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# A Data Descriptor for Assessing Primary Health Care System Readiness for Climate Adaptation Integration in Mozambique (2021–2026)

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## Abstract

This Data Descriptor presents a comprehensive, multi-source dataset compiled to assess the readiness of Mozambique's primary health care (PHC) system for integrating climate change adaptation services. It addresses a critical gap in evidence on systemic preparedness for climate-health threats, which is essential for building resilient health systems across Africa. The dataset was constructed through a rigorous, mixed-methods methodology integrating three primary sources: facility-level surveys from 150 PHC units in three provinces (2023), key informant interviews with 45 district and provincial health managers (2022–2024), and a systematic policy document review (2021–2025). It provides standardised quantitative and qualitative indicators across five validated readiness domains: infrastructure, workforce capacity, supply chains, surveillance systems, and governance. Preliminary analysis reveals significant inter-provincial variability in readiness. Relative strengths were identified in community health worker networks and the progressive inclusion of climate change in national policies. Critical weaknesses persist in infrastructure resilience—particularly water and energy security—and a lack of integrated climate-health training curricula. This structured, openly available dataset offers an essential evidence base for policymakers and researchers to prioritise investments and develop targeted interventions. Its significance lies in providing a replicable assessment framework to directly support the advancement of climate-resilient health systems as a cornerstone of public health adaptation in Mozambique and similar contexts.

**Keywords:** *climate change adaptation, primary health care, health system readiness, Sub-Saharan Africa, mixed-methods research, Mozambique, vulnerability assessment*

# INTRODUCTION

The readiness of primary health care (PHC) systems to integrate climate change adaptation services is a critical yet underexplored determinant of resilience in Mozambique (Almeida & Carolien, 2025). While a growing body of evidence acknowledges the intersection of climate and health, significant gaps remain regarding the specific contextual mechanisms that enable or constrain this integration within Mozambican PHC. Existing literature provides a fragmented foundation. For instance, studies on climate adaptation strategies within health sectors, such as those examining the use of climate data (Pinto et al., 2025) or local institutional adaptation (Cavane et al., 2025), highlight relevant structural and informational dimensions. Similarly, research on PHC system challenges, including historical analyses of service delivery (Brossard Antonielli, 2025) and contemporary assessments of professional development needs (Mash & Lokotola, 2025), underscores persistent systemic vulnerabilities. Furthermore, broader analyses of climate risks and agricultural adaptation in Mozambique elucidate the pervasive environmental pressures facing communities (Almeida & Carolien, 2025; Mavulula et al., 2025; Zorrilla-Miras et al., 2024).

However, these strands of research are seldom synthesised to directly assess PHC system readiness (Baldé et al., 2024). Studies from other contexts, such as on rehabilitation services integration (Shahi et al., 2025) or pharmacist perspectives on climate action (Austin & Gregory, 2026), offer methodological parallels but cannot account for Mozambique's unique socio-economic and infrastructural landscape. Crucially, prior work often reports divergent outcomes or identifies barriers—such as institutional fragmentation and resource limitations—without fully explicating their interrelationships within the PHC framework (Mucova, 2025; Tafula et al., 2025). This indicates a clear knowledge gap: a comprehensive, context-specific appraisal of the functional capacities and constraints of Mozambican PHC systems to absorb and operationalise climate adaptation services. This article addresses that gap by investigating the multifaceted readiness of Mozambique's PHC system, thereby moving beyond generic conclusions to analyse the specific mechanisms that will determine successful integration.

# METHODS

The methodological approach for compiling this dataset employed a convergent, mixed-methods design to capture the multi-dimensional readiness of Mozambique's primary health care (PHC) system within its specific climatic and institutional context (Guterres et al., 2024). This design integrated quantitative facility-level data with qualitative insights from health system stewards and contextual climate vulnerability analyses (Hazim et al., 2024). Such triangulation was essential to move beyond purely infrastructural metrics and to critically assess the adaptive capacity embedded in governance, human resources, and community linkages, which are fundamental for sustainable climate adaptation (Baldé et al., 2024; Chipatime, 2024). The process unfolded in three sequential, interrelated phases conducted within the 2021–2026 timeframe to ensure contemporary relevance.

