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Maternal and child health climate change adaptation: a
qualitative document analysis of South Asian National
Adaptation PlansDinesh Bhandari¹ , Eddie Robinson¹ , Meghnath Dhimal² , Ann Borda³ , Kristie L Ebi⁴
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E-mail: zerina.tomkins@monash.edu**Keywords:** climate change, adaptation, maternal and child health, National Adaptation Plans, Health National Adaptation Plans, low and middle-income countries (LMICs)Supplementary material for this article is available [online](#)

Abstract

Driven by the existential threats of climate change to planetary health, the United Nations Framework Convention on Climate Change (UNFCCC) established a mandate for National Adaptation Plans (NAPs) to facilitate adaptation planning in low- and middle-income countries. However, the extent to which NAPs consider health risks, particularly those affecting maternal and child health in the adaptation planning process, remains unexplored. Employing the READ approach for document analysis, this study assesses the thoroughness with which these risks were considered during the development and implementation of NAPs in selected Asia-Pacific countries: Cambodia, Nepal, Sri Lanka, and Timor-Leste. The findings reveal health is consistently identified as a high-priority sector vulnerable to climate change. Cambodia, Nepal, and Timor-Leste prioritized maternal and child health issues. Consequently, these countries have outlined a broader gender-based approach in their NAP development and implementation processes, addressing some of the maternal and child health threats posed by climate change. The findings underscore the need for enhanced efforts to prioritize reducing maternal and child health risks associated with climate change through effective interventions in national adaptation planning. This need could be met through evidence generation based on the maternal and child health impacts of climate change in under-represented countries. Additionally, the future development and updating of NAPs should involve a more comprehensive and diverse representation of women from various cultural and geographic backgrounds to prioritize the protection of maternal and child health in the climate change policy discourse.

1. Background

Changes in global mean surface temperature, driven by anthropogenic climate change, are projected to exceed the Paris Agreement target of limiting temperature rise to below 2 °C above pre-industrial levels by the end of this century [1]. The consequences of climate change for population health and health systems are evident, resulting in excess morbidity

and mortality from heat-related illnesses, a higher incidence of infectious diseases, and mental health issues [2, 3]. These health impacts disproportionately affect vulnerable populations, particularly those in low- and middle-income countries (LMICs) in Asia, Africa, Latin America, and the Pacific [4]. South Asian countries face heightened risks due to their high population density, lower socioeconomic conditions, weak governance and planning, and reliance on

agriculture [5]. Climate change can exacerbate these vulnerabilities without timely and effective adaptation and mitigation interventions. Even with proactive global efforts to significantly reduce future emissions, the effects of past emissions will continue to affect the health of vulnerable populations [3]. Therefore, nations must design and implement appropriate adaptation measures to effectively manage the magnitude and patterns of health risks from climate impact drivers and reduce vulnerabilities to the consequences of exposure. From health promotion and disease prevention perspectives, adaptation remains an integral component of efforts to promote resilience against climate change.

Emerging evidence suggests that climate change has detrimental effects on maternal and child health through various pathways, including increased exposure to extreme heat and wildfire smoke and reduced access to essential healthcare services and social support [6]. Pregnant women, newborns, and children, particularly in LMICs, are among the most vulnerable due to physiological changes associated with pregnancy, dependence on caregivers for basic needs, and limited access to antenatal and postnatal healthcare services [7]. Exposures to high ambient temperatures are linked to adverse pregnancy and fetal outcomes, including preeclampsia, gestational diabetes, anemia, stillbirth, low birth weight and preterm birth [8, 9]. Despite a 71% reduction in maternal mortality rates and a 72% reduction in under-five child mortality in South Asian countries between 1990 and 2017 and 1990 and 2022, respectively, pregnant women in this region remain susceptible to adverse outcomes [10, 11]. This is due to socioeconomic and cultural factors such as disparities in access to antenatal care, health system limitations, and the necessity to engage in heavy outdoor physical labor, especially in agriculture, during the antenatal period [7, 12]. Given their heightened risk and low capacity to manage extreme stress, and the importance of healthy children for future socioeconomic development, adaptation interventions should prioritize the health and well-being of pregnant women and children.

