Bridging the Climate-Health Data Divide

Improving climate resilience in health systems through data-driven insights

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Executive Summary

Climate change is a growing global health emergency. An estimated 250,000 additional deaths are projected annually between 2030 and 2050, disproportionately affecting low- and middle-income countries (LMICs).[1] While health decision-makers increasingly recognize the need for climate-informed planning, persistent barriers prevent effective integration of climate data into health system operations.[2] There is a need to explore opportunities to bridge this gap and empower health system managers and stakeholders to improve resilience through data-driven insights.[3]

This report examines the barriers that limit the effective integration of climate and health data, and explores how emerging technologies and governance innovations can create opportunities to transform climate-health decision-making, particularly in areas where frontline health systems face the greatest challenges. The report is intended for stakeholders working across regions to improve health outcomes in areas vulnerable to climate-related impacts. These include frontline health organizations, governments, donors, and intergovernmental bodies, as well as actors that shape the broader field, such as policymakers, private sector partners, technology companies, and funders. The findings are designed to inform strategic investments and program design by outlining concrete pathways that link current challenges to opportunities for action.

Drawing from desk research, including a global literature review and over a dozen stakeholder interviews, the report identifies five key challenges. See Figure 1.

1. Limited availability of localized and timely climate data at the community level.
2. A lack of local, community perspectives in data design and use.
3. Technical incompatibilities between climate and health data systems.
4. Capacity gaps at all levels, from data literacy for health workers to advanced analytics expertise for predictive modeling.
5. Fragmented governance structures, including funding challenges, that prevent meaningful cross-sector collaboration.

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Figure 1: Five key challenges

[1] World Health Organization (2023a).
[2] World Meteorological Organization (2023a).
[3] Ansah et al. (2024)

The report identifies promising innovations bridging the climate and health data gap that are demonstrating impact across LMICs. Examples include hyper-local flood monitoring in Kenya, and Artificial Intelligence (AI)-driven predictive models in India, Mozambique, and Malawi that forecast disease outbreaks and guide proactive interventions. Examples are referenced throughout the report to illustrate how creative approaches can overcome traditional data limitations.

Overall, the findings demonstrate that successful climate-health data integration requires coordinated action across technical, institutional, and governance dimensions. While AI and data science tools can significantly reduce barriers to analysis and interpretation, these technologies rely on the human interpretation of findings, and their effectiveness depends on collaborative frameworks that address data sensitivity concerns, investments in local expertise, and sustainable financing models that move beyond fragmented, project-based approaches. To that end, the report calls for six strategic actions for stakeholders working to build adaptive, equitable, and integrated climate-health data ecosystems in LMICs. See Figure 2.

1. Enhance access to localized climate-informed health data.
2. Promote interoperability and harmonized standards.
3. Build capacity for data literacy and advanced analytics.
4. Design inclusive tools that meet frontline needs.
5. Strengthen cross-sector governance and policy frameworks.
6. Mobilize sustainable, locally anchored financing.

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Figure 2: Six strategic actions

The analysis presented in this report demonstrates that bridging the climate-health data gap is both urgent and achievable. While significant barriers persist, innovative approaches already emerging across LMICs show that health systems can effectively integrate climate data when supported by appropriate tools, governance structures, and local capacity. Implementing these six strategic recommendations requires coordinated action from all stakeholders, including governments, donors, technology developers, and community organizations. By prioritizing local leadership, sustainable financing, and user-centered design, health systems can be strengthened to prepare for and respond to climate threats, ultimately protecting the communities most vulnerable to climate change.

Chapter 1: Introduction, Scope, and Methodology

I. Introduction

Climate change represents an escalating global health emergency.[4] Growing evidence indicates that it contributes to increased mortality from preventable diseases such as asthma, heatstroke, cholera, and malaria, with estimates projecting an additional 250,000 deaths annually between 2030 and 2050.[5] These health impacts disproportionately affect vulnerable populations, including women, children, low-income communities, migrants, people with disabilities, and older adults, particularly in low- and middle-income countries (LMICs).[6] In these settings, frontline health systems are often under-resourced and overburdened, serving as the primary and sometimes only point of care for rural and underserved communities.

The escalating burden of climate-related health threats underscores the need for more adaptive, resilient health systems. Meeting this need requires timely, localized, and actionable data that connects climate and health indicators. However, in many countries, particularly in LMICs, health decision-makers operate without the climate data they need to plan for and respond to emerging risks.

While 74% of national meteorological services report sharing data with the health sector, only 23% of health ministries incorporate climate data into their planning and operations.[7] This disconnect has several underlying reasons, such as siloed governance,[8] technical incompatibilities between health and climate data systems,[9] and limited localized, real-time information integrated into health workflows.[10]

The path forward requires coordinated action to bridge this critical data gap.[11] Interviewed stakeholders across the climate and health ecosystem emphasized a key priority: developing integrated digital platforms that deliver localized, real-time climate and health data directly into the hands of health decision-makers. These solutions should not be considered supplementary tools; rather they should be recognized as integral components of core public health infrastructure that enable communities to anticipate climate-related health risks, plan evidence-based interventions, and respond rapidly to emerging threats.

II. Scope and Strategic Focus

[4] World Health Organization (2023a); UNDP (2024).
[5] World Health Organization (2023a).
[6] World Health Organization (2023a); Ngcamu (2023).
[7] World Meteorological Organization (2023a).
[8] Christen et al. (2024)
[9] World Meteorological Organization (2023c).
[10] Linsenmeier & Shrader (2023).
[11] Shumake-Guillemot et al. (2023).

This report maps the current landscape of climate-informed health data for decision-making, predominantly in LMICs. It examines key barriers in depth and identifies strategic opportunities where emerging technologies and governance innovations can support in closing the gap between climate data availability and its effective use in health systems.

Within the broad climate-health nexus, the analysis focuses on data systems that support risk detection and early warning systems, community-based surveillance, and health systems preparedness. The literature review covered resources published between 2015 and 2025, with interviews conducted with stakeholders working directly at the intersection of climate and health data systems. The report centers on data integration challenges and opportunities rather than broader climate-health determinants, such as urban planning or energy systems. While acknowledging the importance of social justice and governance considerations, these are examined primarily through the lens of data accessibility and use. The analysis emphasizes community-centered approaches to climate-health surveillance as a key pathway for ensuring data systems serve frontline health needs and vulnerable populations.

Evidence from stakeholder interviews and literature review is synthesized to highlight promising solutions emerging across LMICs. The report examines these innovations alongside pain points, as well as emerging artificial intelligence (AI) and data science capabilities that open up new ways to democratize access to data, reduce capacity barriers, and enable community-centered approaches to climate-health surveillance.

The primary audience for this report is stakeholders across geographies engaged in improving health outcomes in areas vulnerable to climate-related impacts, including frontline health organizations, governments, donors, and intergovernmental bodies, and those that influence the field, such as policymakers, the private sector, technology companies, and funders. With these findings, the report aims to support more informed, strategic investment and program design by offering concrete pathways from current challenges to opportunities for action.

III. Methodology

This report draws on two primary sources of information to build a comprehensive picture of the climate and health data landscape.

1. **Desk Research**
   A targeted literature review was conducted based on resources identified in a keyword search in Google Search and Google Scholar to examine existing resources on the intersection of climate and health, with particular attention to technical reports, peer-reviewed studies, and research briefs. The search was limited to English-language resources published between 2015 and 2025. To support interpretation and analysis, key findings were synthesized and tagged according to thematic areas. Resources were limited to publicly available and free-of-charge resources. Accordingly, potentially relevant sources requiring payment are not included in this report.

