Climate Change and Health

Review of Evidence for the Indo-Pacific Region

Supported by
The Foreign, Commonwealth & Development Office, New Delhi

UK International Development
Partnership | Progress | Prosperity

Submitted by
The Energy and Resources Institute (TERI), New Delhi

The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

Partners in Asia-Pacific Region

adpc

Bangladesh Centre for Advanced Studies (BCAS)

B.P. Eye Foundation
Towards an Inclusive Society

This report constitutes an output of a study supported by South and Southeast Asia Research and Innovation Hub, Foreign, Commonwealth and Development Office, Government of UK. However, the views expressed herein may not necessarily reflect the official policies of the Government of UK.

Suggested format for citation

T E R I. 2024
Climate Change and Health: Review of Evidence for the Indo-Pacific Region
New Delhi: The Energy and Resources Institute. 112 pp.
[Project Report No.2022GW15]

For more information

Ms Suruchi Bhadwal, Senior Fellow & Programme Director,
suruchib@teri.res.in

T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org
India +91 • Delhi (0)11

Main Contributors

The Energy and Resources Institute (TERI)
Ms Suruchi Bhadwal, Senior Fellow & Director, TERI
Dr Richa Sharma, Fellow, TERI
Ms Sakshi Bajpai, Research Associate, TERI
Ms Shivani Agrawal, Project Associate, TERI
Ms Smita Chakravarty, Associate Fellow, TERI
Ms Sisira P, Project Associate, TERI

Associate Contributors *(Partners in Asia-Pacific region)*

Asia Disaster Preparedness Centre (ADPC)
Mr Aslam Perwaiz, Deputy Executive Director, ADPC
Dr Niladri Gupta, Senior Water Resources Management Specialist, ADPC
Mr Nassim Abiza, Consultant, ADPC

Bangladesh Centre for Advance Studies (BCAS)
Dr Atiq Rahman, Executive Director, BCAS
Dr Dwijen L Mallick, Director/Fellow, BCAS
Ms Jebunnahar Ahmed, Senior Programme Manager, BCAS
Ms Soburunnessa Chowdhury, Senior Research Officer, BCAS

B.P. Eye Foundation (BPEF)
Prof Dr Madan Prasad Upadhyay, Chair Emeritus, BPEF
Dr Madhav Karki, Expert Member, Env. Protection & Climate Change Management National Council, Govt. of Nepal
Dr Manita Pyakurel, Senior Academic and Research Officer, BPEF

Funding Partners

Foreign, Commonwealth and Development Office (FCDO)
Dr Jaya Singh Verma, Senior Policy and Programme Manager, Indo Pacific Regional Department, FCDO
Mr Anirban Ganguly, Research Specialist, South Asia Research Hub, FCDO

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ADB: Asian Development Bank
CoE: Centre of Excellence
CHC: Community Health Centre
EWS: Economically Weaker Sections
GHSI: Global Health Security Index
HAP: Health Adaptation Plan
HDI: Human Development Index
ICMR: Indian Council of Medical Research
IEC: Information, Education and Communication
IMD: India Meteorological Department
IPCC: Intergovernmental Panel on Climate Change
LDC: Least Developed Country
LMIC: Lower Middle Income Country
MoEFCC: Ministry of Environment, Forest and Climate Change
MoHFW: Ministry of Health and Family Welfare
NAP: National Adaptation Plan
NAPA: National Adaptation Programmes of Action
NAPHS: National Action Plan for Health Security
NAPCCHH: National Action Plan on Climate Change and Human Health
NPCCHH: National Programme on Climate Change and Human Health
NCDC: National Centre for Disease Control
NDC: Nationally Determined Contribution
NDMA: National Disaster Management Authority
ODA: Official Development Assistance
PHC: Primary Health Centre
PTSD: Post-Traumatic Stress Disorder
SDG: Sustainable Development Goal
SIDS: Small Island Developing States
UMIC: Upper Middle Income Country
UNICEF: United Nations International Children's Emergency Fund
V&A: Vulnerability and Adaptation
VBD: Vector Borne Disease
WBD: Water Borne Disease
WHO: World Health Organization
WMO: World Meteorological Organization
WRI: World Risk Index

1. Introduction

1.1 Background

Climate change is a major global threat that severely impacts not only the environment, but also human health, national security, stability thereby impeding progress. Detrimental impacts of climate change on health have been increasing globally over time. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, released in 2022,[1] highlights several major concerns related to climate change and human health. Some of the key concerns raised in the report include impacts of climate on health on vulnerable populations such as children, the elderly, and communities in low- and middle-income countries.