The significance of climate change adaptation gained prominence at the 16th Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2010, leading to the establishment of a mandate for National Adaptation Plans (NAPs) under the Cancun adaptation framework [13]. The NAP process builds on the earlier National Adaptation Programmes of Action (NAPAs), which identified urgent and immediate adaptation needs for LMICs. The purpose of a NAP is to identify medium- and long-term adaptation needs. Country-driven NAP processes seek to enhance adaptive capacity and resilience by integrating adaptation interventions into existing and future programs and policies across sectors such as health,

agriculture, forest and biodiversity, industry and tourism [14]. Each country's adaptation strategies are anticipated to be progressive, gender-sensitive, locally tailored, and developed through a participatory approach. The identified priorities will shape national investments in climate change adaptation over the coming decades. A successful adaptation strategy should include gender considerations and encompass various sectors, including agriculture, health, biodiversity, energy, water resources, sustainability, infrastructure and finance [14].

As of December 2023, 52 countries had completed NAPs that were available through the central repository of the UNFCCC, while some nations are working on their 4th NAP updates [15]. In the Southeast Asia and Asia-Pacific region, selected countries, including Cambodia, Nepal, Sri Lanka and Timor-Leste, updated their NAPs, forming the focus of this study. To complement the NAPs, many countries have formulated Health National Adaptation Plans (HNAP) to articulate health-specific adaptation strategies [15]. At the time of completion of this study (December 2023), Sri Lanka and Timor-Leste were drafting their inaugural HNAPs [16], Nepal was updating its HNAP, and Cambodia had an existing HNAP (National Climate Change Action Plan for Public Health 2019–2023). While the HNAP complements the overarching NAP, we have analysed the HNAP of Cambodia as an independent document because it specifically focuses on the health sector. As a result, our final analysis includes four NAPs and Cambodia's HNAP ($N = 5$ documents), collectively referred to as adaptation documents. Policy analysis in health research provides valuable insights into the interests and actors steering health policy development and implementation, significantly contributing to our understanding of influencing and effecting policy change [17]. Consequently, we examine the consideration of maternal and child health risks in NAP development and implementation to determine a country's progress towards achieving sustainable development goals (SDGs) 3 and 13, addressing the promotion of good health and well-being and climate actions, respectively.

1.1. Research question, rationale and objectives

The extent to which health components are integrated into the adaptation discourse of NAPs has received limited research attention, particularly regarding nations from South and Southeast Asia [18]. In 2021, the World Health Organization (WHO) reviewed NAPs from 19 countries; however, Nepal, Cambodia and Timor-Leste were not included in this assessment [18]. Although the Sri Lankan NAP was included, the review primarily explored how health was considered in the adaptation planning process without specific attention to maternal and child health [18]. Adaptation strategies centered on maternal and child health remain underrepresented in national policies

and the peer-reviewed scientific literature [19]. This study aimed to determine how maternal and child health adaptation components are represented in the adaptation documents of Nepal, Cambodia, Timor-Leste and Sri Lanka, aiming to identify knowledge gaps in policy-level adaptation interventions. These countries were selected based on their homogeneity in socioeconomic, cultural and political aspects, coupled with their vulnerability to climate change. Additionally, these were the only countries from South Asia with updated NAPs in the UNFCCC's NAP central repository at the time of the study commencement in February 2023.

2. Methodology

We employed qualitative document analysis, a commonly used method in health policy research [20–22], applying the READ approach [20] to systematically analyze adaptation interventions focusing on maternal and child health. In essence, the READ method is a systematic document analysis approach that involves four sequential steps: (1) reading the documents, (2) extracting data, (3) analyzing data, and (4) distilling and reporting the findings [20].

2.1. Definition of key concepts

For the purpose of this policy analysis, the following definitions were used:

Climate change adaptation is '*the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities*' [23].

Maternal health is defined as '*the health of women during pregnancy, childbirth and postnatal period*' and child health '*as the health of children under five years of age*' [24]. Maternal and child health, as a field of public health, is primarily concerned with the health of mothers and children from birth through five years of age [25]. Therefore, in this study, 'child health' refers specifically to the health of children under the age of five, as children under the age of five are particularly vulnerable to biological and social factors, have a higher dependence on caregivers, and increased vulnerability to health risks [26].

NAP refers to '*a national policy document that is officially endorsed at the national level and includes strategies to coordinate and drive the actions of all actors and stakeholders in their pursuit of national adaptation goals and strategies*' [27].

HNAP is defined by the WHO '*as a plan developed by a country's Ministry of Health as part of the NAP process for ensuring prioritization of actions to address the health impacts of climate change at all levels of planning*' [28].

Climate resilience is defined as '*The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance,*

responding or reorganizing in ways that maintain their essential function, identity and structure [23].

2.2. Document source

The adaptation documents included in this study were obtained from NAP central, the official repository hosted by UNFCCC [15].