2. **Stakeholder Interviews**
   Semi-structured interviews were conducted with a diverse group of 19 experts and practitioners based in Africa, Asia, Europe, and North America. Interviewees included donor organizations, global and regional nongovernmental organizations (NGOs), and research institutions. Interviewees were selected to reflect a range of geographic and thematic perspectives, with a focus on those working directly with climate and health data at the community, national, or cross-sectoral level. The interviews explored climate and health data needs, challenges in data use and access, existing collaboration models, and enablers of successful integration. The approach for identifying stakeholders was addressed by creating a framework that outlines a pathway for how data is collected, stored, analyzed, and interpreted by different audiences. This framework was subsequently used to identify individuals working across the spectrum. See Figure 3.

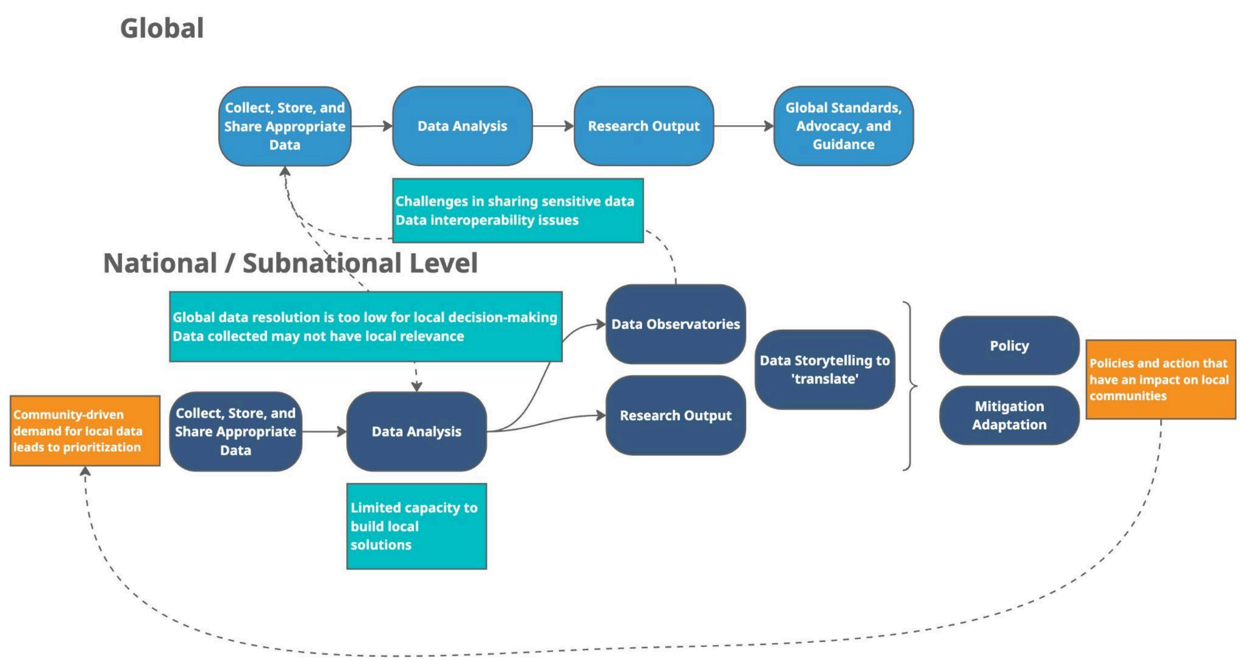

Figure 3: Stakeholder framework

Chapter 2: Research Synthesis

This chapter explores the challenges and opportunities at the intersection of climate and health data systems. The findings reflect themes drawn from desk research and interviews with stakeholders working in climate and health across low- and middle-income countries (LMICs). Interviews were anonymized to allow open insights, and responses were synthesized to identify common challenges and opportunities.

Given the expansive nature of both the climate and health domains, each encompassing numerous determinants, exposure pathways, and cross-cutting dimensions, this research synthesis focuses on data systems integration as the primary lens for analysis. This chapter examines data collection, sharing, analysis, and application challenges at the intersection of climate and health, with particular attention to institutional barriers, technical interoperability, and capacity constraints that prevent effective integration. The analysis prioritizes perspectives from frontline health workers, local decision-makers, and practitioners working directly with climate-health data in LMICs. While acknowledging their importance, this synthesis does not comprehensively address broader climate-health determinants such as urban planning, energy systems, or agricultural policy, except where they directly relate to data system challenges. Similarly, while equity and governance considerations are woven throughout, they are examined primarily through the lens of community-driven data accessibility and use, rather than as standalone policy domains.

Growing demand for climate-informed health data reflects widespread recognition of its importance for building adaptive and equitable health systems, yet persistent barriers prevent effective progress. The most immediate challenge lies in fundamental data gaps. Limited availability, inconsistent quality, and insufficient granularity emerge as the most critical obstacles to address. Technical barriers around integration and interoperability compound these issues, preventing meaningful synthesis of climate and health information and undermining analysis and decision-making. While institutional and governance factors are essential for long-term sustainability, their success hinges on these foundational elements, since effective policies and coordination mechanisms depend on a clear understanding of what data exists, how it can be shared, and the privacy considerations.

Promising solutions are emerging: from satellite-enhanced malaria prediction models to capacity training models for policymakers, and harmonized datasets and standards for improved integration. Investing in these solutions will require sustained investment in local research capacity, responsive public-sector leadership, and cross-sector collaboration to ensure climate-health data systems are inclusive, actionable, and resilient.

I. Climate and Health Data Needs

Across geographies, there is a growing demand for contextually relevant data that links climate dynamics to health system needs,[12] particularly among health service delivery stakeholders. Our research points to the following three main drivers shaping this demand.

Linking Environmental Changes to Health Outcomes

Frontline health workers, particularly in settings with high economic inequality, often observe connections between changing weather patterns and health trends.[13] These observations provide valuable qualitative insights, and their utility can be greatly enhanced when combined with quantitative evidence to guide policy and funding decisions. Improved quantitative data integration at the community and facility level, such as correlating country-specific rainfall patterns with waterborne disease incidences, transforms qualitative observations into actionable evidence. In particular, hyperlocal data allows health systems to identify statistically meaningful patterns within specific catchment areas, build predictive models that reflect local realities, and make investment decisions grounded in measurable climate-health linkages within their own communities, rather than relying solely on anecdotal evidence. Yet, without these localized inputs, global and regional models often fail to capture these dynamics,[14] leaving important interactions underrepresented in research and response frameworks. Reflecting this gap, stakeholders highlighted the need for data that captures climate-health linkages at the community or facility level to better inform decision-making.

Informing Health System Readiness, Resilience, and Response

Access to climate-informed health data is critical for effective mitigation, adaptation, and preparedness for climate-related emergencies, including floods, droughts, and heatwaves.[15] Data that captures gradual shifts and trends enables health system managers to anticipate and respond to the associated health impacts, such as rising incidences of zoonotic or vector-borne diseases, including malaria or dengue.[16] For example, in Nepal, warming temperatures in the highlands have expanded mosquito habitats, leading to a sharp increase in dengue cases.[17] Predictive models, such as those developed in Pune, India, demonstrate the value of data-driven approaches for targeting vector control strategies in high-risk areas.[18]

Understanding Complex Systems and Interconnected Risks

Effective climate-health integration requires cross-cutting data and systems that capture the complex relationships between climate and the health of people, animals, and ecosystems, referred to as 'One Health'.[19] In practice, effectively using climate and health data often depends

[12] Manyuchi et al. (2021); World Meteorological Organization (2024); Ansah et al. (2024).
[13] Wiskel et al. (2024).
[14] Gibb et al. (2023).
[15] Lugten & Hariharan (2022); Romanello et al. (2024).
[16] World Health Organization (n.d.-c).
[17] Abbasi (2025).
[18] Sophia et al. (2025).
[19] World Health Organization (2023b).

on incorporating it with other sources, including demographic, economic, and environmental information. For example, district-level dengue research in Vietnam demonstrated that temperature trends alone could not explain disease dynamics. Rather, incorporating data on water and sanitation infrastructure, land use, and population movements demonstrated how drought and precipitation patterns interacted with local conditions to determine community risks.[20] Similarly, cholera surveillance in Mozambique was significantly strengthened when climate indicators, such as rainfall, were combined with socioeconomic data from household surveys, including access to water, sanitation, and communication tools.[21] These studies show that layered, multisectoral risks require greater investment in cross-cutting data tools that reflect the full spectrum of community vulnerabilities.

