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Editorial: Environmental degradation, health, and socioeconomic impacts

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Editorial on the Research Topic

Environmental degradation, health, and socioeconomic impacts

Introduction

Environmental degradation is one of the most complex and pressing global challenges of the 21st century. The interconnectedness of natural ecosystems, human health, and socioeconomic development has never been more evident. Rapid industrialization, urban expansion, and the unsustainable use of natural resources have placed significant stress on the planet's environmental systems, leading to profound consequences for health, equity, and economic resilience.

The *Frontiers* Research Topic *Environmental Degradation, Health, and Socioeconomic Impacts* was designed to advance interdisciplinary dialogue and stimulate new approaches to understanding and mitigating these intertwined challenges. By bringing together 22 peer-reviewed articles authored by scholars from across Asia, Europe, North America, and Africa, this Research Topic deepens our understanding of how environmental decline affects health outcomes, economic systems, and social stability, as well as how innovation, governance, and technological advancement can foster resilience.

The articles published in this Research Topic collectively suggest that addressing environmental degradation requires more than isolated policy reforms. It demands a paradigm shift toward integrative, data-informed, and justice-centered environmental governance, grounded in cross-sector collaboration and empowered by digital transformation. Collectively, these contributions demonstrate that sustainable development requires not only new technologies but also transformative shifts in governance, social behavior, and economic incentives. This Research Topic underscores how environmental degradation manifests through multiple pathways—pollution, resource depletion, land-use change, and climate stress—each carrying cascading health and socioeconomic consequences. It also emphasizes the importance of innovation, sustainable investment, and governance reform in shaping equitable environmental

responses. The authors not only examine drivers of environmental deterioration but also propose pathways to equitable adaptation and sustainable growth, reaffirming that global environmental health is a shared responsibility requiring continuous scientific engagement and inclusive policy translation.

The articles span diverse methods and geographies, from national energy policy analyses and urban sustainability models to studies linking air pollution with health and demographic change, reflecting the global relevance of this research. This editorial synthesizes key insights across five interdependent themes: environmental health and social inequities; economic and technological pathways to sustainability; urbanization and infrastructure resilience; energy transition and governance; and future policy directions for a sustainable world.

Environmental health and social inequities

Environmental risks disproportionately affect vulnerable populations. [Wen et al.](#) estimated the global, regional, and national burden of ischemic heart disease attributable to lead exposure, highlighting long-term health losses from heavy metal pollution. [Li et al.](#) mapped PM_{2.5} exposure across China and found substantial inequities driven by emissions, meteorology, and socioeconomic status. Complementing this evidence, [Lin et al.](#) examined the health and economic costs of PM_{2.5} pollution from oil consumption in China, quantifying the dual burden of energy dependence and air pollution. [Shi et al.](#) demonstrated that regular exercise can moderate the adverse mental and physical effects of noise pollution, suggesting adaptive behavioral pathways for resilience. [Li and Yang](#) analyzed the household clean-energy transition in China and found that replacing traditional fuels with cleaner energy sources significantly reduces residents' medical expenditures. Their results highlight how sustainable energy policies can yield direct health and economic co-benefits at the community level. In the United States, [Smith et al.](#) showed that communities with higher social vulnerability face elevated cancer risks from airborne toxins in Louisiana.

Collectively, these studies reinforce the concept of environmental justice as an indispensable public health framework. They reveal how pollution, lifestyle, and socioeconomic status interact in ways that perpetuate chronic disease and premature mortality. The findings emphasize the need for intersectional policies that integrate environmental monitoring, behavioral interventions, and equitable access to clean energy and healthcare resources.

Economic and technological pathways to sustainability

Economic development and technological innovation represent essential levers for achieving sustainability. [Hu and Smith](#) examined the transition from fossil fuel dependency to green growth, highlighting the roles of digital innovation, sustainable investment, and workforce adaptation. [Lan and Ma](#) demonstrated that the digital economy influences pollution trajectories through

mechanisms that first exacerbate and then mitigate emissions, depending on technological maturity. [Nuriddinova and Ahmad](#) validated the Environmental Kuznets Curve in Uzbekistan, demonstrating how economic growth initially intensifies but eventually alleviates environmental degradation when cleaner technologies are adopted. [Li and Chen](#) analyzed the relationship between carbon emissions, producer price index (PPI), and consumer price index (CPI), offering evidence of complex feedback between environmental policy and macroeconomic systems. Complementary findings from cross-country analyses by [Zhang et al.](#) underscore that digital transformation and ICT innovation are decisive in reducing environmental degradation across emerging economies. Further, [Mu et al.](#) explored the relationship between environmental efficiency and fertility across OECD countries, revealing that improvements in environmental performance coincide with demographic stabilization, suggesting deeper socio-environmental linkages.

