

Climate change and its impediments to global health security

1 | INTRODUCTION

Climate change is the proverbial elephant in the room. It refers to the long-term changes in the earth's weather and temperature patterns that can occur naturally or be induced by human activities.¹ Over the last few decades, scientists have attributed the rapid deterioration in the quality of life-sustaining ecological habitats to greenhouse emissions and global warming. It is a complex, multifaceted problem threatening human existence and the earth's sustainability for the human race. Almost all the recent health calamities facing human beings are deeply rooted in climate-related issues. Climate change impacts the Triple Billion goals, specifically achieving a billion people's security against health emergencies.² Global health security deals with the emergence and prevention of acute public health emergencies or infectious diseases. Climate change induces ecological shifts by altering homeostasis between crops, weeds, vectors, and pathogens. It can aggravate the decline in pollinating insects, fisheries, and groundwater levels and increase ozone concentrations, adversely affecting flora and fauna.³

Contrary to popular belief, climate change is not just confined to global warming; it also has far-reaching health consequences with the emergence/resurgence of novel infectious pathogens, vector-borne diseases, displacement of people, economic losses, food insecurity, and mental health issues. With the existing health infrastructure inequities, vulnerable communities, particularly those in low-middle-income countries, who have contributed the least to climate change, ironically, are disproportionately impacted by its consequences. The current article intends to bring out the major manifestations of the climate change, its impact on health security and the way forward to address this critical issue.

2 | PRIME MANIFESTATIONS OF CLIMATE CHANGE

2.1 | Global warming

We are increasingly becoming aware of the effects of global warming with more frequent, intense, and protracted extreme thermal events. Several countries participated in the Paris Agreement, aiming to limit global mean temperature rise to below 2°C by reducing 70% of anthropogenic emissions by 2050 and achieving net negative

emission by 2100. However, projections indicate that even if anthropogenic emissions abate immediately, global temperatures will continue to rise by 0.2–0.5°C in the coming decade, reaching 1°C by the end of the 21st century.⁴

World Health Organization estimates that climate change will cause approximately 250,000 deaths annually from malaria, malnutrition, diarrhea, and heat stress between 2030 and 2050. Meteorological reports indicate that severe heat waves have doubled between 2015 and 2020 compared to 1951 and 1980. This has led to 46% of floods, 34% of storms, 32% of wildfires, and 31% of droughts since 1900.⁴ There are frequent occurrences of strange and unpredictable weather events worldwide, ranging from California wildfires to flash floods in India and Pakistan.⁵

2.2 | Air pollution

The adverse air quality indices of urban cities like New Delhi, India have sounded the alarms of global health agencies. Globally, 90% of individuals inhale air with a significant amount of contaminants, which results in approximately seven million fatalities each year due to polluted air, including 660,000 children among those casualties.⁶ Respiratory consequences of air pollution include a higher prevalence of asthma, respiratory tract infections, and respiratory comorbidities in children and adults. Factors accounting for the disproportionate impact on children include the immature lung epithelium, higher exposures among children due to increased minute ventilation, and greater physical activity in outdoor settings in the younger age groups. Furthermore, accumulating evidence indicates long-standing exposure to poor air quality can increase all-cause mortality morbidity due to endocrine, metabolic, and neurological ailments, reproductive issues, and cancer.^{7,8} Recent demographic shifts and regional events in our country, including widespread land acquisition for construction activities in predominantly rural areas, have led to profound air quality contamination.

2.3 | Human diseases

Extreme weather events have become familiar with frequent reports of heat waves, droughts, wildfires, cyclonic storms, and floods. These

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climatic disasters cause immense human suffering by causing widespread crop damage, displacement, and injuries. These can compound human misery by causing food insecurity and rising waterborne diseases like cholera in flood-affected regions due to poor sanitation.⁹ The climate change impacts and the relationship between environmental, flora, fauna, pathogens, and human beings is illustrated in Figure 1. Climate change fuels the emergence of pathogens by altering the environmental milieu and creating disequilibrium amongst species. As the conditions worsen, they may force species displacement from natural habitats, causing the genesis and transmission of novel zoonotic diseases. The climate crisis has also unveiled the profound vulnerability of humanity in facing novel infectious agents. Chaotic and unpredictable rainfall and temperature patterns influence both seasonality and severity of viral pathogens. Poor sanitation practices in flood-affected regions can drive waterborne disease outbreaks like the cholera recently witnessed in Malawi, Africa.¹⁰ Increasing air travel has blurred geographical boundaries, leading to the accelerated international spread of infectious agents and their vectors. Pandemics, public health emergencies, and ill-equipped health infrastructure pose the most significant risks to the global economy and health security.