II. Challenges in Data Collection, Analysis, and Use

Accessibility of Locally Relevant and Granular Climate Data

Climate change is a global challenge that requires local solutions for effective mitigation and adaptation.[22] Across LMICs, persistent gaps in climate and health data systems hinder the ability of frontline stakeholders to collect, access, and analyze data needed for timely, targeted public health responses. Without reliable, granular, and actionable climate-health data, investments in sophisticated tools and capacity building have limited impact. These challenges influence several aspects of climate-health data use.

Limited Availability of High-Resolution Climate Data

The need for granular, place-based data to identify at-risk populations and guide public health interventions remains a fundamental challenge in integrating climate and health information. Most climate data in LMICs lacks the spatial resolution necessary for meaningful local analysis.[23] Frontline health facilities typically serve populations within a 5–20 km radius, yet climate data at this level of detail is rarely available. National meteorological infrastructure is often inadequate, particularly in Sub-Saharan Africa, where average weather station density is one per 26,000 km2—eight times lower than the World Meteorological Organization’s (WMO) recommendation.[24] While Satellite data offer broader coverage, they often require ground-level validation to ensure accuracy and local applicability to minimize gaps.

Several organizations are developing approaches to overcome these limitations. In Nigeria, eHealth Africa adopted an innovative ground-based data collection method using its eHealth Africa–Parsyl Global Health Monitoring device.[25] Designed to monitor temperature-sensitive medical products, the device collects ambient temperature data in clinics to build a baseline of hyper-local, passively collected environmental data that enhances environmental health monitoring.

[20] Gibb et al. (2023).
[21] Armando et al. (2024).
[22] Ballard & Bratosin (2024).
[23] Linsenmeier & Shrader (2023).
[24] Lewis (2024).
[25] eHealth Africa (2025).

Limited Availability of Timely and Actionable Data

The scarcity of real-time or high-frequency data hampers the ability of health systems to respond promptly during climate emergencies. Stakeholders reported that health data platforms, such as DHIS2 and SORMAS (Surveillance Outbreak Response Management and Analysis System), are well-established and widely integrated within health systems. However, monthly reporting cycles may provide limited temporal granularity for time-sensitive or disaster-related responses, where more frequent data updates could be beneficial.

Successful solutions require targeted training of frontline health workers to gather timely data during climate events. In Kenya, Lwala Community Alliance developed a flood response module within the national electronic community health information system (eCHIS).[26] The module enables community health workers to rapidly collect real-time data during flood events, including information mapping affected regions, documenting cholera outbreaks, and tracking population displacement. This approach was piloted successfully during widespread flooding across Kenya and subsequently adopted as a permanent feature of the eCHIS, improving the government's access to timely, localized data. Cross-sector collaboration can enhance these efforts by leveraging existing networks and expertise. In Malawi, Agricultural Extension Development Officers enter local weather data into the DHIS2 application,[27] demonstrating how non-health workers can contribute valuable climate information.

Underrepresentation of Local and Marginalized Voices in Data Systems

National data collection systems and research agendas tend to prioritize urban areas or reflect global narratives that may not align with local realities. A recent Grand Challenges Canada (GCC) Global Survey on the Impact of Climate Change on Health revealed that while heat stress is a leading concern in some middle-income countries, it did not emerge as a priority issue for most LMIC stakeholders. Rather, respondents pointed to issues such as vector-borne and zoonotic diseases as more pressing. These findings underscore the need for context-specific approaches to climate-health priorities.

This is particularly critical for Indigenous, rural, and marginalized populations, who face distinct climate-related health risks, yet remain underrepresented in both data collection and decision-making processes.[28] To ensure climate-health interventions are relevant, targeted, and responsive to community-identified priorities, inclusive development, through engaging local communities and seeking local perspectives, is key.[29] Local organizations and health workers play a critical role in interpreting and contextualizing data. Without their input, data systems risk reproducing existing inequities and failing to address those most affected by climate-related health impacts.

Recognizing the value of local insight, several funders prioritize community-informed, context-sensitive data collection. The International Development Research Centre (IDRC)

[26] Rogers et al. (2024).
[27] DHIS2 (2022).
[28] UNDP (2024a).
[29] Intergovernmental Panel on Climate Change (2023).

exemplifies this approach by providing direct funding to local researchers and institutions on development challenges, ensuring those closest to climate-health issues drive research agendas.[30] This approach emphasizes long-term investment in local research ecosystems. It supports the creation of regional networks and research hubs that foster collaboration and knowledge sharing across countries. Projects are grounded in real-world contexts through implementation research, and findings are designed to be actionable, credible, and relevant to local conditions. Importantly, IDRC often recommends policymaker involvement from the earliest phases of a research project to ensure alignment with government priorities and promote uptake of results. This embedded engagement model strengthens the link between research and policy, supporting the development of sustainable, responsive public systems informed by evidence.

By investing in emerging researchers and embedding hands-on learning within live projects, IDRC also contributes to long-term capacity building. This focus on knowledge translation, research grounded in local realities, and locally owned evidence generation provides a pathway for governments and communities to jointly develop solutions that reflect their lived realities.

Design and User Experience Gaps

Even where data is available and relevant, the tools used to present and apply them are often misaligned with the realities of frontline users. Frontline health workers, who are closest to the health impacts of climate change, often face severe time constraints with high workloads[31] and limited digital literacy training,[32] or operate in environments with poor internet connectivity and limited device functionality.[33] This gap in user-centered design reduces the utility of otherwise valuable climate-health data and reinforces a broader disconnect between data production and use.

Tools are most effective when designed not only for technical analysts but also for community-level users[34] who need to act on insights in real time, particularly during extreme climate events and health emergencies. Presenting data in clear and accessible ways, by avoiding technical jargon and aligning with the workflows, digital environments, and information needs of frontline health workers, makes it more likely that these tools will be used to inform meaningful decisions.

Interoperability

The technical challenges of data integration and interoperability also emerged as critical barriers. For example, climate data often use spatial scales that are misaligned with the administrative boundaries relevant to health systems, making the information difficult to apply without additional processing and investment.[35] Lacking the ability to meaningfully combine

[30] International Development Research Centre (2025).
[31] Astale et al. (2023).
[32] Kansiime et al. (2024).
[33] Greuel et al. (2023).
[34] Becker & Rezabeigisani (2025).
[35] World Meteorological Organization (2023c).

climate and health datasets, even high-quality individual data sources are unable to support the integrated analysis necessary for effective climate-health action.

Data Standardization and Harmonization Barriers

A recurring barrier to using climate and health data effectively is the limited standardization and interoperability across datasets.[36] Meteorological data is often more standardized and longitudinal, whereas health data tends to vary widely depending on geography, health condition, and reporting standards. These differences pose significant challenges for the integration of climate and health datasets. Environmental indicators, such as air quality, present additional hurdles, since they are typically collected from diverse sources using different methodologies, further complicating efforts to harmonize datasets.[37]

Another technical challenge is the lack of widely agreed physiological thresholds for climate-sensitive health outcomes.[38] For example, defining extreme heat in clinically meaningful terms requires longitudinal, locally grounded health data, such as hospitalization rates for heat-related illness, which are often unavailable in LMICs. Even when such data exists, it is difficult to integrate them with high-resolution climate information and disaggregated health statistics. Without this alignment, it becomes much harder to produce timely insights that can guide early warning systems and protect public health through hospital surge planning or resource allocation.[39]

Stakeholders highlighted several ways to simplify the complex process of integrating data, making it easier to generate consistent and reliable analyses that can be used by people with different levels of technical expertise. These include:

