

Ecological risks in Rustavi, Kazreti and Zestaponi - soil and water under the influence of industrial waste

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This study focuses on the radioecological and geochemical assessment of soil and water contamination in major industrial regions of Georgia, including Kazreti, Zestafoni, Rustavi, Bolnisi, and Gardabani. Intensive mining, metallurgical, and energy-related activities in these areas have led to significant environmental pollution by heavy metals and artificial radionuclides (Cs-137, Sr-90, K-40).

The research is based on long-term environmental monitoring conducted during 2022–2024, including laboratory analysis of soil and water samples using atomic absorption spectroscopy (AAS) and high-resolution gamma spectrometry. The results reveal spatial heterogeneity in the distribution of heavy metals (Pb, Cd, As, Hg, Mn, Ni, Zn) and radionuclides, with several locations exceeding national and international environmental standards.

The study identifies distinct pollution patterns: Kazreti is characterized by high radionuclide activity and dominant vertical migration processes, while Zestafoni shows elevated heavy metal concentrations and prevailing horizontal transport mechanisms. An integrated ecological risk assessment model is proposed, combining soil and water contamination indicators for comparative environmental analysis of industrial regions.

The findings provide a scientific basis for environmental risk assessment, improvement of monitoring systems, and the development of sustainable environmental management and policy strategies in Georgia.