Together, these studies demonstrate that sustainability is not merely a technological challenge but an economic and societal one. Integrating green innovation into industrial strategies can yield both productivity gains and emissions reduction. The convergence of ICT, finance, and environmental management reflects a broader shift toward “green digital economies,” where circularity, data transparency, and innovation policy converge to drive structural transformation.

Urbanization and infrastructure resilience

Rapid urbanization presents both risks and opportunities for sustainability. [Tiron-Tudor et al.](#) and [Behera et al.](#) found that limited access to safe water, sanitation, and hygiene (WASH) services continues to impede human development in the least developed countries. [An et al.](#) proposed horizontal ecological compensation to strengthen urban resilience and encourage inter-regional low-carbon cooperation. Parallel analyses by [Zhu et al.](#) showed that green economic efficiency and new-type urbanization evolve in increasingly coordinated trajectories across China, emphasizing the importance of regional balance in sustainable development. Building on this, [Ma et al.](#) examined the spatiotemporal coupling between new-type urbanization and green economic efficiency in Chinese cities, revealing that balanced growth depends on synergies between economic expansion and ecological management.

This evidence collectively signals that cities must act as engines of sustainability rather than sources of environmental degradation. Integrating ecosystem services into urban planning, improving climate resilience infrastructure, and fostering local innovation ecosystems can strengthen cities' adaptive capacity. Moreover, urban governance frameworks that emphasize inclusivity and stakeholder engagement are essential for ensuring equitable access to sustainable development benefits.

Energy transition and governance

The transition toward sustainable energy systems represents both an opportunity and a challenge for achieving climate resilience

and social justice. Boulogiorgou and Kaldellis investigated Greece's decarbonization policies, showing that rapid implementation without adequate community engagement risks exacerbating local economic disparities. Dhar et al. assessed transboundary environmental effects of coal-fired power plants, emphasizing the need for regional cooperation to mitigate cross-border air pollution. Regional modeling by Zhu et al. in Inner Mongolia revealed that effective coordination within the energy–economy–environment system can enhance policy synchronization and promote sustainable industrial transformation. Zhao and Zhang examined legal innovations aimed at balancing environmental protection with public health, while Wang and Li demonstrated that uncertainty in environmental policy can unintentionally drive industrial pollution migration.

These studies collectively suggest that sustainable energy transitions cannot rely solely on technology; they require political will, institutional capacity, and citizen participation to ensure equity and long-term success. They underscore that achieving net-zero goals requires harmonizing environmental regulation, fiscal incentives, and public engagement mechanisms. A “just transition” must therefore address the human dimensions of decarbonization, protecting workers, supporting regional economies, and ensuring energy affordability for all.

Integrative synthesis and future directions

Synthesizing across all contributions, this Research Topic demonstrates that environmental sustainability depends on understanding the mutual feedback loops among ecological, health, and economic systems. The twenty-two papers in this Research Topic converge on a shared insight: environmental degradation, health, and socioeconomic resilience are interdependent. Recent analyses highlight how pollution from energy consumption compounds health and economic burdens, while advances in urban planning and green economic efficiency reveal new pathways toward balanced, low-carbon growth. Sustainable transformation, therefore, depends on integrated data ecosystems that link environmental indicators with health and equity outcomes, ethical applications of artificial intelligence for predictive governance, and institutional frameworks that prioritize vulnerable communities.

The synthesis across these studies reveals a clear research frontier: the operational integration of environmental data, public health outcomes, and socioeconomic indicators. Developing interoperable data systems that allow real-time analysis of pollution, disease, and social vulnerability could revolutionize how policymakers respond to emerging environmental crises. Furthermore, community-centered research, grounded in participatory science and local knowledge, can help bridge the gap between evidence and implementation, ensuring that research outcomes are socially embedded and actionable.

While this Research Topic has made strong contributions to the literature linking environmental degradation, health, and socioeconomic outcomes, it also exposes several critical research gaps. First, persistent data limitations—particularly in low- and middle-income regions—restrict our understanding of long-term

pollution exposure and its health costs. Second, most studies remain correlational; advancing causal modeling between environmental change, health outcomes, and socioeconomic factors is essential. Third, future research should examine system dynamics that connect local exposure, global supply chains, and transboundary flows, providing a fuller picture of how environmental risks propagate. Finally, designing and testing frameworks for “just transitions” that balance environmental, economic, and social objectives remains an urgent global priority. Together, these insights reaffirm that addressing environmental degradation demands integrative strategies linking innovation, infrastructure, governance, and public health to ensure a sustainable and equitable future.

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