- Creating templated datasets for each major climate-sensitive health issue, including key indicators that support interoperability and decision-making across diverse health contexts.
- Creating harmonized methodologies and metadata templates for specific climate-health indicators, such as air pollution, heat stress, and waterborne diseases, that include standardized data formats, consistent column and row structures, and guidance on disaggregation by geography, gender, and age.
- Exploring emerging platforms, such as the Standards for Official Statistics on Climate-Health Interactions (SOSCHI) platform.[40] The knowledge platform will provide a statistical framework and open-source tools to support national statistical offices, decision-makers, and researchers to better estimate climate-related health risks using real-world data sources and local-level modelling.[41]

Efforts to improve interoperability are gaining traction. In several countries, including Kenya, Malawi, and Ghana, governments have established cross-departmental structures to coordinate

[36] World Meteorological Organization (2023b).
[37] Shairsingh et al. (2023).
[38] Romanello et al. (2024); Lung et al. (2021).
[39] Palmeiro-Silva et al. (2024).
[40] Office for National Statistics (n.d.).
[41] Office for National Statistics (2024).

climate and health data sharing.[42] Similarly, international funders, including The Rockefeller Foundation and Wellcome, are investing in collaborative efforts between organizations such as the World Health Organization (WHO) and WMO Climate and Health Joint Programme[43] to develop interoperable tools and promote knowledge sharing between sectors.

While stakeholders remained cautious about the feasibility of a universal integration framework, there was broad consensus that harmonized, context-specific tools and protocols can significantly improve the usability of integrated climate and health data.

Capacity for Analysis and Actionable Interpretation

Even when relevant data is available, it can still be challenging to build the analytical capacity needed to turn data into actionable insights. A key barrier identified by stakeholders is that health practitioners often lack guidance on which specific climate variables are relevant for different health conditions; for example, which temperature thresholds predict heat-related illness or which precipitation patterns signal waterborne disease risk. This knowledge gap is compounded by the absence of standardized templates and integrated platforms that could guide health systems in requesting appropriate climate data from meteorological services and enable seamless interoperability with health data systems.

Since the climate and health field is still considered an emerging field, there is not yet a widely established set of tools for analysis. Linking climate data with health outcomes often requires combining datasets, such as air pollution levels with asthma hospitalizations, that are rarely collected or analyzed in a coordinated way. Without stronger methods and tools, valuable connections between climate risks and health impacts may be overlooked, limiting the evidence available to guide preparedness and policy.

Some efforts support this integration. The DHIS2 platform has developed a Climate App designed to facilitate analysis of climate-sensitive health trends.[44] Stakeholders shared that the effectiveness of such platforms is enhanced when ministries of health adopt standardized data collection tools, enabling more seamless integration and cross-border learning. However, even with compatible platforms, accessing health data remains a significant challenge that creates major barriers to climate-health integration. Data sharing restrictions, privacy concerns, and institutional gatekeeping often prevent researchers and practitioners from obtaining the health datasets needed for meaningful climate-health analysis.

Advanced analytical capabilities present additional challenges. For instance, forecasting cholera and other disease outbreaks based on environmental variables requires advanced data science capacity that is often limited across these contexts.[45] While stakeholders pointed to partnerships with universities or international non-governmental organizations (NGOs) to fill these gaps, they shared that, in some cases, cross-border collaborations can introduce further complications, such as data sovereignty concerns and regulatory hurdles around sharing sensitive information.

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[42] Mulwa et al. (2024); World Health Organization (2021a); Antwi-Agyei (2018).
[43] World Meteorological Organization (2023d).
[44] DHIS2 (2025).
[45] Kiosia et al. (2024).

Supporting in-country expertise remains a key priority for strengthening local capacity to develop, interpret, and act on climate and health data.[46]

The Artificial Intelligence for Pandemic and Epidemic Preparedness and Response Network (AI4PEP) seeks to address these challenges by building in-country expertise to develop and apply predictive models for disease outbreak detection and response.[47] Through a multi-regional network spanning Africa, Asia, Latin America and the Caribbean, and the Middle East and North Africa, AI4PEP strengthens the capacity of local researchers and policymakers to leverage responsible AI solutions for early detection, forecasting, and mitigation of infectious diseases. By grounding its work in timely data, equity, and One Health approaches, the initiative fosters sustainable, locally driven innovations that align with national priorities.

III. Challenges Using Data to Influence Decision-Making and Action

Data availability and technical integration are key barriers to the use of climate-informed health data. Yet, institutional and governance systems that determine how data is managed, shared, and applied are essential enablers. These structural factors create the conditions in which data systems operate and determine whether short-term technical solutions can translate into sustainable impact.

Limited Stakeholder Capacity

Limited capacity to interpret, communicate, and act upon climate and health data is a critical institutional challenge.[48] This gap cuts across all system areas, from frontline health workers and local decision-makers to technical analysts, researchers, and policymakers. Effective climate-informed health decision-making depends on sustained, targeted investments in training and workforce development.

Short-term trainings alone are rarely sufficient to build the deep, context-sensitive expertise required for meaningful climate-health integration. Stakeholders highlighted the value of embedding dedicated data roles within health systems and government institutions, alongside fellowships or mentorship programs that provide hands-on experience with real-world data. Many also emphasized the importance of supporting locally based researchers, particularly across Africa, to drive research that reflects regional realities and strengthens long-term climate-health capacity.

Some funders have recognized this need and incorporated structured capacity strengthening into their research support. IDRC includes training for early-career researchers[49] and opportunities to lead implementation-focused studies. OpenAQ offers ongoing data literacy support and training for researchers, journalists, and community groups in LMICs on how to

[46] Watts et al. (n.d.).
[47] A14PEP (n.d.).
[48] Mazumder & Hossain (2024).
[49] International Development Research Centre (2025).

access, interpret, and use complex air quality data in local contexts.[50] Similarly, the SOSCHI consortium[51] is developing implementation plans for Ghana, Rwanda, and the United Kingdom that demonstrate how climate-health indicators can be systematically incorporated into national statistical institutes for regular monitoring of climate impacts on health.[52] These country-specific implementation frameworks, soon to be published, provide concrete pathways for institutionalizing climate-health data integration within existing government structures.

Fragmented Communication and Language Barriers

Communication challenges, both between the climate and health sectors and with the broader public, emerged as a persistent barrier. Climate and health stakeholders often rely on distinct technical language, terminologies, and conceptual frameworks, which can reinforce silos, hinder collaboration, and limit the effective use of relevant data.[53]

The language gap is particularly evident in cross-sector coordination between institutions, such as ministries of health and meteorological offices. This affects engagement with non-technical stakeholders, such as community members. In Kenya, targeted training sessions were developed for members of the County Assembly, the local legislative body responsible for budget approval. These sessions aimed to raise awareness of the health impacts of climate change and to strengthen legislators' ability to integrate climate considerations into health funding decisions.

Stakeholders emphasized that clear, compelling storytelling linking data to real-world health outcomes is essential for building political will and engaging the public. For example, India's "Help Delhi Breathe" coalition[54] used school-based PM2.5 air quality monitoring to translate complex data into accessible narratives that resonated with families and communities. The effort built broad public support and contributed to government action, including the resourcing of electric buses and other reforms to improve urban air quality.

IV. Additional Barriers Impacting Data Accessibility and Availability

Fragmented Policy and Governance Coordination

Stakeholders reported that governance of climate and health data systems is highly fragmented. National coordination mechanisms that clearly define how data are collected, shared, and used across health, meteorology, environment, and emergency-response agencies are often limited. As a result, collaboration tends to occur on an ad-hoc or project-specific basis, rather than

[50] OpenAQ (n.d.).
[51] The SOSCHI consortium includes the UK Office for National Statistics, the African Institute for Mathematical Sciences in Rwanda, the Regional Institute for Population Studies at the University of Ghana, the UK Health Security Agency, and the Cochrane Planetary Health Thematic Group hosted at the University of Alberta, Canada.
[52] Office for National Statistics. (n.d.).
[53] Fine & Ettinger (2025).
[54] Purpose (2024).

through sustained and interoperable systems.[55] Additionally, formal structures, such as interoperable data platforms and interagency working groups, are often absent.[56] Without these mechanisms, opportunities to strengthen capacity, foster trust and partnerships, and establish a common understanding are missed, limiting the creation of an enabling environment for long-term, cross-sectoral data use.