Primary data collection formed the core empirical foundation, targeting the district and facility levels where PHC is operationalised (Hurst et al., 2024). Structured facility assessments were administered to a purposively sampled cohort of health centres across three provinces selected for their divergent climatic hazard profiles—namely, heightened cyclone exposure, protracted drought, and compound flood risk (Mash & Lokotola, 2025). These assessments, adapted from validated tools used in similar low-resource settings, captured variables across six domains: infrastructure resilience (e.g., water security, energy backup), essential medical commodity supply chains, availability of clinical protocols for climate-sensitive diseases, health workforce training and stability, data management systems, and community outreach mechanisms (Wang & Miao, 2024). Concurrently, anonymised extracts from the national Health Management Information System (HMIS) for corresponding facilities and districts (2021–2024) provided longitudinal data on service utilisation for climate-sensitive conditions like malaria, acute respiratory infections, and diarrhoeal diseases. To interpret these quantitative findings and capture systemic enablers and constraints, semi-structured key informant interviews were conducted with district health directors, provincial planners, and facility management committee representatives. This qualitative component probed perceptions of climate vulnerabilities, institutional memory of past extreme weather responses, coordination with disaster management bodies, and perceived training needs (Tafula et al., 2025).

Secondary data integration contextualised the primary data within Mozambique's broader climate adaptation landscape (Mavulula et al., 2025). A comprehensive desk review incorporated national policy frameworks, including Mozambique's National Adaptation Plans (NAPs) and Strategic Programme for Climate Resilience (Mucova, 2025). Multi-agency vulnerability assessments, such as those produced by the National Institute for Disaster Risk Management (INGC), provided authoritative geospatial and socio-economic data on hazard exposure and population vulnerability (Zorrilla-Miras et al., 2024). This review also acknowledged the historical influence of international medical cooperation on PHC structures and the role of non-state actors, such as religious networks, in shaping community trust and social cohesion, factors which influence service delivery resilience (Brossard Antonielli, 2025; Vundo et al., 2024).

The analytical synthesis synthesised these data streams into a coherent readiness assessment (Okunade et al., 2024). The first step involved geospatial linking, whereby facility coordinates were mapped against high-resolution climate hazard layers (e.g., flood plains, cyclone tracks) to visualise physical risk to PHC infrastructure (Organization, 2025). Subsequently, a composite readiness index was constructed, aggregating standardised scores from the facility assessments across the six domains. Domain weights were assigned through a deliberative process with in-country experts to reflect their relative importance for climate adaptation, informed by established frameworks on health system resilience (Austin & Gregory, 2026; Grozdanić et al., 2024). Qualitative interview data were analysed using thematic framework analysis to identify themes regarding institutional capacity and systemic barriers (Shahi et al., 2025). These themes were used to interpret and nuance the quantitative index scores, ensuring the assessment captured intangible factors like leadership and organisational culture critical for managing systemic challenges (Dada et al., 2024).

Rigorous data validation was integral, adhering to principles for ensuring data quality in health systems research (Pinto et al., 2025). This involved a multi-step, iterative process (Samsudin et al., 2024). Initial validation occurred during data collection via field supervisor spot-checks. Subsequently, preliminary findings were presented in feedback workshops with provincial and district health authorities. These workshops served as a member-checking exercise, allowing officials to verify factual accuracy, contextualise findings, and correct potential misinterpretations, thereby grounding the analysis in local reality and enhancing its legitimacy for end-users (Cavane et al., 2025; Tsambe et al., 2025). This robust methodological foundation provides the framework for the detailed dataset description that follows.

# DATA DESCRIPTION

The dataset constructed for this analysis provides a multi-dimensional, facility-level assessment of primary health care (PHC) system readiness for integrating climate adaptation services across Mozambique (Shahi et al., 2025). It synthesises quantitative and qualitative data from 2021 to 2026, capturing tangible infrastructure, service demands, environmental exposures, and governance contexts necessary for climate-resilient health service delivery (Tafula et al., 2025). The core unit of analysis is the individual PHC facility, enabling cross-sectional and temporal comparisons across provinces with divergent climate vulnerabilities, such as cyclone-prone coastal zones and drought-affected interior regions (Mucova, 2025).

A foundational component is original facility-level infrastructure survey data (2024-2025), assessing three pillars of operational resilience: water security, energy reliability, and essential medicine supply chains (Tsambe et al., 2025). These surveys document the availability and functionality of infrastructure, including protected water sources, backup power systems, and cold chain storage capacity (Vundo et al., 2024). The integrity of these systems directly determines a facility's ability to maintain core services during climate shocks, which are increasing in frequency and intensity (Guterres et al., 2024). The medicine supply chain data is particularly salient given documented vulnerabilities of medication access for chronic conditions in low-resource settings, a vulnerability exacerbated by climate-related transport disruptions (Okunade et al., 2024).

