

## CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGIES IN THE CONTEXT OF IMPROVING PUBLIC HEALTH: A SYSTEMATIC LITERATURE REVIEW

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### ABSTRACT

Climate change represents a critical global health threat, necessitating effective adaptation and mitigation strategies. While numerous studies have examined climate strategies in specific regions, a comprehensive analysis comparing approaches across multiple continents and identifying the most effective strategies from a global public health perspective remains limited. This systematic literature review followed the PRISMA guidelines, analysing 21 studies from 2014 to 2024, sourced from ScienceDirect, Google Scholar, PubMed, and EBSCOhost. The review included studies examining climate adaptation and mitigation strategies with measurable public health outcomes across diverse geographical contexts. The analysis identified five key strategy categories. Health system strengthening and leadership emerged as the most frequently implemented approach (12 countries), demonstrating effectiveness through improved emergency response coordination and resource allocation. Environmental conservation strategies (8 countries) showed significant benefits in reducing direct climate impacts, while green economy approaches (8 countries) provided sustainable funding mechanisms. The findings reveal that the implementation of contextual approaches varies significantly between developed and developing nations. Effective climate-health action requires tailored approaches that consider local capacities and resources. Leadership and health system strengthening provide the foundational framework for successful implementation, while integrated multisectoral approaches deliver the most comprehensive public health protection. Future policies should prioritise context-specific strategies that address both immediate health risks and underlying climate drivers.

**Keywords:** *adaptation and mitigation; climate change; public health*

### INTRODUCTION

As the Earth ages, it can also be observed that the quality of the environment is declining. Human activities that continue to override the



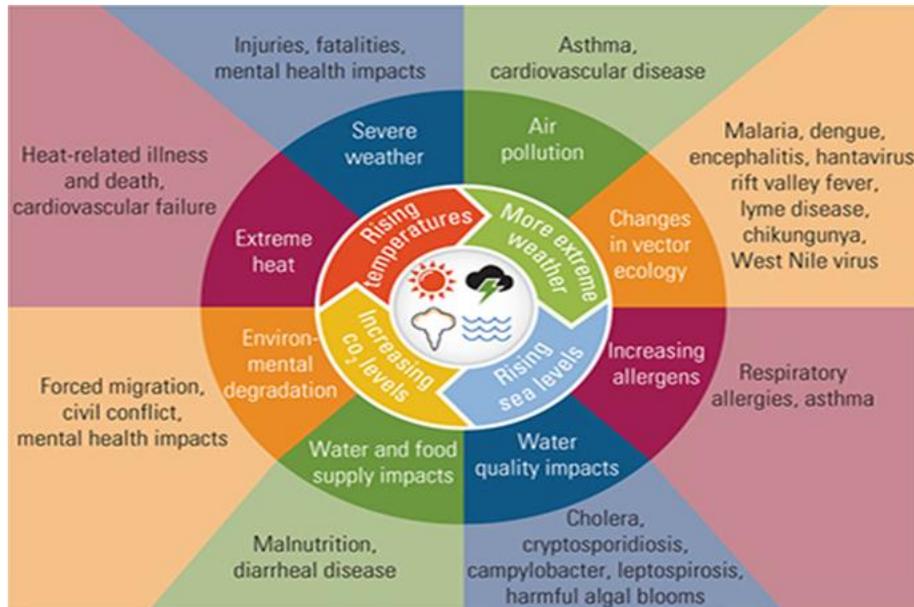
impact on the environment are still occurring today (Briansó Junquera, 2022; Priadi & Fatria, 2024). Climate change is considered the most complex and serious threat to face by all of humanity. Over the past three decades, climate change has become a global crisis that threatens the existence of humans and other living things on Earth (Gabric, 2023; Lukmadi & Sitabuana, 2022). Climate change is primarily caused by population growth, which in turn leads to increased demands for industry, transportation, energy, and agriculture. All of these activities contribute to environmental degradation (Boiyo, Koech, & Manguriu, 2015; Listyarini, Warlina, Sugiarti, Kusumaningrum, & Siregar, 2011; Miller, Rice, Gustafson, & Goldberg, 2022). Climate change poses a significant threat to the stability of ecosystems and the diversity of living organisms. The damage to the Earth's physical and ecological systems can also be evidenced by the depletion of the ozone layer in the stratosphere, the decline in biodiversity, soil degradation, and changes in the water system or cycle (Keman, 2007; Okoli & Ifeakor, 2014). The domino effect of climate change disasters is also characterised by melting