These challenges are further compounded by geopolitical dynamics that shape debates around data sovereignty, ownership, and access. Climate data often lies at the intersection of competing priorities: national sovereignty versus international collaboration, and public sector stewardship versus private sector ownership models.[57] In some countries, meteorological data is classified as national security information, creating significant barriers to data sharing with health authorities. In such contexts, national meteorological agencies may prioritize commercial sales, rendering critical data unaffordable or inaccessible for public health systems that rely on it for planning and preparedness. The integration of health data into this landscape introduces additional complexities. Privacy protections, regulatory requirements, and concerns about cross-sector data misuse, particularly in the age of AI-enabled analytics, further limit opportunities for data sharing and coordination across sectors.

As a potential response to these challenges, several stakeholders highlighted the role of synthetic datasets. These artificially generated datasets preserve the statistical properties of real data while removing personally identifiable information. They enable researchers to analyze climate-health relationships and test for meaningful patterns without compromising sensitive personal data. This approach is particularly valuable in settings where data access is highly restricted, such as where informed consent is difficult to obtain or where data protection policies prohibit the use of real health records, especially for vulnerable populations.

When collaborative governance occurs, it often results from strong executive leadership and explicit political prioritization. Kenya provides a leading example through its National Climate and Health Strategy,[58] which articulated the need for coordinated, cross-sector action and emphasized the role of partnerships across government sectors, including health, environment, energy, water, and agriculture. This national policy direction led to localized implementation at the county level. For instance, in Kajiado County, officials facilitated cross-ministerial coordination across health, agriculture, energy, and social welfare sectors to address interconnected development goals. The alignment between strategic vision and local implementation enabled meaningful policy uptake, supported training of public officers, and catalyzed inter-agency collaboration.

Structured interministerial working groups, established in Ghana, Rwanda, and the United Kingdom through the SOSCHI project,[59] equally demonstrate effective institutional mechanisms for facilitating regular cross-sectoral engagement. These forums convene representatives from the Ministry of Health, national meteorological services, urban planning departments, NGOs,

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[55] World Meteorological Organization (2024).
[56] World Meteorological Organization (2023a).
[57] Verhulst (2024).
[58] Kenya Climate Change and Health Strategy (2022).
[59] Office for National Statistics (n.d.).

and local research institutions. Their objectives include: developing a shared understanding of how climate variability and change are affecting health outcomes; establishing mechanisms for intersectoral data sharing that address institutional barriers and clarify roles; and aligning institutional mandates with national adaptation plans and Sustainable Development Goal (SDG) targets. These working groups have proven critical in advancing standardized, locally relevant approaches to climate and health data integration. By fostering trust and regular communication, they help reduce hesitancy around data sharing and support the creation of sustainable governance structures. This foundation is essential for building the enabling policy environment required for ongoing, collaborative decision-making across ministries, necessary for effective climate-health action.

The WHO operational framework for building climate-resilient health systems[60] demonstrates this necessity to address sectoral silos by emphasizing cross-sectoral collaboration and climate-transformative leadership and governance.[61] Recommendations include integrating climate change considerations across health programs and ensuring health is embedded in climate processes and plans through designating climate and health focal points within ministries, developing health national adaptation plans (HNAPs), and establishing formal agreements with key stakeholders.[62] In Zambia, a longstanding collaboration between the Ministry of Health and the Ministry of Education, which was initially established on the grounds of co-located school clinics, offers a model for cross-sectoral integration. With sustained political will, adequate resourcing, and clear protocols, countries can expand these examples into more systematic approaches, strengthening the integration of climate and health data as a foundation for resilient, evidence-informed decision-making.

The Public Sector's Role in Enabling Equitable Data Ecosystems

Government agencies play a critical role in ensuring that climate and health data remains free, accessible, and actionable, particularly for NGOs and community-based organizations working at the frontlines of climate-health impacts.[63] Stakeholders emphasized that when public institutions invest in open data infrastructure and equitable data-sharing protocols, they strengthen not only national decision-making but also the capacity of local actors to respond effectively.

Yet many LMIC governments face significant constraints. These include limited technical expertise, competing priorities in under-resourced health systems, and inefficient institutional mechanisms to drive complex cross-sector collaboration.[64] Stakeholders noted that fundamental digital public infrastructure challenges, including unreliable electricity supply, inadequate data centers, and limited internet connectivity, further constrain governments' ability to establish and maintain integrated climate-health data systems. Without stable foundational infrastructure, even well-designed data platforms and governance frameworks cannot function effectively. In

[60] World Health Organization (n.d.-a).
[61] World Health Organization (n.d.-b).
[62] World Health Organization (n.d.-b).
[63] World Meteorological Organization (2022); World Health Organization (2021b).
[64] Ansah et al. (2024).

some settings, decision-making is not constrained by data availability challenges but rather by an absence of governance structures that mandate data-driven policy-making.[65]

Despite these challenges, the public sector has a unique capacity to convene stakeholders and set data governance standards. Ministries of health, meteorological agencies, and other public authorities can establish enabling environments for intersectoral collaboration by formalizing data-sharing mandates and committing to free and unrestricted access to public datasets.[66] Governments can also require that health and climate data, particularly on infrastructure readiness, disease burden, and environmental exposure, be made available in usable formats to enable program planning, community advocacy, research, and a localized response.

Several stakeholders noted that NGOs and community-based organizations are often the primary collectors of vital data on climate-sensitive health impacts at the hyper-local level. Yet, without structured mechanisms for integration, this data remains fragmented and underutilized. Governments can address this gap by developing interoperable platforms and inviting NGO participation through formal channels and standardized formats. Key enabling factors include establishing mutual clarity on data standards, usage rights, and attribution practices,[67] as well as recognizing the contributions of NGOs in policymaking and feedback loops that showcase examples of data-informed decision-making.

Public sector actors can also improve climate-health policy relevance by supporting participatory approaches that prioritize community-defined indicators and locally meaningful metrics. These may differ substantially from top-down national targets but are essential for building legitimacy, trust, and uptake of data among frontline actors. Stakeholders identified transparency on public health infrastructure, including health facility resilience, energy backup availability, and emergency response readiness, as critical for both disaster preparedness and long-term planning.

Efforts to create integrated, equitable data ecosystems will require governments to take on both a leadership and collaborative approach by investing in trusted partnerships, co-designing data governance models, and resourcing the data integration pathways between national systems and community-level data collection. While the challenges are complex, the opportunity to build durable, inclusive data systems within the public sector remains key.

Funding and Sustainability

Irregular funding continues to undermine the long-term stability of climate and health data ecosystems. Recent cuts to the United States Agency for International Development (USAID)[68] have disrupted funding for core data infrastructure and programs across LMICs, affecting the Demographic and Health Surveys program,[69] satellite-based early warning systems for

[65] Ansah et al. (2024).
[66] World Meteorological Organization (2022).
[67] Ebi et al. (2025).
[68] Sandefur & Kenny (2025).
[69] Khaki et al. (2025).

disasters,[70] and core administrative data crucial for planning and emergency response. Geopolitical shifts have also introduced new risks to the access of foundational weather data collected by institutions, such as the National Oceanic and Atmospheric Administration (NOAA), that many LMICs depend on.[71]

These disruptions underscore the fragility of data systems built on fragmented, project-based funding models. However, they also present an opportunity to shift toward more sustainable, locally anchored investment strategies. Several funders are working to address this gap through innovative and context-sensitive approaches.

For example, the Advancing Research for Climate and Health (ARCH) initiative, a five-year collaboration between the United Kingdom's Foreign, Commonwealth and Development Office and IDRC, aims to support locally-led, context-specific research to address climate and health challenges.[72] By investing in regional research hubs, the program fosters stronger relationships between ministries and trusted local institutions, with an emphasis on generating credible, actionable evidence to inform health and climate policy.