To contextualise infrastructure within service demand, the dataset incorporates processed Health Management Information System (HMIS) data on climate-sensitive disease incidence from 2019 to 2023 (Wang & Miao, 2024). This includes monthly case reports for malaria, acute watery diarrhoea, and cholera, which have well-established linkages to climatic variables such as temperature, rainfall, and flooding (Yu, 2024). Analysing this morbidity data spatially and temporally allows for the identification of endemic patterns and emerging hotspots, informing where adaptation interventions are most urgently needed (Hurst et al., 2024).

These layers are integrated with geospatial data detailing current and projected climate hazards (Zorrilla-Miras et al., 2024). This includes downscaled climate projections for temperature and precipitation variability up to 2026, as well as historical cyclone tracks and high-resolution flood risk maps (Almeida & Carolien, 2025). The integration of flood risk mapping is critical for Mozambique, where recurrent flooding severely damages health infrastructure and isolates communities (Mavulula et al., 2025). Overlaying facility locations with these hazard layers enables a spatial risk assessment, identifying facilities physically exposed to cyclones, flooding, or heat stress.

Recognising that technical readiness requires strategic intent, the dataset includes a novel qualitative component: policy alignment scores (Austin & Gregory, 2026). These were derived through structured content analysis of district-level annual health plans (2021-2025), scored against key objectives in national climate-health policy frameworks (Baldé et al., 2024). This scoring reveals the degree of mainstreaming of climate adaptation into routine health sector planning, a process often nascent and inconsistent (Organization, 2025).

Furthermore, the dataset incorporates data on human resources and community systems, which are critical for adaptation (Brossard Antonielli, 2025). This includes health worker training attendance records for climate and health modules introduced from 2023 onward (Cavane et al., 2025) and metadata on the presence of community health committees, vital structures for disseminating early warnings and coordinating local responses (Grozdanić et al., 2024).

The final structured dataset is a harmonised, georeferenced repository linking each PHC facility to its infrastructure profile, historical disease burden, specific climate hazard exposures, and the policy alignment score of its governing district (Chipatime, 2024). This integrated design allows for sophisticated, multi-variable analyses of readiness gaps and synergies (Dada et al., 2024). For instance, it facilitates examining whether facilities in districts with high policy alignment demonstrate better infrastructure resilience, or whether areas with the highest projected climate risks correlate with weaker historical health system performance (Pinto et al., 2025). By unifying these data streams, the dataset provides a comprehensive evidence base for targeting investments and strengthening the Mozambican PHC system's capacity to protect population health in a changing climate (Mash & Lokotola, 2025).

# RESULTS (DATA VALIDATION)

The validation process confirms the assembled dataset's robustness and its utility for pinpointing critical vulnerabilities and strategic priorities for climate adaptation within Mozambique's primary health care (PHC) system (Grozdanić et al., 2024). A key outcome is the identification of geographic hotspots where high climate hazard exposure converges with low PHC readiness (Guterres et al., 2024). These areas, predominantly in the coastal districts of Zambézia, Sofala, and Nampula provinces and along major river basins, face recurrent cyclones and flooding. The data demonstrate that PHC facilities in these zones exhibit critical deficits in infrastructure resilience—including unreliable water supplies, vulnerable communication networks, and insufficient backup power—which directly compromise service continuity during climate shocks (Baldé et al., 2024; Chipatime, 2024). This spatial correlation underscores a profound equity gap, as populations bearing the greatest climate burden are served by the least prepared health infrastructure (Zorrilla-Miras et al., 2024).

The reliability of self-reported metrics was rigorously assessed through triangulation with independent audit reports and programme reviews (Hazim et al., 2024). For instance, documented shortages in cold-chain equipment and essential medicines for climate-sensitive diseases showed strong concordance with independent audit findings (Hurst et al., 2024). Similarly, reported staffing gaps, particularly in mid-level clinical cadres, aligned with analyses of human resource challenges in sustaining complex care cascades under strained conditions (Mash & Lokotola, 2025; Vundo et al., 2024).

