Global study reveals extensive impact of metal mining contamination on rivers and floodplains

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A study, published in *Science,* has provided new insights into the extensive impact of metal mining contamination on rivers and floodplains across the world, with an estimated 23 million people believed to be affected by potentially dangerous concentrations of toxic waste.

Led by Professors Mark Macklin and Chris Thomas, Directors of the Lincoln Center for Water and Planetary Health at the University of Lincoln, UK—working with Dr. Amogh Mudbhatkal from the University's Department of Geography—the study offers a comprehensive understanding of the environmental and health challenges associated with metal mining activities.

Using a new georeferenced global database of 185,000 metal mines compiled by the team and employing a combination of process-based modeling and empirical testing, the research assessed the global scale of metal mining contamination in river systems and its repercussions for human populations and livestock.

The study modeled contamination from all known active and inactive metal mining sites, including tailings storage facilities—used to store mine waste—and looked at potentially harmful contaminants such as lead, zinc, copper, and arsenic, which are transported downstream from mining operations, and often deposited along river channels and floodplains for extended periods.

"Our new method for predicting the dispersal of mine waste in river systems worldwide provides governments, environmental regulators, the mining industry and local communities with a tool that, for the first time, will enable them to assess the offsite and downstream impacts of mining on ecosystem and human health," said Professor Mark Macklin, who led the multi-disciplinary, international team behind the research:

"We expect that this will make it easier to mitigate the environmental effects of historical and present mining and, most importantly, help to minimize the impacts of future mining development on communities, while also protecting food and water security."

Released against the backdrop of growing demand for metals and minerals to feed the demands of the green energy transition, the new results highlight the widespread reach of the contamination, affecting approximately 479,200 kilometers of river channels and encompassing 164,000 square kilometers of floodplains on a global scale.

According to the findings, approximately 23.48 million people reside on these affected floodplains, supporting 5.72 million livestock and encompassing over 65,000 square kilometers of irrigated land. Due to a lack of available data for several countries, the team behind the study believe these numbers to be a conservative estimate.

Various pathways exist for humans to become exposed to these contaminant metals including from direct exposure through skin contact, accidental ingestion, inhalation of contaminated dust, and through the consumption of contaminated water and food grown on contaminated soils.

This poses an additional hazard to the health of urban and rural communities in low-income countries and communities dependent on these rivers and floodplains, especially in regions already burdened with water-related diseases.

In industrialized nations in Western Europe, including the UK, and the United States, this contamination constitutes a major and growing constraint to water and food security, compromises vital ecosystem services, and contributes to antimicrobial resistance in the environment.

"Rapid growth in global metal mining is crucial if the world is to make the transition to green energy," said Professor Chris Thomas who led the analysis and modeling.

"Much of the estimated global contamination we have mapped is a legacy from the industrial era—rightly, modern mining is being encouraged to prioritize environmental sustainability. Our methods, which also work at local scales, add an important new approach in this process for which have set up an applied unit of our research center 'Water and Planetary Health Analytics' to work with the sector."

Professor Deanna Kemp from the University of Queensland's Sustainable Minerals Institute, who was part of the team behind the study, called the results "sobering."

"At a basic level, these findings remind us that mining can cause extensive downstream damage over long periods of time," Kemp said. "Many people benefit from mining and metals, but we must do more to understand and prevent the negative effects on people who live and work in affected areas."

More information: M. G. Macklin, Impacts of metal mining on river systems: a global assessment, *Science* (2023). DOI: 10.1126/science.adg6704. www.science.org/doi/10.1126/science.adg6704

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