GCC's Climate and Health initiatives focus on scaling innovations at the intersection of the two fields.[73] Programming aims to support data generation and application, grounded in local priorities and institutional partnerships. These efforts reflect a growing recognition that data systems require technical support and long-term, flexible funding aligned with local governance structures.

In parallel, global philanthropic actors such as The Rockefeller Foundation and Wellcome are investing in initiatives that promote international coordination. Their support of the WHO-WMO Climate and Health Joint Programme[74] reflects a strategic emphasis on convening stakeholders across sectors and borders to define shared priorities, develop global public goods, and promote interoperable data standards.

Looking forward, several stakeholders highlighted the potential for funders to play a more catalytic role in creating the mechanisms required to transform fragmented data systems into cohesive, responsive ecosystems. This includes:

- Expanding funding for open-source platforms and tools that make data more accessible, transparent, and user-friendly.
- Advancing the establishment of pooled or multi-donor funds to facilitate longer-term investment in core infrastructure, such as interoperable data systems, shared analytics platforms, and secure data hosting environments.
- Supporting the capacity-building of local intermediary organizations with the skills to bridge across health, climate, and technology sectors, helping to integrate, interpret, and mobilize data for decision-makers at all levels.

[70] Worley (2025).
[71] Shetty (2025).
[72] International Development Research Centre (n.d.).
[73] Grand Challenges Canada (n.d.).
[74] World Meteorological Organization (2023d).

Ultimately, sustained and equitable investment in climate and health data systems requires governance and funding strategies that are both globally coherent and locally responsive. Moving beyond siloed, donor-driven models toward co-designed, country-led platforms will be essential for ensuring that the data needed for climate-resilient health systems is available, trusted, and used.

Key Takeaways

The research points to significant challenges hindering effective climate-health data integration. This disconnect stems from multiple reinforcing barriers, including inadequate spatial and temporal resolution of available data, limited capacity to interpret and apply climate variables to health outcomes, fragmented governance structures that prevent cross-sector collaboration, and tools that fail to meet the practical needs of frontline health workers.

Yet, promising innovations across LMICs demonstrate that these barriers are addressable. From Kenya's community-driven flood response systems to Nigeria's repurposed temperature monitoring devices and Malawi's integrated agricultural-health platforms, successful examples share common elements: locally-led implementation, integration with existing health workflows, and governance structures that enable sustained cross-sector partnerships.

The evidence shows that bridging the climate-health data gap requires more than technical solutions. It demands coordinated investment in local capacity, inclusive governance frameworks that center community voices, and sustainable financing models that move beyond fragmented, project-based approaches to support long-term sustainable change.

Chapter 3: Future of Climate and Health Tools

The integration of climate and health data faces significant challenges, from data sensitivity and limited collaboration between agencies to accessibility barriers and capacity constraints. However, emerging technologies, particularly artificial intelligence (AI) and advanced data science tools, are creating unprecedented opportunities to overcome longstanding barriers and create more responsive, equitable, and effective climate-health data systems.

This chapter explores how emerging technologies can address critical gaps while highlighting proven applications and the enabling conditions necessary for success, including practices for developing and using AI responsibly and in ways that benefit society while minimizing the risk of negative consequences.

I. The Transformative Potential of AI and Data Science

The expanded availability of accessible AI tools, particularly large language models (LLMs) and multimodal systems, has fundamentally transformed the feasibility of building community-centered climate-health data platforms. Tasks that once required specialized data science or engineering expertise can now be performed interactively and at scale - directly addressing many of the capacity and accessibility barriers identified in our research. What was once technically daunting is now increasingly within reach for local governments, civil society, and community health networks, accelerating the path from data collection to actionable insight.

Democratizing Data Analysis

AI systems can assist users in uploading and cleaning data, formulating research questions, and navigating dashboards through simple conversational interfaces. Complex processes like extracting structured data from PDF reports, translating health records across formats, or generating summaries of climate trends from datasets are now accessible to non-technical users.

For frontline health workers operating under severe time constraints and with limited digital literacy training, AI-powered conversational assistance can serve as a guide, answering questions, explaining charts, helping formulate queries, or prompting workflows like data uploads or risk model runs. This makes analytics accessible to those unfamiliar with complex filters or dashboards, addressing the tool usability barriers that have historically limited uptake.

Bridging Technical and Communication Gaps

AI tools have the ability to assist with translation between the distinct technical languages and terminologies used by climate and health stakeholders, and help translate between data that operate on different spatial and temporal scales. For example, meteorological data might be available at a national or regional level, while health data is needed at the district or facility level to be actionable. Climate data often comes in monthly aggregates, whereas health events, such as heat-related mortality, require daily granularity. Additionally, the format of climate data has traditionally been difficult for non-specialists to interpret intuitively.

Recent methodological advances are addressing these scale challenges directly. New statistical methods have been developed that enable valid epidemiological analysis even when climate data is available daily but health data exists only in weekly or monthly aggregates. These approaches, which use temporally aggregated health data to make unbiased estimates of temperature-related mortality, are particularly valuable for low-resource settings where daily health records may not be available. Such methodological innovations complement AI tools in bridging the technical gaps that have historically prevented effective climate-health data integration.[75]

AI-powered tools, however, are poised to assist with making climate data more interpretable for health decision-makers through ‘bite-sized’ and ‘digestible’ formats that maintain precision without requiring specialist knowledge. This would help to reduce the sector silos and enable more effective cross-sector coordination between Ministries of Health, meteorological offices, and other agencies. A cited example of good data translation, without losing precision, is the climatetrace.org map.

II. Proven Applications: From Pilot to Scale

Several initiatives from low- and middle-income countries (LMICs) demonstrate how AI and data science can transform climate-health data integration, moving beyond theoretical potential to deliver tangible value for health systems.

[75] Basagaña & Ballester (2024).

Integrated Health and Climate Surveillance

In Malawi,[76] the National Agriculture Management Information System (NAMIS) integrates climate and health data using DHIS2 to enhance food security and climate resilience. This system connects Malawi's Ministry of Health, Ministry of Agriculture, and Department of Climate Change and Meteorological Services through shared data infrastructure - enabling the combined analysis of agricultural, meteorological, and health datasets within a single platform. Agricultural Extension Development Officers and Health Surveillance Assistants provide hyper-local field data (weather, health) that is integrated with satellite observations and meteorological data. The system generates forecasts and risk alerts for farmers while building toward a comprehensive One Health platform that connects human and animal health with agricultural data.

DataKind

Figure 4: Case study on integrated health and climate surveillance in Malawi.[76]

Predictive Health Intelligence

Mozambique's[77] approach demonstrates how AI can enhance disease surveillance by combining malaria data from DHIS2 with geospatial data from the Copernicus satellite program. Statistical models generate malaria outbreak predictions that inform preventative measures through accessible dashboards. Similar predictive capabilities are being developed in India,[78] where researchers have created dengue dynamics models that integrate meteorological data with disease surveillance to forecast outbreaks and support vector control strategies in high-risk areas.

DataKind

Figure 5: Case study on predictive health intelligence in Mozambique[77] and India[78]

[76] Mpakata (2024).
[77] HISP Africa (n.d.).
[78] Tripathy et al. (2025).

Innovative Data Collection Methods

In Nigeria, eHealth Africa has developed creative solutions to the "limited availability of high-resolution climate data" challenge. Their eHealth Africa–Parsyl Global Health Monitoring devices,[79] originally designed to monitor temperature-sensitive medical products, now collect ambient temperature data in clinics to build hyper-local environmental baselines. This passive data collection approach demonstrates how existing health infrastructure can be repurposed to generate valuable climate-health data without requiring additional investment.

