

Impacts of Climate Change on Public Health Promotion in Zambia: Integrating Sustainable Development Processes

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Abstract

Climate change poses significant threats to public health promotion, particularly in resource-constrained settings such as Zambia. Increasing occurrences of droughts, floods, and heatwaves disrupt health service delivery, intensify disease burdens, and worsen inequalities among vulnerable populations. This study systematically reviews literature published between 2000 and 2024 to assess the impacts of climate change on public health promotion in Zambia and to identify pathways for integrating sustainable development into health strategies. Data were collected from major databases, including Web of Science, Scopus, PubMed, CAB Abstracts, and Google Scholar, and screened through a structured selection process. A total of 18 studies met the inclusion criteria and were analyzed thematically. The findings indicate that climate change contributes to increased risks of waterborne and vector-borne diseases, malnutrition, and psychosocial stress, while also placing pressure on health infrastructure and sanitation systems. Several adaptive strategies have been identified, such as improved disease surveillance, climate-smart agriculture, renewable energy use in healthcare facilities, and community-based awareness programs, although challenges in large-scale implementation remain. In conclusion, integrating sustainable development into public health promotion is

essential to enhance resilience, reduce inequalities, and protect long-term population health in Zambia.

Keywords: Climate change, Public health promotion, Sustainable development, Zambia, Health equity, Resilience

Introduction

Climate change is one of the most pressing global challenges, affecting social, economic, environmental, and health domains. Climate change poses significant threats to public health in Zambia, affecting vulnerable populations through extreme weather events and disruptions to food, water, and infrastructure (Chavula et al., 2024). It threatens progress toward Sustainable Development Goal (SDG) 3 ensuring healthy lives and well-being while simultaneously complicating efforts to achieve resilience and sustainability in line with SDGs 6, 11, 13, 14, and 15.

In the Southern African Development Community (SADC), projections indicate more frequent droughts, heatwaves, and floods, intensifying pressures on already fragile systems. Despite recognition of these risks, climate change's intersection with public health in Africa remains underexplored, particularly in Zambia, where evidence on promoting health within a changing climate is limited (Mwale, 2025). A systematic assessment is therefore needed to understand the impacts, highlight challenges, and propose sustainable pathways forward.

Climate change affects health both directly through extreme weather events, heat stress, and floods and indirectly, by disrupting food systems, water supplies, and infrastructure. Vulnerable groups such as the poor, elderly, chronically ill, children, and rural populations bear the heaviest burden (Addy et al., 2024). Globally, events such as the 2003 European heatwave, which claimed over 35,000 lives, and recurrent bushfires in Australia demonstrate the devastating public health consequences of climate variability. In Zambia, where many livelihoods depend on climate-sensitive sectors such as agriculture, these risks are magnified, exacerbating health inequities and undermining resilience.

The Zambian context highlights the urgency of this issue. Rising temperatures, erratic rainfall, droughts, and floods are increasingly observed, reducing agricultural productivity, straining food security, and heightening the spread of waterborne and airborne diseases. These climatic stressors not only disrupt socio-economic development but also undermine the promotion of public health (Nie et al., 2024; Raihan, 2023). Public health promotion defined as preventing disease, encouraging healthy lifestyles, and improving well-being relies on strong infrastructure, awareness, and education. Yet, the integration of sustainable development processes into climate and health responses remains limited, leaving gaps in resilience-building efforts at both local and national levels.

The last national climate risk assessment in Zambia emphasized the vulnerability of the health sector the most climate-sensitive sector yet little scholarly evidence has focused on how climate change specifically affects public health promotion or how sustainable development processes can mitigate these effects (Morton et al., 2019; Shelton et al., 2018). Contemporary evidence suggests that floods, droughts, and heatwaves disrupt health systems, increase

disease burdens, and reduce adaptive capacity. These impacts compound development setbacks, including job losses, poverty, and weakened food systems, which in turn compromise health promotion. Thus, climate change constitutes both a direct health threat and an obstacle to achieving broader development objectives (Morton et al., 2019).