2.3. Analysis

The selected adaptation documents underwent independent readings and re-readings by three researchers (DB, ZT and ER). Relevant data pertaining to maternal and child health were extracted using a pre-prepared Excel sheet data-extraction template. Specific keywords, such as 'women', 'gender', 'children', 'pregnant*', 'female', 'sex', 'health', 'healthcare', 'maternal health', 'child health' and 'infant health' were targeted to capture maternal and child health aspects within the policy documents. Data extracted by each researcher were consolidated into country-specific Word documents after establishing consensus through weekly team discussions. A comprehensive qualitative content analysis (conceptual analysis: where, when, how and why?) using the inductive open coding method was then conducted to categorize and summarize maternal and child health issues addressed in the adaptation documents [29]. Coding of the data was performed by DB and ZLT using NVivo 12. The analysis extended to concepts that, while not explicitly mentioning health adaptation interventions, were likely to protect overall health and wellbeing [29].

The ecofeminism theoretical perspective, integrated within the environmental determinants of health framework, ensured that gender aspects were not overlooked in the inclusion of adaptation interventions when confining the research question to a narrow scope of maternal and child health [30]. Ecofeminism epistemology, which represents the convergence of feminist and environmentalist perspectives, aims to comprehend and address the intertwined oppression and exploitation experienced by women and the environment. It acknowledges hierarchical systems perpetuating the subjugation and domination of women and nature [30]. Following the categorization and abstraction of relevant categories, final categories were refined through iterative team discussions, encompassing aspects of policy documents related to maternal and child health adaptation.

NVivo software [31] was used to generate a radial tree chart illustrating code consolidation into distinct categories. Color-coded elements in this chart symbolize aggregated data categorized hierarchically, illustrating key categories from the qualitative content analysis. Each segment's size reflects the number of references or data coded to each sub-category. Detailed information about codes and

sub-categories in the radial tree chart is available in the Supplementary file containing the coding frame.

Additionally, concise excerpts aligning with pertinent categories from adaptation documents were included. From an epistemological standpoint, these data extracts affirm the explanation and interpretation within each category, providing evidence for readers to assess the accuracy of the analysis [32]. The criterion for selecting excerpts depended on their explanatory power and representativeness across selected adaptation documents [32]. Where text was truncated, three full stops were used (...); however, truncation of the results did not change the meaning of the results. The proportion of data related to the category 'maternal and child health adaptation', as referenced in the individual adaptation documents, was computed using NVivo software. In this calculation, the denominator comprised the total volume of data extracted from the individual documents as described above, while the numerator included data coded under the specific category of maternal and child health adaptation.

3. Results

The health sector was identified as a high priority sector vulnerable to climate change in all NAP/HNAP documents ($N = 5$) analyzed (table 1). Only four documents prioritized maternal and child health issues [33–36], and just three outlined a broader gender-based approach that could mitigate some of the threats to maternal and child health posed by climate change [33, 35, 36].

Five broader categories were constructed from the content analysis of the extracted data: (1) health-related climate impact drivers and strategic interventions; (2) empowering society and health systems for a climate-ready future; (3) enhancing climate and health literacy through effective risk communication; (4) policy governance and guidelines for health adaptations; and (5) intersection of gender, child health and climate change, as shown in figure 1.

3.1. Health-related climate impact drivers and strategic interventions

The primary health risks identified in the documents include changes in the frequency and distribution of vector-borne diseases, food- and waterborne diseases, respiratory diseases, mental health issues, disaster threats, injuries and deaths, food insecurity and malnutrition, non-communicable diseases, health impacts of extreme heat, disruptions in health services, deterioration of water sanitation and hygiene (WASH), and air pollution. The following data extracted from the documents exemplify the coverage of health threats posed by climate change.

Vector-borne diseases, particularly malaria and dengue remain a significant health risk in Cambodia (p iii). Increase in the burden of water-borne and water related diseases are important threats posed by climate change (HNAP Cambodia, p 1).

Increased risk of vector-borne diseases (e.g. Dengue, malaria). Risk of new areas becoming susceptible to vector-borne and pathogenic diseases. Increased risk of new vector-borne disease outbreaks. Increased risk of food- and water-borne disease outbreaks (NAP Sri Lanka, p 129).

The impacts of climate change on social infrastructure include disruption to and lack of access to health and education services. These social impacts tend to be higher for children, women, the elderly, expectant mothers, people with chronic health problems, and disadvantaged population groups (NAP Nepal, p 25).

Increasing temperature will increase heat-related illness and mortality, and could lead to the spread of vector-borne diseases.(...) Increased disaster frequency and intensity has a range of implications for health (NAP Timor-Leste, p 7).