DataKind

Figure 6: Case study on innovative data collection methods in Nigeria.[79]

Community-Driven Emergency Response

Kenya's flood response system, developed by Lwala, is a standout example of how frontline health workers are integral to climate-health data systems.[80] The flood response module within the national eCHIS enables community health workers to rapidly collect real-time data during extreme weather events, including mapping affected regions, documenting cholera outbreaks, and tracking population displacement. This approach was successfully piloted during widespread flooding and subsequently adopted as a permanent feature of the eCHIS, demonstrating how community-centered data collection can improve government access to timely, localized information during emergencies.

DataKind

Figure 7: Case study on community-driven emergency response in Kenya.[80]

[79] eHealth Africa (2025).
[80] Rogers et al. (2024).

III. Toward Integrated Climate-Health Intelligence Platforms

Building on several proven initiatives across LMICs, stakeholders emphasized the need to move beyond pilots to sustainable, practical, action-oriented tools that deliver tangible value. Frontline stakeholders and local entities particularly envision more comprehensive platforms that can serve as a centralized hub for climate-health analysis and decision-making. These systems need to be able to integrate multiple data streams in ways that address concerns around privacy, data security, and political sensitivity to support real-world decision-making.

Tactically, to anticipate climate-sensitive disease outbreaks earlier than current systems, allowing time for targeted resource allocation and community preparedness requires climate-health intelligence platforms to be able to combine current and historical data streams from meteorology (rainfall, temperature), health systems (disease surveillance, non-communicable diseases, vector-borne and zoonotic diseases), supply chains (cold chain monitoring), and agriculture (crop loss risk, pest outbreaks) into a unified interface.

This cross-sector coordination has been noted as key to the utility of a climate-health platform. Brazil's *Clima e Saúde* Observatory demonstrates the feasibility of this approach at the national level, providing a model for how integrated platforms can visualize and quantify causal links between climate events and health outcomes while strengthening supply chain readiness and emergency preparedness. Similarly, the Standards for Official Statistics on Climate-Health Interactions (SOSCHI) platform is developing a globally usable framework for official statistics on climate-health interactions to enable national statistical offices to estimate climate-related health risks across ten key areas, from extreme weather events to vector-borne diseases.[81]

The vision of a **modular, replicable, climate health observatory,** combined with opportunities afforded by AI technologies can support efficient operational workflows, build early warning systems, and translate complex data into risk scores that inform action plans. Stakeholders have called for the platform to be more responsive to community input (as noted in examples earlier, community health workers are actively using mobile tools to report on climate-related health impacts). To that end, seamless integration with existing platforms like DHIS2, OpenSRP, and the Community Health Toolkit would go a long way in ensuring compatibility with established workflows that have already made significant progress in centering data and information flows from frontline health organizations.

IV. Enabling Conditions for Success

Realizing the potential of AI-driven climate-health systems requires addressing the structural, governance, and capacity barriers while ensuring sustainable, equitable implementation.

[81] Office for National Statistics (2024).

Collaborative Governance and Data Sharing: Establishing shared frameworks for data governance and access that address the sensitivity of both climate and health data is needed. This might include creating steering committees or technical working groups with participation from climate and health government stakeholders, and certainly requires the appropriate anonymization of health data to ensure no personally identifiable information is present. Climate data sharing restrictions must be navigated carefully, given political sensitivities around subnational data. Synthetic datasets, which preserve statistical properties without exposing personally identifiable information, offer promising solutions for analysis in data-restricted environments.

Capacity Building and Local Ownership: While AI can democratize access to complex analytics, sustainable implementation requires investment in local capacity building. Prioritizing locally-led research and institution building, following models like the International Development Research Centre (IDRC)'s emphasis on direct funding to local researchers and long-term investment in regional research ecosystems, is key to ensuring local participation within health systems.[82]

Sustainable Financing and Open Source Development: Moving beyond fragmented, project-based funding models requires innovative approaches to sustainable financing. This includes supporting pooled or multi-donor funds for longer-term investment in core public infrastructure and empowering local intermediary organizations to bridge across health, climate, and technology sectors.

Open-source platform development ensures adaptability to local needs while contributing to broader regional and global systems. This approach can be implemented as locally hosted solutions for privacy and sovereignty or as global goods supporting shared open datasets.

Equity and Accessibility by Design: Platforms must be designed with equity and accessibility as core principles, ensuring that tools work effectively in resource-constrained environments. This requires multilingual support, culturally relevant interfaces, offline access capabilities, and simplified data presentation that avoids technical jargon. Tools must deliver user-friendly insights rather than requiring users to navigate raw datasets or complex dashboards.

Responsible AI Practices: As advances in generative AI technologies are opening up new and clear ways to integrate climate and health systems, responsible adoption is essential. AI offers significant opportunities, such as democratizing access to data and analysis. However, its use introduces risks that need to be carefully managed to maintain trust, safety, and equity. It is important to note that applications of AI vary in their risk profiles, with some applications safer than others. Asking an LLM to provide answers directly from its training data offers more potential for hallucination and bias than a low-level technical use, such as using an LLM to predict metadata or to automatically detect data anomalies or missing values and flag them for human review (auto-correction, however, introduces less control and potentially more risk).

[82] International Development Research Centre (2025).

Trust grows when communities see AI as a partner in problem-solving rather than an external imposition. Co-designing tools with local partners, creating shared governance structures, and embedding feedback mechanisms can help ensure these systems remain responsive, equitable, and transparent.

Another key consideration in the use of AI is the environmental cost. AI systems, particularly LLMs, have non-trivial energy and carbon footprints. Exploring lightweight, efficient models for localized use cases and developing AI systems rooted in local contexts with locally trained models can improve accuracy, enhance trust, and reduce dependency on energy-intensive global platforms. Furthermore, this place-led approach also supports capacity building, enabling communities to own, maintain, and adapt their AI systems over time.

Key Takeaways

The convergence of AI advances and climate-health data needs creates unprecedented opportunities to address longstanding barriers in data integration and use. The examples highlighted demonstrate that these technologies can democratize access to complex analytics, bridge communication gaps between sectors, and enable community-centered approaches to climate-health surveillance.

However, realizing this potential requires sustained attention to governance, capacity building, and sustainable financing. Success depends on creating collaborative frameworks that address data sensitivity concerns, investing in local expertise and ownership, and ensuring that technological solutions are designed with equity and accessibility as core principles.

As the impacts of climate change escalate, the transformation from fragmented, siloed data systems to integrated, AI-enabled platforms represents both an urgent necessity and an achievable goal. With appropriate investment in enabling conditions, including responsible AI practices, these tools can become powerful instruments for building climate-resilient health systems that protect the most vulnerable populations.

Chapter 4: Conclusion and Recommendations

Climate change is placing a growing strain on health systems, particularly in low- and middle-income countries, where its impacts intersect with longstanding health system vulnerabilities. While awareness of the need for adaptive responses is increasing, frontline health decision-makers face persistent challenges in accessing timely, localized, and actionable climate data needed for effective planning.

Two core themes emerged across both desk research and interviews:

1. Systemic barriers, such as fragmented data systems and limited capacity, continue to hinder effective climate-health data integration.
2. Emerging tools, particularly those powered by artificial intelligence and advanced analytics, offer new opportunities to address these barriers, but only when paired with governance frameworks, institutional trust, and investments in local expertise.

Despite promising solutions emerging across regions, from community-driven emergency data collection in Kenya to integrated climate-health surveillance in Malawi, persistent challenges limit the routine use of climate data in health systems. These include limited data granularity and timeliness, underrepresentation of local perspectives, technical incompatibilities between data systems, and a lack of user-centered tools that meet the needs of frontline health workers.

To address these issues and unlock the potential of climate-informed decision-making, a coordinated, multi-level approach is needed. The recommendations below reflect opportunities identified by stakeholders to build more inclusive, interoperable, and actionable climate-health data ecosystems across sectors and settings. Each is aimed at bridging the gap between climate data availability and real-world decision-making in health systems. These actions may be led or supported by a range of stakeholders, including public agencies, funders, technical partners, and community-based organizations.

