Biocontaminant

Editorial

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Biocontaminant—toward sustainable development and planetary health

Yi Luo* and Hongqiang Ren*

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This Editorial marks the inaugural issue of *Biocontaminant*, an international journal and platform dedicated to multidisciplinary research on biocontamination and its profound impacts on sustainable development and planetary health.

The 21st century has been marked by unprecedented challenges of pandemics, environmental pollution, and biodiversity loss. As the world strives toward the United Nations' 17 Sustainable Development Goals (SDGs), biocontaminants—such as pathogens, toxins, invasive species, and allergens—emerge as systemic threats to this global blueprint, directly threatening human well-being, ecosystem services, and planetary health. *Biocontaminant* is launched as a multidisciplinary platform to dissect these complex challenges and pioneer solutions for a resilient future.

Human health under siege

Biocontaminants directly undermine SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation) (Fig. 1). Waterborne pathogens cause over 1 million annual diarrheal deaths globally—a tragic paradox in an era of advanced water treatment. This crisis stems from the vicious cycle of contamination: inadequately sanitized wastewater releases pathogens like *Cryptosporidium* and norovirus into surface water; these resilient agents persist in aquatic environments, later infecting humans through drinking water, contaminated produce, or recreational exposure. In Bangladesh, cholera outbreaks linked to monsoon-flooded sanitation systems exemplify this cycle. Compounding this, antimicrobial resistance (AMR)—driven by antibiotic overuse in aquaculture, animal farming, and disease control—has become a global health threat. In India's polluted waterways, AMR genes from pharmaceutical wastewater effluents have rendered life-saving drugs ineffective against common infections like typhoid, directly undermining SDG 3's promise of health equity.

Sabotaging food security

Biocontaminants also compromise food safety and availability (SDG 2). Foodborne pathogens (e.g., *Salmonella* and *Listeria*) sicken 600 million people annually, while carcinogenic aflatoxins from *Aspergillus* fungi contaminate 25% of global grain supplies. In Kenya, maize-dependent communities face cyclical outbreaks of aflatoxin-induced liver cancer, perpetuating medical poverty. Simultaneously, spoilage organisms like *Botrytis cinerea* destroy fruit and vegetable harvests globally, deepening malnutrition in a world where 2.3 billion people lack consistent food access. Climate change intensifies these threats: warming temperatures expand mycotoxin ranges into Europe's wheat belt, while irrigation water tainted with *E. coli* transforms leafy greens into disease vectors, as seen in the 2018 US romaine lettuce outbreak.

Ecosystems and services in peril

Biocontaminants amplify the triple planetary crisis—climate change (SDG 13), ocean degradation (SDG 14), and terrestrial biodiversity loss (SDG 15). Invasive pathogens like the chytrid fungus *Batrachochytrium dendrobatidis* have driven 90 amphibian species to extinction from Costa Rica to Australia, collapsing insect-control services and nutrient cycles. Meanwhile, agricultural runoff saturated with nitrogen fuels cyanobacterial blooms in lakes from Lake Erie (USA) to Lake Taihu (China), suffocating fish and contaminating drinking water with neurotoxins. Climate change accelerates these dynamics: warming oceans expand *Vibrio* habitats, increasing shellfish-borne infections; deforestation around the globe heightens bat-to-human Hendra virus spillover; and extreme floods disperse invasive pests like the Mediterranean fruit fly into new territories, devastating Italy's citrus industry.

Cascading failures across planetary health

These impacts trigger domino effects across the SDG framework, ultimately threatening planetary health. AMR genes in Indian rivers

* Correspondence: Yi Luo (luoy@nju.edu.cn); Hongqiang Ren (hqren@nju.edu.cn)

Full list of author information is available at the end of the article.

Fig. 1 Beach closure at Imperial Beach, San Diego, CA, USA on August 14, 2022. A yellow sign warns residents and tourists of ongoing pollution from the Tijuana river. Sewage-related bacteria, consistently exceeding health standards, originate in Tijuana and are carried by the river, causing persistent water quality issues and beach closures in the area for years. More information is available from the San Diego Department of Environmental Health and Quality: www.sdbeachinfo.com. Photo by Greg Bulla on Unsplash.

(SDG 6) increase neonatal sepsis deaths (SDG 3), while aflatoxin-contaminated crops (SDG 2) reduce smallholder farm incomes in Nigeria, exacerbating poverty (SDG 1). Invasive species carry hidden costs: the emerald ash borer beetle, introduced via global timber trade, has killed millions of North American trees, increasing urban heat islands (SDG 11) and burdening municipalities with USD$10 billion in removal costs (SDG 8). Critically, biocontaminants exploit socioeconomic fractures: Indigenous communities in Canada face elevated tuberculosis rates due to overcrowded housing, while pesticide drift is contaminating indigenous medicinal plants in Ecuador, impacting both the health of local communities (SDG 3) and the biodiversity of the region (SDGs 14 and 15), and eroding cultural resilience (SDG 16).

Our mission: integrating science for solutions

Biocontaminant aims to dismantle these interconnected threats through multidisciplinary dialogue. We seek research that answers pressing questions: Can urban wastewater aerosols (Fig. 1) in megacities transmit antibiotic-resistant pathogens through ventilation systems, driving ICU outbreaks? How do biofilms in drip irrigation systems spread plant pathogens like *Xylella fastidiosa*, threatening crop yields? Can machine learning predict algal blooms using satellite chlorophyll data, protecting global fisheries? What trade policies prevent the spread of the fall armyworm from Africa to Asia's maize fields? By bridging virology, ecology, and social science, we catalyze innovative strategies to tackle biocontamination for a sustainable future.

A call for united action

As we launch this journal, we are reminded of the words of Wangari Maathai: '*In the course of history, there comes a time when humanity is called to shift to a new level of consciousness*'. Let *Biocontaminant* be that call to action—a beacon of collaboration amid the triple planetary crisis—climate change, biodiversity loss, and environmental pollution.

To the global community of researchers, practitioners, and policymakers: *Biocontaminant* invites you to share your insights, challenge conventions, and pioneer solutions. Whether you are investigating microplastics as vectors for marine pathogens, developing AI-driven models for outbreak prediction, or advocating for stricter indoor air quality standards, your work belongs here. We particularly welcome studies centering on vulnerable populations—smallholder farmers, Indigenous peoples, and local communities, and marginalized groups disproportionately impacted by biocontaminants.

Together, let's advance into a future where planetary health and human well-being are inseparable—a future where safe food, thriving ecosystems, and equitable resilience are not aspirational goals but universal realities.

Declarations

Competing interests

The authors declare that they have no conflict of interest.

Author details

State Key Laboratory of Water Pollution Control and Green Resource Recycling, School of Environment, Nanjing University, Nanjing 210023, China

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