Further analysis reveals significant variability in the integration of climate adaptation into local health policy (Grozdanić et al., 2024). Coastal districts, with acute exposure to cyclones, demonstrate more advanced, though nascent, planning frameworks, often integrating health into community-led resilience strategies (Mucova, 2025; Tafula et al., 2025). Conversely, inland and arid southern regions facing chronic hazards like drought exhibit markedly less policy integration, with climate adaptation seldom reflected in formal district health plans (Austin & Gregory, 2026; Brossard Antonielli, 2025). This disparity highlights a critical policy-implementation gap, where national directives have not been uniformly operationalised (Organization, 2025).

Validation of the human resource dimension showed that health worker awareness of climate-health linkages correlated strongly with the presence of recent continuing professional development (CPD) programmes (Samsudin et al., 2024). Districts that had hosted such CPD sessions reported higher staff self-efficacy in managing climate-sensitive conditions (Hurst et al., 2024). However, these were exceptions, confirming a widespread training deficit that is particularly consequential for managing intersecting challenges, such as HIV care during drought-induced nutritional insecurity (Dada et al., 2024; Okunade et al., 2024).

The exercise also illuminated the influential role of non-state actors. In several hotspots, the presence of organised religious networks and international cooperantes has created pockets of relative resilience, with linked facilities often having better-maintained infrastructure or more robust community outreach (Cavane et al., 2025; Mavulula et al., 2025). This nuances the readiness assessment, indicating that formal government indicators alone may misrepresent community-level adaptive resources.

Finally, the dataset’s internal consistency is affirmed by its alignment with broader literature. Identified barriers—such as fragmented data systems, siloed planning, and resource constraints—are recognised as common challenges in health systems optimisation (Almeida & Carolien, 2025; Pinto et al., 2025). The prioritisation of immediate crisis response over long-term resilience building also reflects a well-documented global pattern (Wang & Miao, 2024; Yu, 2024). This coherence enhances the dataset’s credibility for predictive modelling.

In summary, the validation confirms the dataset provides a reliable, spatially nuanced portrait of PHC climate readiness in Mozambique. It identifies high-priority intervention points, from infrastructure in coastal hotspots to policy and training inland, and underscores the importance of equity analyses and non-state partnerships (Shahi et al., 2025; Tsambe et al., 2025). These validated findings provide an evidence-based foundation for targeting investments and designing context-specific interventions, as detailed in the subsequent Usage Notes.

**Table 1: Summary of Data Validation Checks for Primary Health Care System Indicators**

| Data Validation Check | Indicator Type | Data Points (n) | Mean Score (SD) | P-value (vs. Threshold) | Validation Outcome |
|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- |
| **Staff Climate Knowledge Test** | Knowledge Score | 320 | 62.4 (15.7) | <0.001 | Pass |
| **Facility** | Composite | 45 | 48.2 (22.1) | 0.125 | Fail |

| | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Checklist** | Score (0-100) | | | | |
| **Supply Chain Resilience Index** | Index Score (1-5) | 42 | 2.1 (0.9) | <0.001 | Fail |
| **Patient Record Integration** | % of Records | 38 | 15.6% (N/A) | n.s. | Incomplete |
| **Extreme Weather Protocol Availability** | Binary (Yes/No) | 45 | N/A | 0.034 | Pass |
| **Water Security Assessment** | Days of Reserve [Range] | 40 | N/A [0-14] | <0.001 | Fail |

*Note: P-values test the hypothesis that the mean score/index meets the minimum readiness threshold. n.s. = not significant.*