Evidence shows that rising temperatures have been found to result in heat-related illnesses[2] and worsening air quality can exacerbate respiratory and cardiovascular diseases.[3] Similarly, changes in precipitation patterns often contaminate water sources and along with rising temperatures, enhance the risk of water-borne diseases causing shifts in the distribution of disease-carrying vectors, resulting in increased occurrences of these diseases, for instance, malaria and dengue.[4,5,6,7] Changes in temperature and precipitation patterns have also been found to have a negative impact on agriculture and food production, resulting in food shortages and starvation, thereby leading to food and nutritional insecurity.[8] Recent studies have documented instances of mental health with climate change.[9] Furthermore, studies are being conducted to establish linkages between migration and displacement caused by extreme weather events and other environmental disasters and the increased risk of disease outbreaks (communicable and non-communicable).[10,11,12]

The above scientific understanding and the large evidence base shows that climate change impacts human health both directly and indirectly thereby adding an additional strain on existing health systems, in many cases in developing countries which may already lack the resources or capacity to respond effectively.[13]

Thus, in order to ensure that our health systems are equipped to shoulder the increasing disease burden, it is critical to understand the climate health linkages, pathways of growth and gaps in current research on climate and health. Also, response measures and its adequacy may help understand how well countries may respond to the challenges of this growing concern on human health impacts. The aim of this report is to discuss the impacts of climate change on human health and its responses in the Indo-Pacific region. The impacts of climate change on human health as well as the various pathways that determine linkages between the two are presented in Section 3. The section highlights direct and indirect impacts and vulnerability routed through various conditions being created that contribute to the mortality and morbidity. A discussion on differential vulnerability and the underlying drivers of vulnerability in the study region is also presented in this section. Section 4 delves into the current structures of the public health systems in the selected countries, providing in-depth information about their mechanisms for responding to climate adaptation. It also outlines the potential benefits and co-benefits associated with these response mechanisms.

1.2 Research Questions

Given the above concerns, key research questions are as follows:

1. What is the current understanding and advancement in science discussing various pathways that indicate the linkages between climate change and health?
2. What are the key adaptation and mitigation actions/priorities in the study region as outlined in the Nationally Determined Contributions (NDCs), Long Term Strategy (LTS), and National Adaptation Plans (NAPs)?
3. What are the main drivers of differential vulnerability identifying marginalized populations affected by climate change impacts on health and how do they interact with each other?
4. What are the abilities of existing health systems in responding to climate-induced health impacts?
5. Are there approaches by way of plans, policies, practices, pilots that serve as good practice for scaling up?
6. What recommendations can be provided to improve on health systems response to climate-induced risks in the selected countries?

1.3 Objectives of the Study

Based on the above, the study seeks to focus on the following broad objectives:

1. Conduct a desk-based review of evidence on impacts of climate change on health in order to establish linkages and conceptual pathways between climate change and human health in the Indo-Pacific region.
2. Review of literature to identify adaptation and mitigation actions that address health impacts through direct or indirect interventions including mapping of actions that lead to tangible health outcomes.
3. Assessing the degree of disproportionate impacts on vulnerable groups in the selected countries and identifying the underlying drivers of differential vulnerability based on biophysical, socioeconomic, governance characteristics.
4. Understand the existing public health systems in selected countries and their abilities to include response to climate-induced health risks (strategies, interventions and delivery models) including targeting the poor and the vulnerable.
5. Highlight the approaches—plans, policy, practices, and pilots from the selected countries that can serve as good practices to be considered for scaling up.
6. Outline the potential recommendations to enhance the resilience of health systems to climate risks based on policy priorities aligning with different multilateral, national processes where these linkages can be established.

