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Assessment of Torrent-Related Processes and Mitigation Measures in the Mureș River Basin

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Abstract: *This study provides a documentary assessment of torrent-related processes and mitigation options in the Romanian Mureș River Basin. It identifies mountain headwaters and the Upper Mureș–Arieș subcatchments as priority areas due to rapid runoff, erosion, and sediment transport. Recommended measures include protective afforestation, grass cover, gully stabilisation, check dams, bank protection, and adaptive monitoring. The findings offer a preliminary framework for prioritising erosion control and flood-risk reduction, rather than site-specific engineering designs.*

• Introduction

Torrential processes are triggered by intense rainfall in steep, sparsely vegetated catchments, causing rapid runoff, soil erosion, sediment transport, and deposition [3, 4].Forest vegetation reduces runoff and stabilises soil, while effective torrent control combines afforestation, vegetation restoration, sustainable land use, and hydrotechnical structures such as check dams [5, 6].The Mureș River Basin covers over 28,000 km² in Romania and includes diverse landscapes with varying erosion and flood risks. Its tributaries, including the Târnave, Arieș, Strei, and Sebeș, can contribute to rapid runoff and sediment transport [2].

• Material and method

This study is based on documentary analysis of public hydrographic data, flood-risk management documents, and specialist literature on torrent control [1, 2, 8, 10, 11].The assessment examines five main factors influencing torrential processes: slope and relief, geology and soils, vegetation and land use, rainfall and hydrology, and human pressures. Potential mitigation measures were identified according to their effects on runoff, erosion, and sediment transport.The proposed measures are conceptual, planning-level recommendations and do not replace site-specific surveys, hydraulic calculations, or engineering design.

• Results and discussions

The Mureș River Basin covers approximately 28,310 km² in Romania and includes 758 coded watercourses totalling 10,861 km. Torrential processes are most significant in mountainous and hilly subcatchments, where steep slopes, intense rainfall, erodible soils, and reduced vegetation cover promote rapid runoff and sediment transport.Priority areas include the Upper Mureș and Arieș, followed by the Târnave, Strei, and Sebeș subcatchments. Recommended measures include afforestation, grass cover, gully stabilisation, check dams, bank protection, sediment management, and regular maintenance of existing structures.

• Conclusions

Torrent control requires an integrated approach combining forestry, biological, and hydrotechnical measures. Forest restoration and sustainable land use help prevent erosion at its source, while channel structures reduce bed instability and sediment transport. Climate variability highlights the importance of monitoring, maintenance, and adaptive management. Further field investigations and hydraulic studies are needed to establish site-specific priorities and engineering designs.