In general, the four NAP documents outlined specific adaptation objectives and programmatic adaptation actions in their sector-wide approach dedicated to health development. The Cambodian HNAP places distinct emphasis on diverse health adaptation strategies, which include improving governance to address climate change impacts in the health sector, building institutional capacity and skills for effective planning and implementation of adaptation measures, strengthening surveillance systems, and developing a robust financing mechanism dedicated to climate change adaptation within the health sector. The following extracts contextualize the strategic health adaptation interventions represented in the reviewed documents.

It presents a list of actions that were assigned the highest priority by stakeholders from respective sectors (health) and the priority actions identified for overcoming the health adaptation needs (NAP Sri Lanka, p 48).

Establish a surveillance programme for detection and monitoring of climate induced diseases. (...) Conduct research studies on impact of climate change

Table 1. Summary of the coverage of maternal and child health adaptation in HNAPs/NAPs from Cambodia, Nepal, Sri Lanka, and Timor-Leste.

| Countries | Documents | Date of submission to UNFCCC | Health identified as vulnerable sector | Maternal and child health identified as a priority sector | Inclusion of maternal and child health adaptation strategies | Proportion of the data that discuss maternal and child health adaptation (%) |
|-----------------------|------------------------------------------------------------------|------------------------------|----------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------|
| Cambodia ^a | Cambodia climate change strategic plan 2014–2023 | 7 July 2021 | Yes | Yes | No | N/A |
| Cambodia ^a | National Climate Change Action Plan for Public Health 2019–2023 | 7 July 2021 | Yes | Yes | Yes | 5.49 |
| Nepal | National Adaptation Plan 2021–2050 | 30 October 2021 | Yes | Yes | Yes | 2.86 |
| Sri Lanka | National Adaptation Plan for Climate Change Impacts in Sri Lanka | 1 November 2016 | Yes | No | No | N/A |
| Timor-Leste | Timor-Leste's National Adaptation Plan | 31 March 2021 | Yes | Yes | Yes | 1.13 |

^a NAP and HNAP of Cambodia were treated as two separate documents.

prevalence and spread of vector-borne and pathogenic diseases. (...) Develop research institutes' capacity conducting research on health impacts of climate change. (...) Strengthen the mechanisms for sharing information between disaster management and health management agencies (NAP Sri Lanka, p 49).

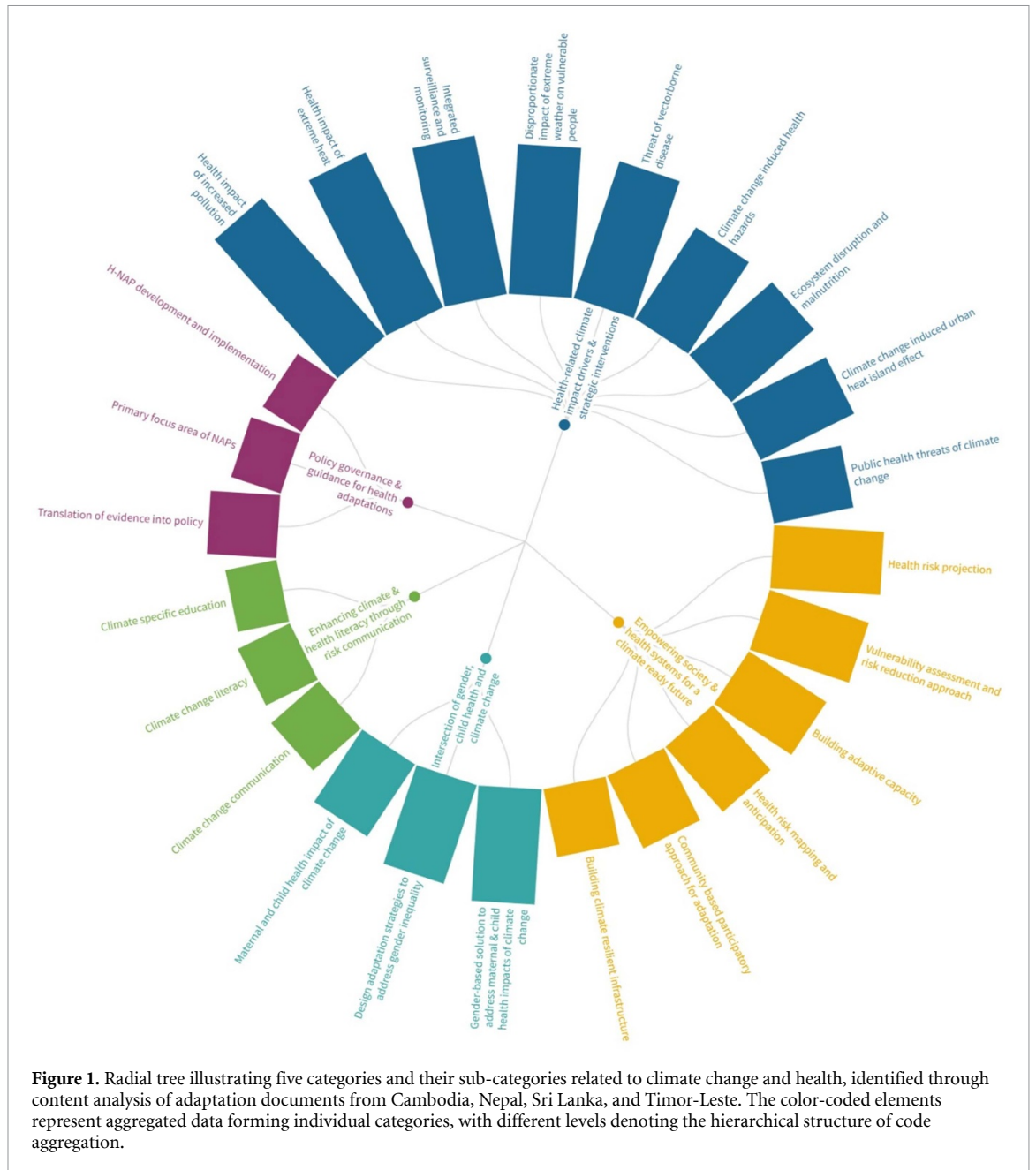
Specific programs in health sectors include: capacity building of health and hygiene service providers on climate resilient health and hygiene service planning and implementation, implement climate resilient wash interventions, ensure climate resilient water supply, support climate resilient WASH programs, strengthening of climate sensitive disease surveillance system with emergency preparedness and response, integrate climate