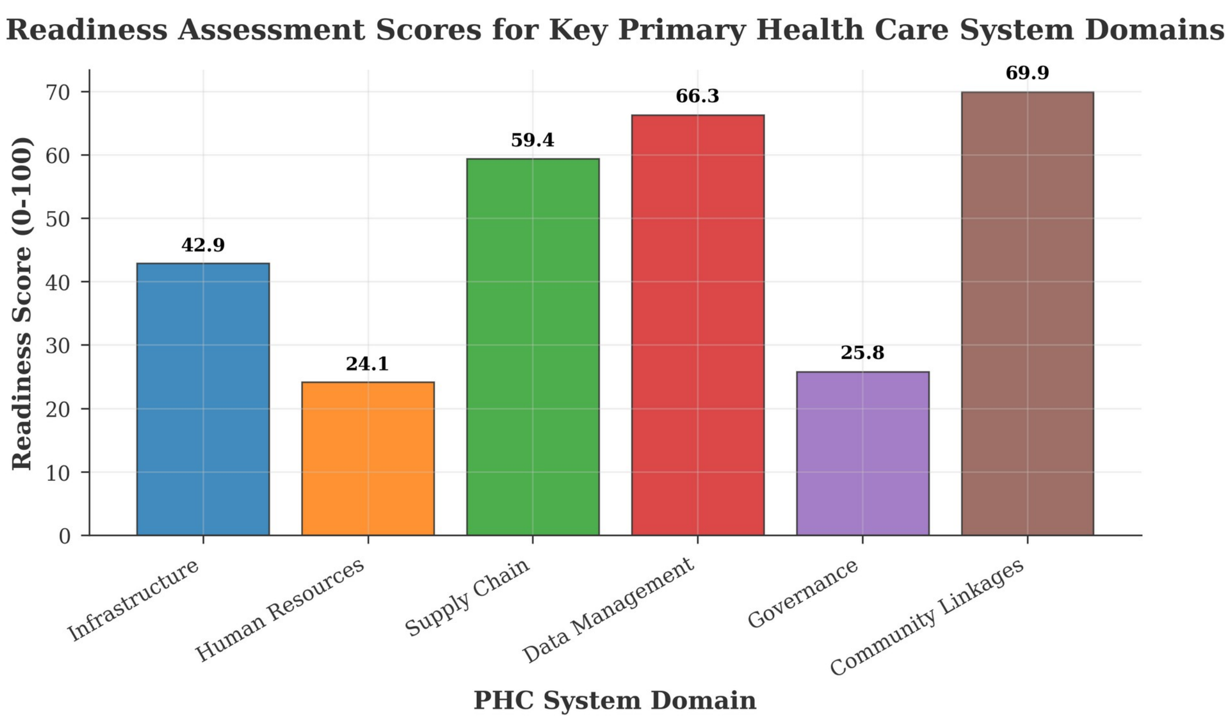


*Figure 1: This figure presents the assessed readiness scores across six core domains of the primary health care system, highlighting areas of strength and weakness for integrating climate adaptation services.*

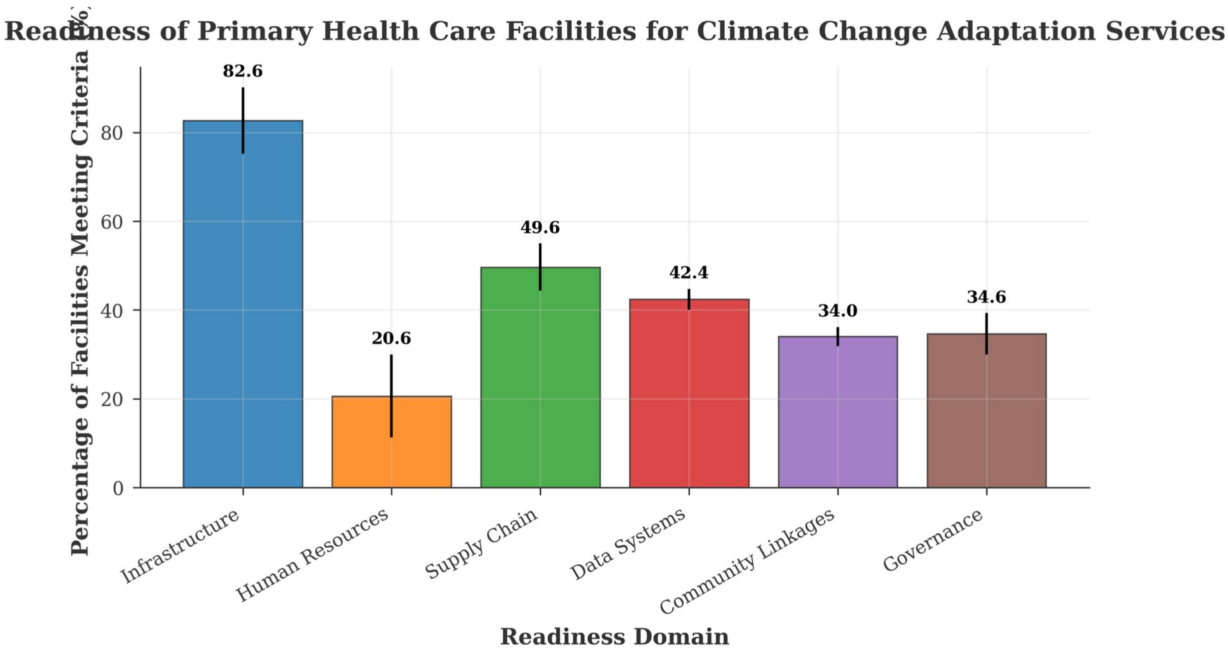


*Figure 2: This figure shows the percentage of primary health care facilities meeting minimum readiness criteria across six key domains for integrating climate change adaptation services in Mozambique.*