polar ice, rising sea levels, natural disasters, disruptions to food security, and an increase in the incidence of environmentally based diseases (Kamal, Fekri, El-Magd, & Soliman, 2021; Zukmadini & Rohman, 2023). The indirect impact of this phenomenon is associated with disturbances in human health, including air and water pollution, disease vectors, malnutrition, and disturbances in mental health (Ernyasih et al., 2023; Fatria, Priadi, Apriyanti, et al., 2025). These health impacts manifest through multiple pathways globally, creating complex public health challenges across different geographical contexts. Direct effects include injuries and fatalities resulting from extreme weather events, such as floods, storms, and heatwaves, while indirect pathways encompass changes in patterns of infectious diseases, worsening air quality, and disruptions to food and water security (WHO, 2021). The mental health consequences are equally significant, with climate-induced disasters, livelihood disruptions, and community displacements contributing to increased anxiety, depression, and post-traumatic stress disorders across affected populations (Hayes, Blashki, Wiseman, Burke, & Reifels, 2018). The



specific manifestations vary geographically based on climatic, economic, and social factors, requiring tailored approaches to climate-health

adaptation and mitigation. The impact of climate change on human health show in **Figure 1**.

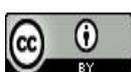


**Figure 1.** The Impact of Climate Change on Human Health

Source: (UNICEF Indonesia, 2023)

An increase in the frequency and intensity of heat waves accompanies global climate change. Temperatures that are too extreme can lead to increased morbidity and mortality. The dangers of climate change in the future are characterised by: (1) rising temperatures; (2) changes in rainfall patterns; (3) sea level rise; (4) a crisis of clean water and natural resources. These hazards can affect microbial contamination pathways, dynamic transmission media, and angroe ecosystems, as well as socio-economic and demographic factors, factors, and can cause various domino

effects on human health through the occurrence of environmental and region-based diseases (Sriwulantari et al., 2024; Susilawati, 2021). It has also been confirmed that the climate crisis contributes significantly to the global health crisis by triggering vector-borne diseases such as dengue fever and malaria. Indonesia, as a tropical country, is highly vulnerable to the impacts of climate change, requiring strong adaptation and mitigation in its environmental health policies and practices (Fatria, Priadi, SN, et al., 2024; Fatria, Priadi, SN, & Sunarti, 2025).



In line with the above, logically related to Indonesia's geographical location as a tropical country flanked by two continents and two oceans, the impact of climate change is likely to be different from that of a country that is only flanked by land (Arwan, Dewi, & Wahyudin, 2021). For example, the impact that occurs in Indonesia will be clearly different from the impact on Mongolia, which factually does not have a sea area and has a continental climate. Extreme and erratic climate change can lead to outbreaks of diseases such as dengue fever, skin diseases, coughs, and colds (Abbass et al., 2022; Ainurrohmah & Sudarti, 2022; Linh Tran et al., 2023). Overall, climate change poses a significant threat to public health in the context of coastal ecosystem decline, and urgent adaptation and mitigation strategies are needed to address these challenges (Sriwulantari et al., 2024; Widmer, 2018). The indirect effects of climate change on human health are through infectious insect and rodent-transmitted diseases (e.g., malaria, dengue fever, West Nile fever virus, Lyme disease and hantavirus pulmonary syndrome), increased smog and air pollution, disease-borne and foodborne diseases associated with the disease

(e.g., giardiasis, Ecoli infection, and shellfish poisoning), and Strong ultraviolet radiation that can cause skin cancer and cataracts (Matlack et al., 2024; Raksanagara, Arisanti, & Rinawan, 2015).