change and health in academic curriculum, strengthen diagnostic capacity of laboratories, improve urban settlements by ensuring open spaces (NAP Nepal, p 32&33).

Improving healthcare coverage with adequate medical staffing, stock of medicines and treatment guidelines in climate health sensitive areas, especially at the sub-national levels. 5.2 Promoting climate and disaster proofing of healthcare infrastructure and facilities at national and sub-national levels (HNAP Cambodia, p 14).

The following extract from Timor-Leste exemplifies our analysis approach to latent concepts and their indirect contribution to the achievement of health adaptation goals.

Timor-Leste has developed a roadmap for the implementation of the 2030 Agenda and the Sustainable



Development Goals (GoDRTL ND). To guide the country’s efforts to meet the SDGs, a Working Group was established in 2015 to identify ways in which the SDGs and the 2030 agenda could be harmonized with the SDP 2011–2030. This working group identified synergies and entry points and concluded that the SDP is largely aligned with the SDG 13: Climate Action. As the NAP process progresses, its steering mechanism will ensure proper coordination with the country’s efforts to implement the SDGs (NAP Timor-Leste, p 36).

3.2. Empowering society and health system for a climate-ready future

All documents emphasize empowering society and health systems for a climate-ready future by anticipating future health threats from climate change, developing the capacity of the health workforce, initiating community-based participatory approaches for designing and implementing locally identified interventions, establishing evacuation centers, and implementing programs to improve disaster preparedness. The majority of these adaptation strategies align with the components of the WHO Operational Framework for Building Climate Resilient Health Systems [37]. All NAPs prioritize periodic vulnerability and adaptation assessments

to create a climate-ready future. The HNAP of Cambodia and the NAPs of Timor Leste and Nepal propose action plans to develop climate-resilient health infrastructures. The following extracts exemplify the approaches proposed to empower society and health systems.

Strengthen the capacity for collection, analysis, modeling and interpretation of climate data and information dissemination to various end-users, including seasonal forecasting for adaptation and community early-warning facilities for disaster risk management (NAP Cambodia, p 17).

Enhance the capacity of the health sector and communities to anticipate and respond to changes in distribution of endemic and epidemic climate-sensitive diseases, and reduce the vulnerability to infection of population in areas at risk from expansion of climate-related diseases. Create awareness among the health service providers at all levels on the different types of health risks associated with different types of climate risks and the different coping and adaptation measures so that these coping strategies could be communicated to the vulnerable populations (NAP Timor-Leste, p 75 and 76).

Specific program in health sector for capacity building of health and hygiene service providers on climate resilient health and hygiene service planning and implementation, empower and inform health care providers about climate change impacts, develop climate resilient infrastructure (NAP Nepal, p 32 and 33).