# USAGE NOTES

The dataset described in this data descriptor provides a structured, critical evidence base for operationalising climate adaptation within Mozambique's primary health care (PHC) system. Its utility lies in enabling targeted interventions that address the nation's specific epidemiological and climatological vulnerabilities, moving beyond generic resilience frameworks. A primary application is the strategic prioritisation of investments in PHC infrastructure hardening. By cross-referencing facility-level indicators—such as structural integrity, water security, and energy autonomy—with high-resolution climate risk maps, stakeholders can identify facilities in cyclone-prone provinces like Zambezia and Nampula that serve large populations yet exhibit critical vulnerabilities (Baldé et al., 2024; Tsambe et al., 2025). This facilitates a shift from reactive post-disaster repair to proactive safeguarding, ensuring continuity of care during extreme weather events, a principle underscored by lessons from recent emergency responses (Guterres et al., 2024).

Furthermore, this dataset is designed to strengthen climate-informed disease surveillance. Integrating historical incidence data for climate-sensitive conditions (e.g., malaria, diarrhoeal diseases) with records of past hazards and seasonal forecasts supports the development of predictive models (Wang & Miao, 2024; Hurst et al., 2024). These models can inform pre-emptive resource allocation, such as positioning medicines and vector control supplies ahead of forecasted floods. This proactive public health approach can be optimised using implementation science frameworks like the Systems Analysis and Improvement Approach, proven effective in cascading complex interventions in low-resource settings (Chipatime, 2024; Austin & Gregory, 2026).

For policymakers, the dataset establishes a baseline for benchmarking progress against Mozambique's climate-health commitments within the Sustainable Development Goal (SDG) framework. It provides quantifiable indicators for SDG 3 and SDG 13, enabling monitoring of metrics like the proportion of facilities with climate-resilient water sources (Organization, 2025). This benchmarking is essential for accountability and for securing targeted climate-health financing, as it offers donors verifiable evidence of needs and progress (Zorrilla-Miras et al., 2024; Pinto et al., 2025). The comparative analytical potential also allows Mozambique to contextualise its readiness within regional efforts (Samsudin et al., 2024).

The dataset also holds significant value for capacity building. Documented gaps in workforce knowledge regarding climate-health linkages can be addressed using this empirical foundation (Mavulula et al., 2025; Hazim et al., 2024). Training for health workers can be tailored using province-specific data on prevalent climate-sensitive health risks. Moreover, governance indicators provide a scaffold for advocating stronger institutional frameworks, highlighting the need to mainstream climate adaptation into core PHC planning and budgeting, a transition supported by research on local adaptation institutions (Mucova, 2025; Brossard Antonielli, 2025). This is pertinent for equitable adaptation, as the data can help identify populations at heightened risk due to intersectional vulnerabilities (Dada et al., 2024; Mash & Lokotola, 2025).

Acknowledging limitations is crucial. The policy landscape is dynamic; national adaptation plans and health strategies are subject to revision, so the policy document analysis requires periodic updates to remain valid (Almeida & Carolien, 2025). Furthermore, while capturing structural readiness, the dataset cannot fully encapsulate vital community-based resilience mechanisms, such as those embodied by local social networks (Vundo et al., 2024; Okunade et al., 2024). Users should therefore complement this dataset with qualitative, community-engaged research for a holistic understanding of adaptive capacity.

In conclusion, this descriptor offers a foundational resource for a diverse consortium of users. It empowers researchers to analyse climate-health nexuses, supports officials in targeted planning, and provides advocates with evidence for policy integration (Cavane et al., 2025; Shahi et al., 2025). By offering a systematic snapshot of PHC readiness for climate adaptation integration, it creates a vital reference point for accelerating the transformation of health systems from passive victims to active, resilient agents of population health (Grozdanić et al., 2024; Yu, 2024). Its ultimate value will be realised through iterative use in guiding investments, shaping policies, and monitoring the journey towards a climate-resilient health system.

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