This study seeks to address these gaps by examining the impacts of climate change on public health promotion in Zambia and exploring how sustainable development processes can be integrated to strengthen resilience (Assarkhaniki et al., 2023; Reyers et al., 2022). The guiding research questions are: (i) How does climate change affect public health promotion in Zambia? and (ii) Which sustainable development processes provide the most effective avenues for mitigating these impacts? By addressing these questions, the study aims to contribute evidence that informs policy, strengthens health systems, and promotes sustainable development in the face of climate change.

Methods

Search Strategy

A systematic review approach was adopted to identify relevant studies addressing the impacts of climate change on public health promotion, with a specific focus on Zambia and the broader Southern African context. Searches were conducted across multiple electronic databases, including Web of Science, Scopus, PubMed, CAB Abstracts, and Google Scholar. The search strategy combined terms related to *climate change*, *public health*, *health promotion*, *sustainable development processes*, and *Zambia*. Boolean operators and controlled subject terms were adapted to suit each database. To capture recent trends and policy-relevant findings, the search covered literature published between 2000 and 2024.

Eligibility Criteria

Studies were eligible for inclusion if they (i) examined climate change impacts on health or health promotion in Africa, with priority to Zambia, (ii) addressed links between climate stressors and public health outcomes such as disease prevalence, nutrition, water and sanitation, or health infrastructure, and (iii) provided insights into or recommendations for integrating sustainable development processes in health interventions. Excluded were studies without clear methodological detail, non-English publications, editorials, and works unrelated to the intersection of climate and public health. Additional literature was identified through citation tracking of eligible works.

Screening and Selection

The screening process followed three stages: titles were first reviewed to remove clearly irrelevant articles, followed by abstract review for topical relevance, and finally, full-text appraisal of potentially eligible studies. Two reviewers independently applied the inclusion criteria, with discrepancies resolved by consensus. This approach ensured both methodological rigor and thematic focus.

Data Extraction

Key information was extracted from each included study using a structured template. Data collected included publication details, geographic scope, study objectives, health outcomes assessed, climate stressors addressed, methodological approach, and discussion of sustainability or development processes. Additional extraction fields captured cross-cutting issues such as vulnerable populations, adaptation measures, and institutional or policy contexts.

Data Synthesis

Extracted data were synthesized using a thematic narrative approach. Studies were categorized based on (i) type of climate stressor (e.g., floods, droughts, heatwaves), (ii) health promotion domains affected (e.g., disease prevention, health education, nutrition, sanitation, mental health), and (iii) sustainable development processes highlighted (e.g., community participation, policy integration, infrastructure strengthening, or education programs). Patterns and gaps were identified across categories, allowing comparative insights into both direct and indirect health impacts.

Rationale for Approach

This methodology provides a comprehensive foundation for assessing the current evidence base on climate change and health promotion in Zambia. By systematically reviewing literature across disciplines and integrating a sustainability perspective, the study aims to highlight practical options for embedding sustainable development processes into health promotion strategies. This approach ensures that the findings are not only academically robust but also directly relevant to policy and practice in Zambia.

Results and Discussion

Study Selection

The systematic search across multiple databases yielded 6,214 records. After removing duplicates and applying eligibility criteria, 41 full-text articles were assessed, of which 18 met the inclusion threshold for final synthesis. The included studies span from 2005 to 2023, covering diverse themes such as climate-sensitive diseases, food and water security, health infrastructure resilience, and integration of sustainable development processes.

Study Characteristics

Most studies were conducted in Zambia or in regional Southern African Development Community (SADC) contexts with implications for Zambia. Ten studies employed primary data through surveys, focus groups, or participatory community assessments, while the remainder relied on secondary datasets, modeling exercises, or policy analysis. Collectively, the evidence highlights that climate change exerts both direct and indirect impacts on public health promotion in Zambia. Direct impacts include increased frequency of waterborne and vector-borne diseases such as cholera, malaria, and diarrheal infections. Indirect impacts emerge through food insecurity from prolonged droughts, malnutrition associated with declining crop yields, and psychosocial stress linked to displacement and loss of livelihoods.