Due to the complex relationship between climate change and human health, it is crucial to address this global issue to protect the well-being of present and future generations. Climate change is also affecting public health by increasing air pollution, which has an impact on respiratory diseases. In addition, it is estimated that climate change will lead to more severe societal disruption and increased inequality, which in turn leads to poverty, population migration, and poorer health (Amalia, Windusari, Sari, Fajar, & Rahmiwati, 2024; Bi, Shi, & Liu, 2020; Ji et al., 2023). The root of environmental health problems is also exacerbated by various other factors, namely (1) the government's lack of attention to efforts to improve environmental health; (2) increased water pollution and lack of clean water supply; (3) poor environmental behavior of the community; and (4) inadequate environmental health conditions of public places (Fatria, 2023). Due to the many significant impacts of climate



change disasters on health, various public health protection strategies are urgently needed.

On the other hand, mitigation and adaptation efforts are also necessary to mitigate the impact of climate change. These efforts must include increasing people's knowledge and capabilities. A nationwide commitment to climate and health policy agendas is urgently needed to protect human health and the environment from the impacts of climate change, both now and in the future (Amalia et al., 2024). This issue is one of the development priorities that are included in the Sustainable Development Goals (SDGs), which are particularly explicit in the 3<sup>rd</sup> point goal, which is a healthy and prosperous life, the 6<sup>th</sup> point, which is clean water and proper sanitation, and the 13<sup>th</sup> point, which is the handling of climate change (Fatria, Priadi, & Fransiska, 2024; Fatria, Priadi, & Nofalinda, 2023). We also need to strengthen our environmental health systems to face the challenges of climate change by integrating technology and innovation in environmental health management (Aydin, Sogut, & Erdem, 2024; Fatria, Priadi, SN, et al., 2025).

Despite growing evidence of climate change impacts on health, significant

knowledge gaps remain in the current literature. First, most studies focus on either adaptation or mitigation strategies in isolation, with limited research examining integrated approaches that combine both (Chersich & Wright, 2019). Second, existing literature often examines single countries or regions, lacking comparative analysis across diverse geographical and economic contexts (Ferreira, Leite, Junior, & Vicente, 2023). Third, there is insufficient evidence regarding which strategies demonstrate consistent effectiveness in improving public health outcomes across different implementation settings (Walter, Bricknell, Preston, & Crawford, 2024). This systematic review addresses these gaps by comprehensively analysing both adaptation and mitigation strategies across five continents to identify common patterns, contextual variations, and evidence of effectiveness.

## **MATERIALS AND METHODS**

The method employed in this study was a systematic literature review, conducted using the Preferred Reporting Items for Systematic Reviews (PRISMA) approach. The data used is secondary data obtained from the results of



research findings that have been carried out by previous researchers, published in scientific articles of accredited and reputable journals. Database: The reference for this investigation comes from international and national scientific publications, including ScienceDirect, Google Scholar, PubMed, and Ebscohost. The criteria established in this investigation utilise the PICO protocol to summarise the research questions. P (Population or problem): global community groups affected by climate change; I (Intervention): Climate Disaster Adaptation and Mitigation Strategies; C (Comparison): Other programs besides climate change disaster adaptation and mitigation; O (Outcome): Improvement of Public Health and its protection. The inclusion criteria set in this investigation are articles that have variables, namely climate change disaster adaptation and mitigation strategies in order to improve the status of society, articles come from health sciences or other relevant sciences and published in the range of 2014-2024 (last 10 years), pdf format articles with full text (available on the Open Journal System reputation), for research derived from student scientific works is available through the repository page of each