Increasingly warmer climates foster vectors' growth and survival, leading to vertical and horizontal expansion of vector-borne diseases in newer geographical territories. Humid and warm temperatures shorten the oviposition of mosquitoes and increase the likelihood of bites due to the lack of protective clothing worn in these climatic conditions. Recent studies have indicated that malaria and dengue

are losing the seasonality of epidemics. In the next two decades, climate change will be responsible for nearly 33,000 additional mortalities, the largest share happening in Sub-Saharan Africa and South Asia.¹¹

2.4 | Food insecurity

Climate change adversely affects food production and safety in all domains of the nutritional ecosystem (availability, access, utilization, and stability). The nutritional content of crops depends on the atmosphere's carbon dioxide content. Unpredictable climate-related disasters such as droughts, excessive rainfall, windstorms, floods, and hailstorms also have an adverse impact on agricultural production. Extreme temperatures and precipitation also increase the pathogen load, promoting the heavy use of pesticides. Moreover, floods and other natural disasters influence the access and distribution of food to the affected areas. Lastly, the global food processing industry contributes an average of 16 billion tonnes of CO₂ equivalents per year, thus adding to greenhouse emissions causing climate change.

2.5 | Socioeconomic impacts

Regarding economic impact, direct health costs due to climate change are expected to be 2–4 billion USD/year by 2030. Around 12% of the global population allocates a minimum of 10% of their household

