutual understanding between professional and volunteer actors. Strengthening these linkages enhances both operational readiness and community-level resilience.

From response to recovery: institutional learning and resilience

Water-related disasters extend well beyond the immediate response phase. Recovery involves damage assessment, restoration of infrastructure, and the implementation of long-term risk reduction measures. Experience shows that recovery processes are significantly more effective where preparedness measures, trained personnel, and coordination mechanisms were established before the event.

Institutional learning plays a critical role in this process. Lessons identified during response and recovery phases must be systematically integrated into planning, training, and operational procedures. In this way, water management functions not only as a response mechanism, but as a key driver of long-term disaster risk reduction and climate adaptation.

Overall, water management in Hungary illustrates that effective disaster preparedness relies on a balanced combination of institutional stability, technical capacity, continuous training, practical experience, and community engagement. As hydrological extremes become more frequent and complex, strengthening these interconnected elements remains essential for safeguarding communities and supporting resilient development.

Keywords: water management; flood protection; disaster preparedness; institutional framework; local water damage; training and exercises; volunteer engagement; recovery and resilience; climate change adaptation