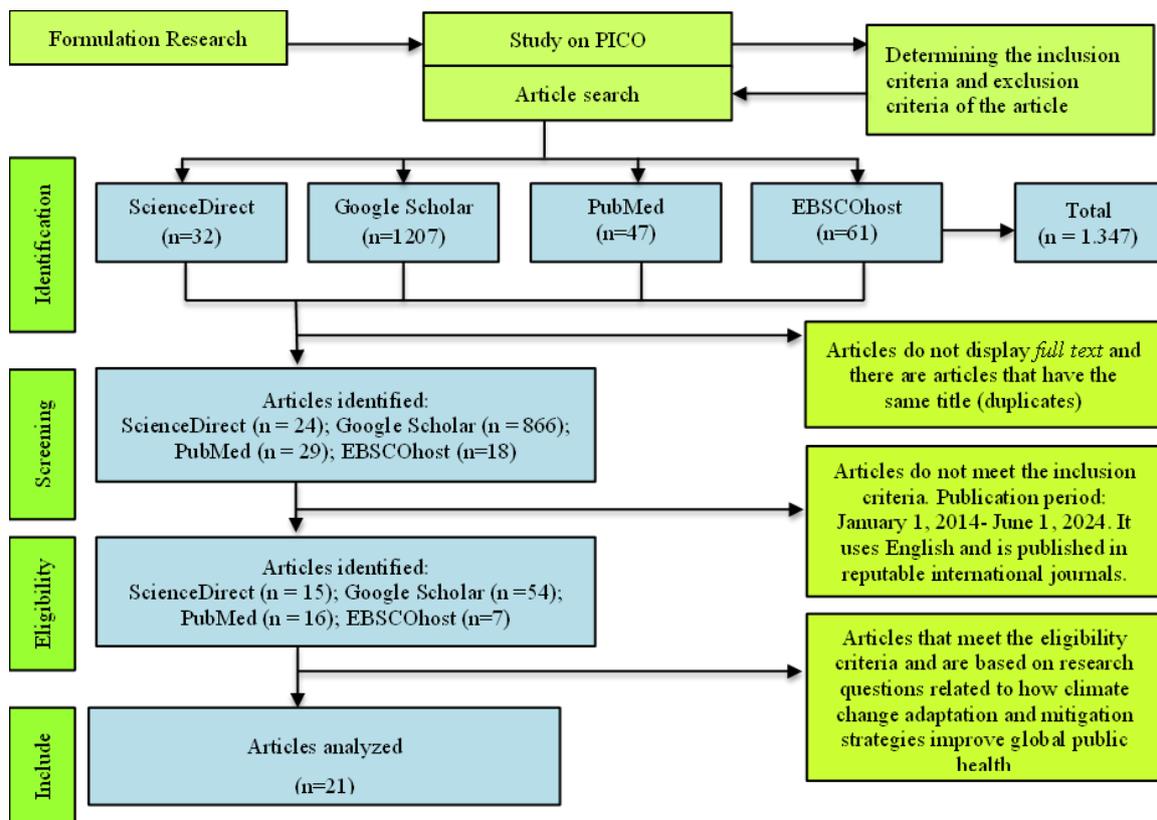
campus. This investigation will be carried out from early February to June 2024. The process of implementing systematic literature studies begins by collecting articles using several Search engines In order to be able to browse relevant articles on climate change disaster adaptation and mitigation in the global community, with the main root of the problem being environmental degradation due to unwise human behaviour towards the environment and the rapid transmission of environment-based diseases (Butarbutar et al., 2024; Fatria, Putrawan, & Artanti, 2019; Lange, 2023).

The literature search was carried out on four databases: ScienceDirect, Google Scholar, PubMed, and EBSCOhost. The main keywords in this study are climate change disaster adaptation, climate change disaster mitigation, and the impact of climate change on public health. Then, the team wrote down the keywords, specifically the relationship between climate change and global public health, spanning the last ten years. Relevant articles were identified from Science Direct, Google Scholar (1,207 articles), PubMed (47 articles), and EBSCOhost (61 articles). The article was reviewed by title, and the abstract



was read carefully to determine if it met the inclusion criteria set by the investigation team for use as literature in this investigation. For articles that pass the screening process, they are entered into a table for further analysis. Data analysis uses narrative analysis. Narrative analysis consists of three

stages: data management, intra-article analysis, and inter-article analysis (Primahesa, Sajidan, & Ramli, 2023). The next step is data collection, which involves extracting relevant information from the primary study for further analysis. For more details, the study process is illustrated in **Figure 2**.



**Figure 2.** PRISMA Protocol Systematic Review Flow Chart

Source: Framework Construct Model by Investigation Team (2024)

This review has several methodological limitations. The restriction to English-language publications may have excluded relevant studies in languages other than English. The focus on recent publications (2014-2024) might overlook earlier foundational research.