3.3. Enhancing literacy about the health impacts of climate change

Effective risk communication regarding the health implications of climate change was prioritized as a crucial adaptation strategy in all documents to improve literacy among the public and health professionals. These documents emphasized the importance of implementing awareness initiatives at institutional and community levels to foster sustainable practices and nurture a climate-resilient society. Notably, the NAP from Cambodia and Nepal strongly advocate for integrating climate change curricula at all levels of education as a strategy to improve knowledge, capacity, and awareness among the younger generation, who are expected to bear the largest burden of climate-sensitive health risks in the future. Below are some examples of adaptation

strategies from Cambodia, Sri Lanka and Timor-Leste that focus on enhancing climate change and health literacy.

Facilitate public access to information on climate change through radio, television, newspapers, mobile and web technologies, and targeted outreach materials for key audiences such as most-vulnerable groups, women, children, youths and minorities (...). Incorporate climate change into school curricula for all levels of education and develop programs for climate related disaster management and recovery (NAP Cambodia, p 17).

Increase the knowledge and awareness on health impacts of extreme events among healthcare workers (e.g. MOH, PHI) (NAP Sri Lanka, p 69).

Create awareness among the health service providers at all levels on the different types of health risks associated with different types of climate risks and the different coping and adaptation measures so that these coping strategies could be communicated to the vulnerable populations (NAP Timor-Leste, p 75).

3.4. Policy governance and guidelines for health adaptations

The analysed documents strongly advocated for the development and review of guidelines for managing climate-induced health risks. Each document emphasizes the importance of establishing effective communication and coordination mechanisms across line ministries and divisions at the national level. These efforts aim to establish shared consensus among stakeholders and decision-makers on adaptation needs and promote the adoption of a comprehensive and inclusive interdisciplinary approach to designing adaptation action plans within priority sectors, including the health sector. The adaptation action plans prioritized under this category can be mapped to the leadership and government component of the WHO Operational Framework [37]. This is reflected in the following excerpts from the NAPs of Sri Lanka, Timor-Leste and Nepal.

Develop guidelines for management of climate induced disease incidents. Improve the coordination between disaster management and health management agencies. Develop disaster risk preparedness guidelines for health workers in vulnerable settings (NAP Sri Lanka, p 69).

Review all existing guidelines and Standard Operating Procedures (SOPs) considering climate change and its adverse effects. Support preparation of —Health Risk and Preparedness Map— in relation to different climate risks, magnitude of existing and potential health risks due to each type of climate risk and existing and planned public health service delivery capacity at the national, sub-national and local levels (NAP Timor-Leste, p 74).

Responsiveness through identifying action to reduce climate change policy coherence through national priorities, actions, plans, & development goals. International commitments through UN conventions. Integration of climate change adaptation in the planning, budgeting, & implementation of action in each governmental level (NAP Nepal, p 15).

3.5. Intersection of gender, child health and climate change

Four analysed documents (3 NAPs: Cambodia, Nepal and Timor-Leste and HNAP: Cambodia) considered gender components and acknowledged the maternal and child health risks associated with climate change. Meanwhile, the Sri Lankan NAP does not explicitly mention the terms ‘gender’, ‘female’, or ‘women’ in the main text. The only section mentioning these is the prologue, in which an authority from the Ministry of Mahaweli Development and Environment states that ‘the document is a country-driven, gender-sensitive and a fully transparent approach to deal with climate change in Sri Lanka (p 5)’ [38].

The documents of the other countries identified various maternal and child health risks associated with climate change. The Cambodian NAP effectively integrated a gender component to leverage the potential of women in designing adaptation strategies, acknowledging gender dynamics and the possible disproportionate impacts of climate change on women. However, it falls short in addressing specific adaptation strategies aimed at protecting maternal and child health. Similarly, HNAP for Cambodia and NAPs for Nepal, and Timor-Leste allocated a substantial proportion (5.49%, 2.86% and 1.13% of the coded text, respectively, see table 1) of their content to propose adaptation strategies aimed at safeguarding maternal and child health. Detailed discussions of sub-categories under this category are provided below.

- i. **Maternal and child health impacts of climate change:** analyzed documents from all three countries, except Sri Lanka, identify women

and children as vulnerable groups to the health impacts of climate change. Their susceptibility to food and waterborne diseases, vector-borne diseases, food insecurity, and other chronic health conditions in the context of a changing climate is highlighted across all four documents. The NAP of Timor-Leste specifically references poor infrastructure, inaccessibility to healthcare services, and cultural norms as additional factors exacerbating the vulnerability of women and children living in rural areas.