Notably, several studies emphasized that climate change undermines progress towards national health goals by straining infrastructure, reducing access to clean water, and impeding community-level health education efforts (Kilungo et al., 2024). Evidence from rural provinces, particularly Southern and Eastern Zambia, showed that recurring droughts and floods disrupt sanitation systems, increase disease burdens, and weaken household coping strategies.

Risk of Bias and Quality of Evidence

Of the 18 included studies, two-thirds demonstrated a low risk of bias based on methodological rigor, transparency, and alignment with stated objectives, while the remainder were assessed as moderate due to limited sample size, incomplete data, or reliance on self-reported outcomes. Despite these limitations, the overall evidence base was considered robust, offering credible insights into the nexus between climate change, health promotion, and sustainable development in Zambia.

Effectiveness of Interventions

Intervention-focused studies revealed that locally adapted strategies can significantly reduce vulnerability. Prominent interventions included small-scale irrigation schemes, promotion of drought-tolerant crops, strengthening of early-warning and disease surveillance systems, and community-based education on hygiene and nutrition (Hussain et al., 2025; van & Biradar, 2021). Health promotion initiatives linked to sustainable development processes—such as integrating renewable energy for rural clinics, adopting reforestation to stabilize water cycles, and embedding climate education in school curricula—were reported as promising avenues to build resilience. While effectiveness varied across contexts, community participation consistently emerged as a determinant of success.

Thematic Synthesis

Three dominant themes emerged from the synthesis: (1) Climate-Sensitive Health Risks – Increased incidence of cholera, malaria, and malnutrition highlights how climate variability intensifies health inequities; (2) Gaps in Infrastructure and Governance – Weak health systems, inadequate sanitation facilities, and limited emergency preparedness hinder Zambia’s ability to manage health threats; (3) Pathways for Sustainable Integration – Studies underscore the importance of embedding sustainable development processes, such as multi-sectoral planning, stakeholder engagement, and eco-health frameworks, into health promotion (Rüegg et al., 2024). These approaches not only reduce vulnerability but also advance broader development goals.

Exploratory Insights

Despite progress, the review reveals significant knowledge gaps. Few studies holistically assess how climate change exacerbates public health burdens across different demographics, and even fewer explore long-term sustainability pathways. Evidence suggests that integrating climate action into public health promotion requires more than reactive measures—it demands deliberate alignment with sustainable development processes that leverage

indigenous knowledge, strengthen institutional capacity, and encourage inclusive participation (Fox et al., 2019).

Principal Findings and Certainty of Evidence

The review revealed that climate change is already exerting substantial pressure on Zambia's public health promotion efforts. The evidence indicates that climate variability disrupts health service delivery, amplifies disease burdens, and undermines community well-being, particularly among the most vulnerable populations (Ebi et al., 2021). Consistent with findings from the World Health Organization (WHO), our results confirm the necessity of embedding climate change adaptation within public health system strengthening.

The strongest evidence relates to waterborne diseases such as cholera, diarrheal infections, and vector-borne diseases like malaria, which increase following floods and seasonal shifts. Nutrition-related challenges, especially stunting and malnutrition during drought years, further highlight how climate change exacerbates morbidity and mortality (Agostoni et al., 2023). While several interventions such as early warning systems, health surveillance, reforestation programs, and renewable energy integration show promise, the evidence base remains fragmented. Only a few studies rigorously assessed the scalability of such interventions, and quality appraisals indicate moderate variability in methodological robustness. Nevertheless, convergence across diverse studies strengthens confidence that climate change is a determinant of health inequalities in Zambia (Wright et al., 2024).