Additionally, the narrative synthesis approach, while comprehensive, lacks the quantitative rigour of meta-analysis.

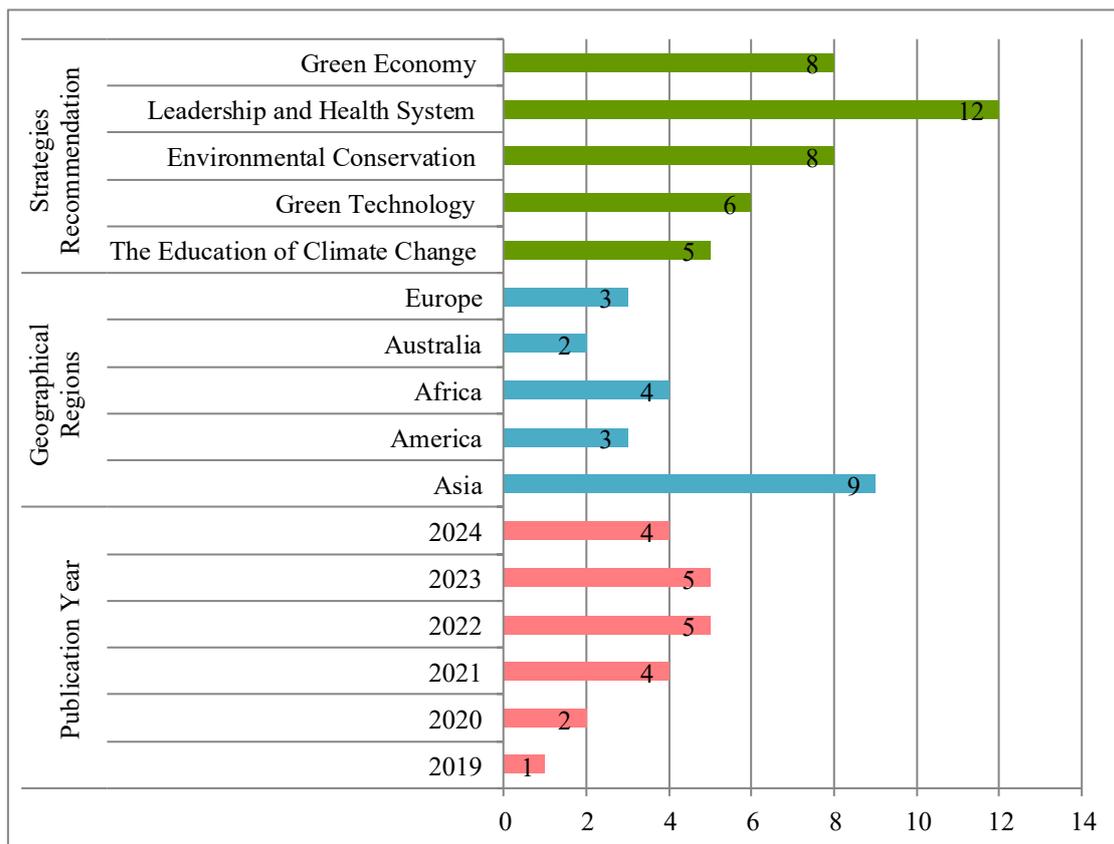
## RESULTS AND DISCUSSION

### 1. Global Patterns of Climate-Health Strategies



The systematic analysis of 21 studies across five continents revealed five predominant strategy categories for climate change adaptation and mitigation in public health contexts. Health system strengthening emerged as the most frequently implemented approach (12 countries), followed by environmental conservation and green economy implementation (each eight countries), green technology adoption (6 countries), and climate education (5 countries).

The distribution of strategies showed distinct geographical patterns. Developed nations, such as Australia, Finland, and Japan, emphasised technological solutions and systematic governance approaches, while developing countries in Africa and Asia prioritised community-based adaptation and the development of basic infrastructure. This variation reflects differences in economic capacity, institutional development, and specific climate vulnerabilities across regions.



