

Evaluation of the Impact of Atmospheric Precipitation on Surface Water Pollution through Chemical and Biological Indicators: A Case Study of Bolnisi City

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Atmospheric precipitation plays a significant role in the dynamics of surface-water pollution, as it mobilizes pollutants accumulated in the environment and transports them into aquatic ecosystems. This issue is particularly salient in regions with intensive mining activities, such as Bolnisi Municipality, where anthropogenic pressures are pronounced.

The primary objective of this study is to evaluate the influence of atmospheric precipitation on the dynamics of heavy-metal contamination in the Mashavera River within Bolnisi Municipality. The specific aims are (i) to determine heavy-metal contamination levels across different reaches of the Mashavera River on the basis of chemical analyses, and (ii) to characterize the river's ecological status and degree of contamination through biomonitoring.

The findings demonstrate the seasonal precipitation-driven dynamics of heavy-metal contamination in the Mashavera River with respect to proximity to pollution sources. Furthermore, trends in bioindicator responses were identified that reflect the ecological effects of heavy-metal pollution. The resulting data are pertinent both to water-quality assessment and to the refinement of environmental policy.

Novelty of the study: For the first time, seasonal trends in heavy-metal contamination of the Mashavera River have been evaluated using data from 2020–2025.