Comparison with Prior Reviews and Novel Contributions

Previous systematic reviews of climate change and health in Africa often generalized findings at continental scale and rarely addressed Zambia specifically. Our synthesis builds on this limited foundation by focusing explicitly on the Zambian context and introducing the dimension of sustainable development integration. Unlike earlier reviews, this study does not stop at describing vulnerabilities—it highlights opportunities for leveraging education, renewable energy, waste management, community engagement, and climate-smart agriculture as vehicles for health promotion. This novel framing underscores that resilience-building in Zambia requires moving beyond reactive health interventions toward proactive, cross-sectoral strategies that align with SDGs 3, 6, 11, and 13.

Practice Implications

The results suggest that Zambia must mainstream climate adaptation across public health programs, disaster risk management, and agricultural development. Strengthening inter-ministerial coordination, fostering partnerships with civil society, and investing in climate-resilient health infrastructure will be critical. For instance, integrating renewable energy into rural health posts can reduce service disruptions, while community-driven reforestation programs can stabilize water cycles and mitigate disease risks. Furthermore, embedding climate education within schools and health campaigns offers a low-cost but high-impact approach to build awareness and resilience. Importantly, public health promotion cannot remain siloed within the health sector. It must be integrated into national planning frameworks on agriculture, environment, energy, and education (McGrane et al., 2019). This broader

systems approach will ensure that climate change adaptation is not an afterthought but a guiding principle in national development strategies.

Equity, Ethics, and Governance

Findings highlight that climate change disproportionately affects Zambia's poorest and most marginalized groups, including rural households reliant on rain-fed agriculture, urban slum dwellers, and the elderly (Nkhuwa, 2024). This exacerbates pre-existing health inequities. Ethical governance demands that public health promotion strategies explicitly target these groups, not only by redistributing resources but also by enabling their participation in decision-making. Equity-based approaches, including community-led planning and respect for indigenous knowledge, are essential to ensure that climate and health policies are socially just and contextually relevant.

Implementation in Low-Resource Settings

Implementing climate–health interventions in Zambia faces significant barriers. Financial constraints limit the adoption of technologies such as climate services, disease surveillance platforms, and resilient infrastructure (Ansah et al., 2024). Although global funding mechanisms under the Paris Agreement allocate resources for adaptation, only a fraction reaches the health sector. As a result, Zambia must innovate with limited resources—prioritizing low-cost, scalable interventions such as mobile health technologies, local capacity building, and decentralized renewable energy systems. International partnerships and cross-border collaboration within SADC could also play a pivotal role in mobilizing technical expertise and financial support.

Limitations

The evidence base, though robust, remains constrained by methodological heterogeneity and data gaps. Few longitudinal studies exist to capture the long-term impacts of climate change on health promotion in Zambia. Additionally, the geographic distribution of studies is uneven, with most research concentrated in Southern and Eastern provinces, leaving knowledge gaps for other regions. These limitations underline the need for nationally representative, multi-sectoral research.

Future Research Agenda

Future research should move toward multidisciplinary and participatory approaches that bridge health sciences, climate research, and sustainable development. Longitudinal cohort studies could track the cumulative impacts of climate variability on public health outcomes, while experimental and implementation research could evaluate the scalability of specific interventions, such as decentralized renewable energy for health facilities or climate-smart nutrition programs. Importantly, future work must integrate open science principles to improve transparency, foster collaboration, and ensure accessibility of findings to policymakers and communities.

Conclusion

Important factors of the climate change phenomenon such as its drivers and impacts including its relationship with other sectors of development important for public health promotion in Zambia were discussed. It also identified the limited evidence available on how public health promotion for climate change impacts in Zambia can be undertaken through social determinants of health in an integrated sustainable development process. Empirical research was recommended to gain better insight into the complex nature of sustainable development policy and community development processes promoting public health in Zambia. The principal objective was to determine how the impacts of climate change on public health promotion in Zambia can be better assessed and effectively undertaken as a process of sustainable development in Zambia. Focus was therefore on better understanding of an integrated sustainable development policy and programme approach for public health promotion rather than on analysis of the health impacts. The integration of climate change adaptation responses in the broader approach of local development is necessary. It is argued that a better understanding of intra-sectoral linkages of the drivers of climate change and their direct and indirect impacts on health promotion provides a basis for identifying these integrated processes.

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