**Figure 3.** Results of the Investigation of Article Reviews Related to Climate Change Adaptation and Mitigation Strategies

Source: Results of Investigation Team Performance (2024)



The visual analysis in **Figure 3** provides three key insights into the investigation results. First, the temporal distribution reveals a notable increase in climate-health publications since 2018, indicating a growing research focus on this critical intersection. Second, the geographical representation demonstrates global engagement, albeit

with varying continental density, which may reflect both research capacity and climate vulnerability patterns. Third, the strategy implementation analysis confirms the predominance of health system strengthening while revealing important contextual variations in strategy preferences across different regions and development levels.

**Table 1.** Climate-Health Strategies Implementation Across Continents

Strategy Category	Key Interventions	Health Benefits	Regions Implementing
<b>Health System Strengthening</b>	Leadership development, Governance reform, Emergency preparedness	Improved disaster response, Better resource allocation, Service continuity	Global (12 countries)
<b>Environmental Conservation</b>	Reforestation, Water conservation, Green infrastructure	Reduced disease vectors, Cleaner air/water, Flood mitigation	Asia, South America, Europe
<b>Green Technology</b>	Renewable energy, Eco-sanitation, Green transportation	Reduced pollution, Energy security, Sustainable sanitation	Asia, Europe, Africa
<b>Climate Education</b>	Public awareness, School curriculum, Community training	Behavioural change, Early adaptation, Community resilience	Africa, Asia
<b>Green Economy</b>	Climate funding, Carbon pricing, Green investment	Sustainable financing, Job creation, Low-carbon development	Global (8 countries)

Source: Investigation Team Review (2024)

2. System Strengthening: The Foundational Strategy  
 Human activities together always require leadership, and climate change adaptation is no exception. Leadership is an essential part of management, encompassing planning and organising,

but its primary role is to influence others to achieve the set goals (Sumarto, 2016; Tobing, 2021). Leadership will be effective if it can fulfil its functions to guide, motivate, establish communication networks, and provide efficient supervision, including in



disaster mitigation efforts (Telaumbanua & Ginting, 2019).

This leadership function proves critical in climate-health action, as demonstrated across multiple continents. In South Africa, the increasing leadership of the health sector enabled the reframing of climate change as a health priority requiring an urgent response (Chersich & Wright, 2019). Australia's National Adaptation Plan process demonstrated how political engagement strategies, governance reforms, and preventive funding allocation build health system resilience (Walter et al., 2024). Similarly, Peru's decentralised adaptation plans demonstrated that integrating health considerations into climate policy at multiple governance levels enhances protection for marginalised communities (Aracena, Barboza, Zamora, Salaverry, & Montag, 2021). The consistency across 12 countries confirms that effective leadership provides the essential coordination mechanism for multisectoral climate health initiatives.

### 3. Climate Education: Building Community Resilience

Strengthening climate change education has been confirmed by several countries

that can strengthen climate change adaptation and mitigation actions in order to improve public health, such as Nigeria (Anabaraonye, Okolo, & Wala, 2022), Ghana (Abunyewah et al., 2023), Egypt (Kamal et al., 2021), South Africa (Chersich & Wright, 2019) and Bangladesh (Chowdhury, Hasan, & Islam, 2022). To carry out these strategic steps, education is used as a fundamental foundation to empower the community from an early age. In the face of climate change and its disruptions to global health, the education sector plays a crucial role in providing climate change education to the community. Knowledge about climate change mitigation and adaptation is indispensable for taking effective action in the face of the inevitable challenges of climate change.

Climate education demonstrates particular effectiveness in resource-limited settings. Ghana's approach to prioritising strategies for innovation in the creation and dissemination of community climate knowledge (Abunyewah et al., 2023) demonstrates how education can build adaptive capacity, even with limited technological resources. Similarly, Thailand's integration of traditional wisdom and community-owned ecological



knowledge (Traiyut et al., 2024) demonstrates the value of culturally appropriate educational approaches. This contrasts with, but complements, technological approaches in higher-income countries, showing that education provides a cost-effective foundation for climate-health action across diverse economic contexts.