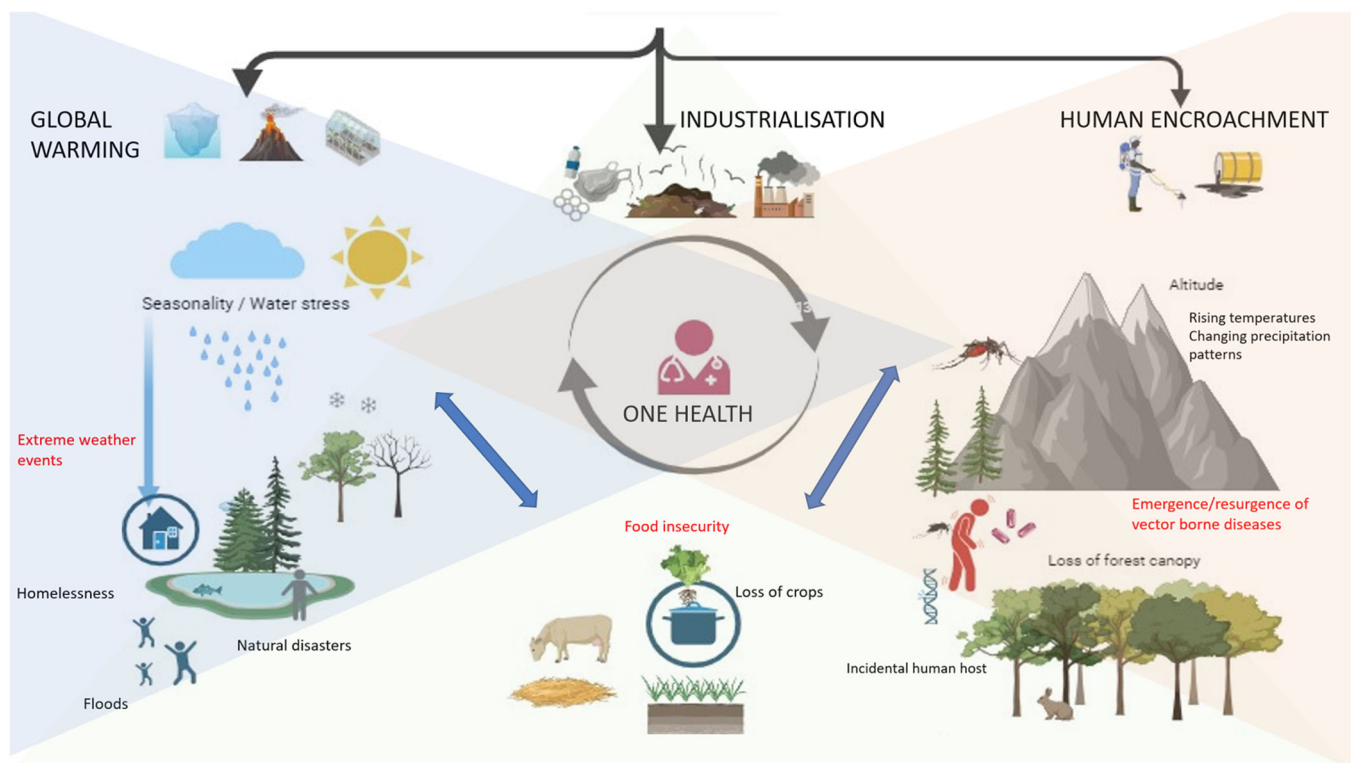


FIGURE 1 Climate change impacts and the relationship between environmental, flora, fauna, pathogens, and human beings.

income to cover healthcare expenses.¹² A surge in infectious disease will significantly increase healthcare expenditure, tipping poverty scales, and deepening the health security crises

3 | WAY FORWARD

The mitigation strategies involve four crucial aspects.

3.1 | To periodically evaluate vulnerabilities and preparedness for climate-induced disasters

Developing and integrating early warning systems for forecasting extreme weather can enable the timely institution of preventive strategies and estimating possible health risks, devising medical rescue plans, and establishing a structured program for post-disaster rehabilitation.

3.2 | Reinforce climate resilience and environmental sustainability

Fossil fuel burning is the major contributor to air pollution and is responsible for over six million deaths annually.¹³ Adopting clean and renewable energy sources, including solar, wind, geothermal, and wave power, can help reduce emissions. The use of electric vehicles to discourage fossil fuel usage, carpooling, cycling, and availability of public transportation are some of these climate-resilient strategies that can mitigate the current healthcare crisis. Initiatives such as the widespread ban on plastic bags and the promotion of millet-based diets resilient to climatic conditions are some innovative solutions to tackle the climate crisis and food insecurity.

3.3 | Multisectoral collaboration in the implementation of health promotion intervention and advancement of climate justice

Various national and international public health awareness programs are regularly undertaken to increase awareness about conservation and climate action methods. These include climate champions to sensitize young children and adults about sensible waste disposal, avoidance of plastic bags, and water and fuel conservation strategies. Implementation research in this domain can be leveraged to translate the plans into action at the community level effectively.

Climate action is one of the most fundamental Sustainable Development Goals (SDG) closely interlinked with other health-related

SDGs. Globally, it is being increasingly recognized that climate action is synonymous and synchronous with health action and goals. Resonating with this vision, the Intergovernmental Panel on Climate Change 2023 advocated resilient climate development that integrates adaptation and mitigation to advance sustainable development for all. It campaigns for international collaboration to ensure equitable distribution and accessibility of financial resources, inclusive governance, and coordinated policies.¹⁴ Regulatory policies limiting deep emissions must be scaled up and applied widely across nations. Technological advancements must be capitalized on to overcome barriers in implementation and facilitate widespread adoption of climate action. All actions must be based on a multisectoral concept of “one health” that recognizes the interconnectedness of humans, animals, and environmental health.¹⁵

Climate change and its impact is becoming increasingly apparent with extreme weather events, floods, droughts, and wildfires. Such events impact human health through noncommunicable diseases, infections, and injuries, as well as leading to issues with food scarcity and housing instability. Considerable political will, institutional frameworks, policies, and collaborative strategies are necessary for ensuring access to capital and technology, especially in regions with poor economies.

KEYWORDS

global health, public environmental & occupational health, public health

AUTHOR CONTRIBUTIONS

Nisha Toteja: Conceptualization; data curation; investigation; methodology; validation; writing—original draft. **Aravind P. Gandhi:** Conceptualization; methodology; resources; supervision; writing—review and editing. **Prakasini Satapathy:** Methodology; project administration; resources; supervision; writing—review and editing. **Sarvesh Rustagi:** Methodology; project administration; resources; writing—review and editing. **Ranjit Sah:** Conceptualization; methodology; project administration; writing—review and editing.

CONFLICT OF INTEREST STATEMENT



The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All relevant data are included in the manuscript.

TRANSPARENCY STATEMENT

The lead author Ranjit Sah affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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