- ii. **Design adaptation strategies to address gender inequality:** all four documents referenced in this category prioritize the development of adaptation strategies that address gender issues. Mainstreaming gender considerations in climate change responses and minimizing gender-based violence are critical priorities for Cambodia, Nepal, and Timor-Leste. These documents emphasize establishing focal points to facilitate coordination between health departments and community-based institutions dedicated to the welfare of women and children.
- iii. **Gender-based solution to address the maternal and child health impacts of climate change:** while these documents did not explicitly outline adaptation strategies specifically targeting maternal and child health, they included broader gender-based approaches that could mitigate some of the maternal and child health threats posed by climate change. The proposed strategic objectives and corresponding key activities for safeguarding maternal and child health from the impacts of climate change are outlined in table 2.

4. Discussion

Our findings demonstrated that out of the five examined documents (4 NAPs and 1 HNAP), four identified maternal and child health risks associated with climate change. While direct references to adaptation strategies targeting maternal and child health were absent in all documents, adaptation strategies from three documents (NAPs of Nepal and Timor-Leste and HNAP of Cambodia) could contribute to safeguarding maternal and child health in a changing climate. In these countries, women’s position in the family and society is dictated by patriarchal values and social norms, limiting their role in decision-making and access to economic assets [39, 40]. This gender dynamic exacerbates women’s vulnerability, particularly of pregnant women. As such, the UNFCCC’s technical guidelines for the NAP process mandate the integration of a gender perspective [41].

The inclusion of gender perspectives in climate change adaptation policies is a crucial step. It represents a positive example of how climate change and

Table 2. Proposed action plans for addressing maternal and child health impacts of climate change.

| Strategic Objectives | Adaptation action plan (key activities) | Document source |
|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| To support increased evidence generation on maternal and child health impacts of climate change. | <ul style="list-style-type: none"> • Include gender components in national demographic and health surveys or vulnerability risk assessments to ensure that issues related to women's health are identified, especially elderly women and pregnant women. • Conduct focus group discussions with women's groups separately for any assessment of their health, with the assistance of female facilitators. | HNAP Cambodia, p 8 |
| | <ul style="list-style-type: none"> • Increase research on the health risks of climate change on gender. | NAP Nepal, p 37 |
| | <ul style="list-style-type: none"> • Improve research capacity to examine the linkage between gender, climate/weather-related phenomena, and disease incidence. | NAP Timor-Leste, p 43 |
| To promote governance, coordination and partnership for protecting maternal and child health from the impacts of climate change. | <ul style="list-style-type: none"> • Design gender sensitive climate change adaptation action plans focusing on health and capacity building against domestic violence within the MoH Gender Working Group, Public Health Department Gender Focal Points and Gender Focal points of Health Centre. • Educate the community about gender-based climate change adaptation approach within the health sector and strategies for protection against domestic violence with support from the Public Health Department as well as the MoH. • Establish coordination between health centers and commune women and children focal points to integrate gender components into climate change adaptation strategies, particularly focusing on target diseases including malaria, dengue, diarrhea. | HNAP Cambodia, p 8 & 9 |
| | <ul style="list-style-type: none"> • Minimize gender-based violence and violence against children by providing immediate service and referrals during climate emergencies. | NAP Nepal, p 37 |
| | <ul style="list-style-type: none"> • Design programs and adaptation actions that are participatory, transparent, gender and socially inclusive to address needs of women/girls, children, pregnant women and elderly people with disabilities. | |
| | <ul style="list-style-type: none"> • Socialize and disseminate gender-sensitive mechanisms within the community to enhance protection against extreme weather and climate events, so that communities understand how to provide immediate responses when extreme weather events occur. • Address the gendered impacts of climate change and their drivers through concrete actions at all levels of government. | NAP Timor-Leste, p 38. |
| | | |

maternal and child health issues are prioritized in adaptation policies. These findings corroborate similar analyses of other climate change policy documents from LMIC countries, in which four NAPs utilized a gender lens in their health adaptation actions [18, 42, 43]. A review of Nationally Determined Contribution (NDC) was conducted by the United

Population Fund (UNFPA) to assess the inclusion of gender and health, including sexual and reproductive health rights, within the national climate frameworks, plans, and strategies. Out of the 50 NDCs analyzed, six included references to sexual and reproductive health rights, with maternal health being the most common [43].

By embedding the ecofeminist approach within the environmental determinants of health framework [44], we identified aspects of women's health considered in the NAPs as a surrogate for maternal health issues. Adaptation strategies outlined in the NAPs of Cambodia, Nepal and Timor-Leste, such as enhancing biodiversity, water security, food security, and disaster risk management, integrated gender considerations to reduce women's vulnerabilities.