#### 4. Green Technology Adoption: Contextual Applications

In the situation of increasingly severe climate change, it is necessary to switch to environmentally friendly technology (Fatria, Priadi, SN, et al., 2025). The use of green technology has been confirmed as an effective strategy in dealing with climate change, as evidenced by research findings in various countries such as China (BI et al., 2020), Poland (Smaliychuk & Latocha-Wites, 2023), New Zealand (Lawrence et al., 2024), Finland (Ratinen & Uusiautti, 2020), Nigeria (Anabaraonye et al., 2022), and the Maldives (Sakamoto et al., 2022). Green technology is conceptualised as practical knowledge related to technology that can be used to achieve sustainable development without harming natural resources.

The implementation mechanisms vary significantly across different economic contexts, as reflected in the regional distribution in **Table 1**. China's green transportation and green hospitals represent capital-intensive technological solutions requiring substantial research and development investment (BI et al., 2020). In contrast, Nigeria's tree-planting activities and green technology demonstrate the appropriate application of technology in resource-constrained settings (Anabaraonye et al., 2022). Finland's focus on fuel-efficient cars and public transportation (Ratinen & Uusiautti, 2020) reflects the existing infrastructure capacity, while the Maldives' infrastructure development for sea-level rise adaptation shows technology serving immediate survival needs (Sakamoto et al., 2022). This variation highlights the importance of context-specific technology adoption rather than one-size-fits-all approaches.

#### 5. Environmental Conservation: Direct Health Benefits

Environmental conservation strategies have demonstrated effectiveness in reducing climate-related health risks across eight countries spanning three continents (Table 1). Brazil (Ferreira et



al., 2023), Indonesian (Willetts et al., 2022), Polish (Smaliychuk & Latocha-Wites, 2023), South Korea (Moon, Chae, Lee, Kim, & Kim, 2021), Nigeria (Anabaraonye et al., 2022), Sri Lanka (Gunaratne, Radin Firdaus, & Rathnasooriya, 2021), Finnish (Ratinen & Uusiautti, 2020), and Thailand (Traiyut, Srijuntrapun, & Rawang, 2024) have all implemented conservation approaches that address floods, landslides, sea level rise, temperature extremes, and environment-based diseases. The importance of studying ecosystems extends beyond scientific aspects to practical implications in conservation efforts, mitigation of environmental change, and the sustainability of natural resources (Fatria, Priadi, & Apriyanti, 2025; Gamage, Pearson, & Hanna, 2017; Sriwulantari et al., 2024; Widmer, 2018). Environmental conservation demonstrates cost-effective health benefits across various economic contexts. Brazil's integration of environmental protection with public health policies reduced vector-borne diseases through ecosystem management, while Poland's urban green infrastructure directly improved air quality and reduced urban heat island

effects (Smaliychuk & Latocha-Wites, 2023). Sri Lanka's comprehensive approach, which combines water conservation, soil conservation, mangrove forest reforestation, and coastal conservation (Gunaratne et al., 2021), demonstrates how multiple conservation strategies can be integrated for maximum health impact. The diversity of successful applications, ranging from large-scale ecosystem approaches to urban planning, illustrates the strategy's adaptability to different environmental and social contexts.

#### 6. Green Economy: Sustainable Financing Mechanisms

Green economy approaches have been implemented in eight countries across global regions (Table 1), addressing the critical funding gap in climate-health action. Brazil (Ferreira et al., 2023), Australia (Walter et al., 2024), Indonesia (Willetts et al., 2022), South Korea (Moon et al., 2021), Pakistan (Adnan et al., 2024), New Zealand (Lawrence et al., 2024), Sri Lanka (Gunaratne et al., 2021), and Finland (Ratinen & Uusiautti, 2020) have all developed economic mechanisms to support climate-health initiatives. A green economy refers to a sustainable economic model that



emphasises renewable energy, low-carbon industries, circular economy principles, and environmentally friendly practices that increase productivity without harming the ecosystem (Fatria, Judijanto, Amruddin, et al., 2025; Mubarak, 2023; Popkova, Sergi, & Bogoviz, 2023).