Six Strategic Recommendations

1. Enhance Access to Localized, Timely, and Granular Data: Prioritize real-time, community-level climate and health data collection while including marginalized communities in validation efforts to improve relevance and equity.

2. Promote Interoperability and Data Standardization: Develop harmonized data templates and metadata standards for climate-sensitive health conditions, establish cross-departmental coordination mechanisms, and support platforms bridging health and climate domains.

3. Build Capacity for Climate-Health Data Use: Provide targeted training on predictive modeling and data literacy for frontline users, while fostering institutional partnerships and peer-to-peer learning between governments, nongovernmental organizations, and academic institutions.

4. Design Inclusive and User-Centered Tools: Create tools for low-connectivity environments with multilingual interfaces, leverage AI-powered assistants to lower interpretation barriers, and integrate with existing systems, such as DHIS2 or OpenSRP, through co-design processes.

5. Strengthen Cross-Sector and Multi-Level Governance: Formalize data-sharing mandates and interministerial working groups while addressing data sovereignty concerns and engaging community organizations as decision-making contributors.

6. Mobilize Sustainable, Locally Anchored Financing: Shift toward long-term, flexible funding for core systems and regional research ecosystems, investing in locally owned platforms aligned with national health strategies.

These recommendations highlight the systemic, technical, and institutional changes needed to enable climate-informed decision-making at scale. Emerging technologies such as AI and machine learning offer unprecedented opportunities to reduce burdens on resource-constrained systems and expand the reach of climate-health analysis. Yet these tools are only as effective as the governance, institutional trust, and human capacity that support them. Ensuring that data systems serve frontline health needs requires co-design with users, integration into public systems, and financing models that reinforce long-term sustainability.

While this report offers a broad synthesis of current challenges and promising approaches, further research will benefit a deeper understanding at the country level, particularly on implementation barriers, capacity gaps, and success metrics. Continued engagement with frontline actors and iterative testing of climate-health tools will be critical to ensuring their relevance and effectiveness.

With sustained commitment to local leadership, interoperability, and inclusive design, stakeholders have a timely opportunity to transform how health systems anticipate and respond to climate threats to protect communities from the accelerating impacts of climate change.

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Appendix

About DataKind

DataKind® is a global nonprofit that harnesses the power of data science and AI in the service of humanity. For more than a decade, DataKind has empowered social impact organizations with the tools, knowledge, and capacity to solve the world's toughest challenges. Named one of Fast Company's top 10 innovative nonprofits, DataKind creates tools that improve impact, increase efficiency, and develop greater insight. DataKind works extensively in the areas of economic opportunity, humanitarian response, climate & environment, and frontline health systems. DataKind mobilizes more than 30,000 volunteer data scientists and technologists to support local organizations, lead data collaborations across sectors, and provide critical context. Today, DataKind maintains a presence in the UK, India, Singapore, Kenya, and major US cities. For more information on our partners and programs, visit: www.datakind.org.

List of Stakeholder Organizations

Besides the core project team, stakeholders from the following organizations and entities contributed to this landscape report by providing subject matter expertise:

Organization	Sector	Type
Digital Health and Climate Working Group	Nonprofit	Advocacy and policy; research; technical assistance
Drury Consulting	Private	Policy; technical assistance
eHealth Africa	Nonprofit	Health service delivery
Grand Challenges Canada	Nonprofit	Donor agency
HealthEnabled	Nonprofit	Advocacy and policy; technical assistance
Healthy Learners	Nonprofit	Health service delivery
International Development Research Centre	Government agency	Donor agency
King's College London	Academia	Academia and research
Lwala	Nonprofit	Health service delivery
Medic	Nonprofit	Health service delivery
Office for National Statistics	Public	Government - non-ministerial

		department
OpenAQ	Nonprofit	Data and technology
PATH	Nonprofit	Advocacy and policy; data and technology; technical assistance
The Rockefeller Foundation	Foundation	Donor agency
Spectrum Africa	Nonprofit	Advocacy and policy; technical assistance

Sample of Interview Guide Questions

The following questions represent a sample of those used during the semi-structured interviews conducted for this report. The specific questions asked varied based on the stakeholder's role, expertise, and organizational context. Interviews were tailored to explore relevant dimensions of climate and health data use, access, and integration, while maintaining consistency across core thematic areas. This approach allowed for comparative analysis while capturing diverse perspectives across institutions, sectors, and geographies.

1. Can you briefly describe your work at the intersection of climate and health?
2. The World Meteorological Organization reports that while 74% of national meteorological services share climate data with the health sector, only 23% of ministries of health report systematically integrating this data. In your view, what are the primary barriers to integration?
3. What types of climate and health data do you work with most frequently, and at what geographic or administrative scale?
4. What types of climate or health data do you wish were more accessible, and how would this data support your work?
5. What strategies, tools, or technologies (AI-enabled or otherwise) have you used to improve the accessibility and availability of climate and health data, particularly in low-resource or infrastructure-limited settings?
6. In your opinion, what does success look like when using climate data to inform decision-making within ministries of health or health systems? What bottlenecks hinder this success?
7. What are the most critical data-related gaps that urgently require investment to improve the use of climate information in health systems? Which of these would have the greatest impact at the local or frontline level?
8. How can external partners, such as NGOs, academic institutions, or donors, help bridge government capacity gaps in the routine or systematic use of climate data for health?
9. Can you share one or more examples of data-driven climate and health interventions that led to measurable improvements in health system resilience or adaptation outcomes?

Acronyms

Acronym	Definition
AI	Artificial intelligence
AI4PEP	Artificial Intelligence for Pandemic and Epidemic Preparedness and Response Network
ARCH	Advancing Research for Climate and Health
eCHIS	Electronic community health information system
GCC	Grand Challenges Canada
HNAP	Health national adaptation plan
IDRC	International Development Research Centre
LLM	Large language model
LMIC	Low- and middle-income country
NAMIS	National Agriculture Management Information System
NGO	Nongovernmental organization
NOAA	National Oceanic and Atmospheric Administration
SDG	Sustainable Development Goal
SORMAS	Surveillance Outbreak Response Management and Analysis System
SOSCHI	Standards for Official Statistics on Climate-Health Interactions
USAID	United States Agency for International Development
WHO	World Health Organization
WMO	World Meteorological Organization

Glossary of Terms

Term	Definition
Artificial intelligence	A field of computer science focused on creating systems capable of performing tasks that typically require human intelligence. These tasks include problem-solving, decision-making, understanding natural language, and recognizing patterns and images. Artificial intelligence systems can range from simple, rule-based algorithms to complex neural networks that mimic the way the human brain operates.
Data science	An interdisciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from structured and unstructured data. Data science combines aspects of statistics, computer science, and information science to analyze and interpret complex data. It encompasses data analysis, machine learning, and big data analytics, aiming to provide a basis for decision-making and strategic planning.
Large language model	A type of artificial intelligence trained on vast amounts of text data to understand and generate human-like text for various tasks, including translation, summarization, and answering questions.
Machine learning	A subset of artificial intelligence that involves the development of algorithms that can learn from and make predictions or decisions based on data. Unlike traditional programming, where instructions are explicitly provided to perform a task, machine learning algorithms adjust their parameters based on the patterns found in data, improving their performance over time without being explicitly programmed to do so.
One Health	An integrated, unifying approach to balance and optimize the health of people, animals, and ecosystems. It uses the close, interdependent links among these fields to create new surveillance and disease control methods.

Acknowledgements

We are grateful for the invaluable contributions of the following individuals and organizations.

Feedback and insights:

- Stakeholders from the following organizations - Digital Health and Climate Working Group, Drury Consulting, eHealth Africa, Grand Challenges Canada, HealthEnabled, Healthy Learners, International Development Research Centre, King's College London, Lwala Community Alliance, Medic, Office for National Statistics, OpenAQ, PATH, The Rockefeller Foundation, Spectrum Africa

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