Although these NAPs did not link the gains of these action plans with enhancing maternal and child health outcomes, gender-responsive strategies in these sectors could create a dynamic and interconnected system to support maternal and child health [42, 45]. For example, in the Timor-Lester NAP (p. 29), gender-responsive water management strategies could alleviate women's burden—such as a daily walk of more than 30 min to fetch large volumes of water—and protect their health, particularly during pregnancy, during climate-related events. Consideration of gender-responsive strategies to address the broader determinants of health, such as nutritional insecurity, biodiversity, and ecosystem degradation, would facilitate the involvement of women in the decision-making process, allowing them to prioritize the needs of pregnant women and newborn children [45].

Likewise, employing an ecofeminist perspective in the latent analysis of the data identified acknowledgment of gender-based violence as a critical issue in the NAPs of Cambodia, Nepal and Timor-Leste, necessitating immediate action plans to safeguard women's health in the context of increases in the frequency and intensity of extreme weather and climate events. Indeed, gender-based violence, particularly violence against women, is a significant health problem with substantial repercussions for women's physical and mental health [46]. As mounting evidence indicates a strong association between ambient temperature and intimate partner violence among women in South Asian countries [47], addressing gender-based violence is a positive stride towards consideration of maternal and child health.

4.1. Future opportunities

There is a need to review the risks of climate change on access to and delivery of healthcare services for pregnant women and mothers with young children, particularly those from rural communities. While the analysed documents considered improving healthcare infrastructures to establish climate-resilient health systems, interventions aimed at improving health service delivery or workforce supply did not receive adequate attention. This oversight is significant because alternative approaches to ensuring essential health service delivery during extreme weather or climate-related disruptions

remain untapped. Therefore, it is essential for NAPs to prioritize the design and implementation of strategies that ensure a continuum of care, including antenatal and postnatal services, to improve maternal and child health [48]. Notably, the NAPs propose strategies and action plans for cross-cutting sectors relevant to maternal and child health protection. However, the proposed adaptation plans did not link across priority sectors.

Consequently, the sectoral strategy that addressed a determinant of health, for example, ensuring water security, may not be directly reflected as a strategy to address broader health outcomes, including maternal and child health. This issue is not unique to South Asian countries. The NAPs of other LMICs such as Brazil, Burkina Faso, Kenya, Kiribati, the State of Palestine, Sudan, and Suriname, do not directly address maternal and child health adaptation strategies [42, 43]. Instead, they include nonspecific references to these issues by considering sexual and reproductive health rights. For instance, Fiji's health sector NAP indirectly promotes maternal and child health resilience by advocating for women's access to sexual and reproductive health information and services [42]. Given that specific adaptation priorities are highly determined by vulnerability and adaptation assessments, these assessments in LMIC countries should include maternal and child health issues to develop and provide the evidence base for proposing relevant and effective adaptation interventions towards building climate resilience through proactive planning and implementation strategies [49, 50]. Furthermore, as the structure and form of NAP may vary by country, the future NAP development and updating processes should facilitate a strong representation of women and maternal and child health experts to advocate for timely and effective adaptation options.

4.2. Limitations

Our analysis included data from the NAPs of Cambodia, Nepal, Timor Leste, Sri Lanka and HNAP of Cambodia, which were submitted to the NAP repository of UNFCCC by the end of December 2023. Subsequently, the selected countries may be updating sector specific adaptation documents or other relevant policy documents, such as national climate policy. Manual extraction of data from the selected documents using keywords is susceptible to limitations such as incomplete information capture, especially when the data does not precisely align with the chosen keywords, and subjective interpretation of those keywords [51]. Finally, the convenience sampling approach and smaller sample size limit the generalizability of our results for the broader Asia-Pacific region.

5. Conclusion

Our findings underscore that maternal and child health is generally recognized as vulnerable to the impacts of climate change by stakeholders and authorities in Cambodia, Nepal, Timor Leste, and Sri Lanka. However, it is evident that the assessed NAPs and HNAP documents need to address specific adaptation strategies to protect maternal and child health from the impacts of climate change. To enhance the future development and updating of NAPs, it is essential to generate an evidence base on the impacts of climate change on maternal and child health from under-represented countries. Furthermore, it is essential to involve a more comprehensive and diverse representation of women and maternal and child health experts from various cultural and geographic backgrounds. This inclusive approach will effectively prioritize reducing maternal and child health risks of climate change and help to center stage the protection of maternal and child health within the climate change policy discourse.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

Conflict of interest

Z L T is a member of the Climate and Health Alliance, Alliance of Nurses for Healthy Environments, World Health Organisation Global Community of Practice for Nursing and Midwifery specific to Climate Change, and Climate Reality Leadership Corps.

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