The implementation of green economy strategies exhibits significant variation based on the level of economic development. Australia's preventive funding allocation and South Korea's climate budget increases tied to GDP growth demonstrate how high-income countries can leverage domestic resources for sustained implementation (Moon et al., 2021; Walter et al., 2024). In contrast, Pakistan's need for increased funding for climate and water-related research (Adnan et al., 2024) and Sri Lanka's requirement for significant policy reforms and structural changes (Gunaratne et al., 2021) highlight how financial constraints can limit implementation in developing contexts. This variation underscores that while green economy principles are universal, their application must be tailored to local economic capacities.

## 7. Contextual Implementation and Cross-Cutting Lessons

The analysis reveals significant differences in strategy implementation across various economic contexts, as clearly illustrated in the regional patterns presented in Table 1. Developed countries generally pursued capital-intensive, technology-driven approaches, while developing nations emphasised community-based, low-technology solutions that leverage local knowledge and social capital. This variation reflects pragmatic adaptation to differential economic capacities, institutional development levels, and immediate population needs.

Indonesia's hybrid approach demonstrates how middle-income countries can integrate multiple strategy types based on local capacities. The combination of technological solutions (climate-resilient sanitation systems) with community-based programs (ProKlim Climate Village Program) represents an adaptive model that addresses both infrastructure limitations and community empowerment (Willett et al., 2022). Compared to Thailand's traditional knowledge integration and China's technological focus, Indonesia's



approach highlights the importance of context-specific strategy combinations. Despite contextual variations, several cross-cutting lessons emerge. First, integrated approaches that combine multiple strategy types generally demonstrate greater effectiveness than single-strategy interventions. Second, community engagement and the integration of local knowledge enhance program sustainability across all contexts. Third, adaptive governance that allows for flexibility and context-specific modifications proves critical for successful implementation. These lessons suggest that while specific strategy choices should be context-dependent, the underlying principles of integration, participation, and adaptability apply universally across different implementation settings.

## CONCLUSIONS

A systematic review of 21 studies across five continents provides compelling evidence that effective climate change adaptation and mitigation for public health improvement requires an integrated, multifaceted approach tailored to specific contexts. This analysis yielded three key findings with significant implications for policy and

practice: (1) Strengthening health systems emerged as a fundamental strategy for effective climate-health action, where the success of this approach lies in its ability to address implementation challenges, particularly in facilitating coordinated multisectoral responses, robust governance that facilitates efficient resource allocation during climate emergencies, and systematic capacity building ensures sustainable implementation; (2) Environmental conservation and green economy strategies provide complementary benefits that address immediate health risks and underlying climate drivers, which can provide direct health protection through ecosystem services that reduce disease vectors, improve air and water quality, and mitigate the impacts of extreme weather, while simultaneously, green economy mechanisms create sustainable financing pathways that facilitate the implementation of long-term programs; (3) Contextual implementation factors determine success; although the five strategic categories show consistency across regions, their specific application must consider local economic capacity, health system development, cultural factors, and geographic vulnerability.



Significant differences between developed and developing country approaches highlight the need for tailored solutions rather than one-size-fits-all approaches.

This review has several methodological limitations that should be taken into account in future research. Restrictions on English language publications may have excluded relevant studies in other languages, particularly from non-English-speaking regions. The focus on recent publications (2014–2024), while ensuring contemporary relevance, may overlook early foundational research that established key links between climate and health. The geographic distribution, which spans five continents, reveals a notable absence of representation from North America and the Middle East. Finally, the narrative synthesis approach, while comprehensive for qualitative analysis, lacks the precision of quantitative meta-analysis. For policymakers and public health practitioners, this review suggests several actionable recommendations. Strengthening health systems should be prioritised as the core framework for health-climate action, supported by conservation, economic, technological, and educational strategies tailored to the

specific context. This literature review can serve as evidence-based decision-making material that protecting public health from the threats of climate change requires an approach that transcends single sectors to adopt integrated and adaptive strategies that address both climate drivers and health vulnerabilities. By combining the strengthening of basic health systems with targeted and tailored interventions, we can achieve comprehensive climate and health resilience that protects populations while contributing to global climate action.

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