2. Methodology

Encompassing an extensive stretch from the Indian Ocean to the western shores of the Pacific Ocean, the Indo-Pacific region includes remarkable cultural, economic, and geopolitical diversity, with around 40 countries within its bounds (Figure 1). This expansive area features economic powerhouses such as China, Japan, and South Korea, alongside emerging economies spanning Southeast Asia and the Pacific Islands.[14]

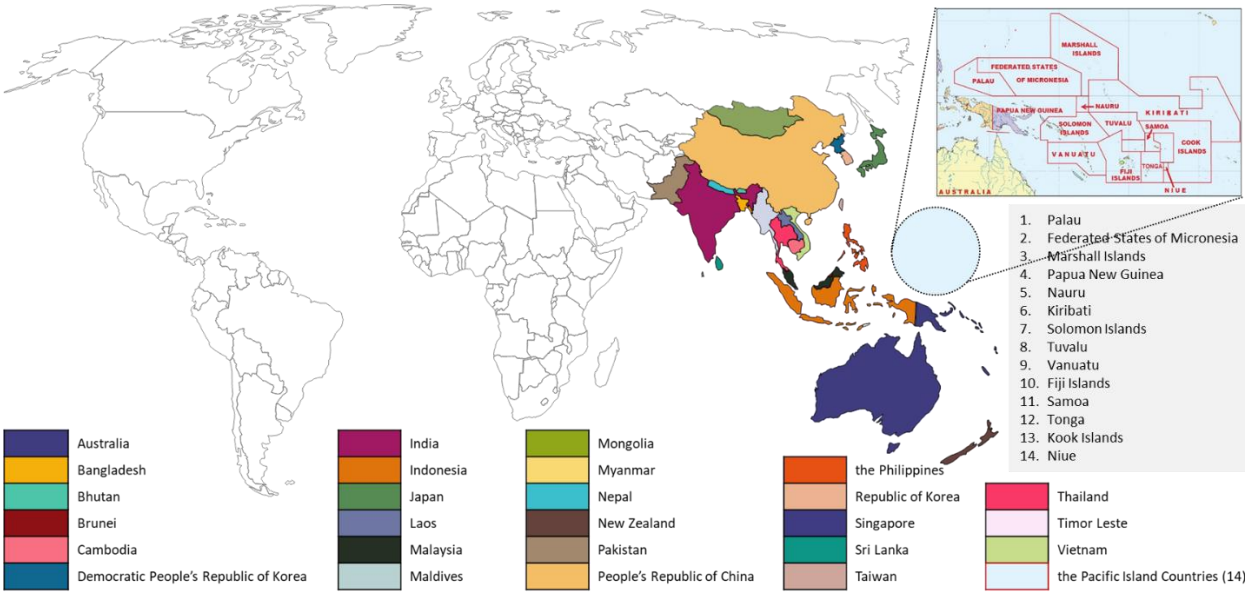

Figure 1 Countries in the Indo-Pacific Region
Source: Compiled by authors

Amidst the rapid economic growth and urbanization, the region confronts the urgent challenge of climate change. From coastal areas grappling with sea-level rise to countries contending with extreme weather events and vector-borne diseases, this region presents a rich tapestry of climate challenges that can profoundly impact the health and well-being of its diverse populations. The objective of this study is to gather evidence on the health impacts of climate change in the Indo-Pacific region by conducting in-depth analyses and case studies for eleven specific countries. The aim is to enhance the understanding of the current state of research and knowledge concerning the interlinkages of climate change and health risks in the region. Furthermore, the study also seeks to assess the preparedness of the healthcare systems to effectively address the challenges posed by these risks.

The study encompasses a thorough initial review of existing literature and consultations with the FCDO team to ensure alignment between the study's objectives and FCDO's strategic priorities. These consultations guide decisions regarding the selection of the countries to be studied, the research methodology, and the overall direction of the study. Besides, other experts and consultants were identified for consultations to further strengthen the various outputs. Subsequently, the study proceeds by selecting specific countries within its scope. This is followed by a comprehensive narrative literature review conducted within the selected countries to analyse

the available evidence on the impacts of climate change on health. This process also involves identification of adaptation health response and understanding differential vulnerability across population to these impacts.

Additionally, a comprehensive review of public health systems in the selected countries is undertaken to assess their readiness to confront climate change-related health challenges. Institutions were identified to partner and lead the work in the identified countries to develop the country reports. The partners further conducted extensive consultations with local institutions/organizations working on climate change and health related issues in the selected countries.

The proposed methodology is described in Figure 2.

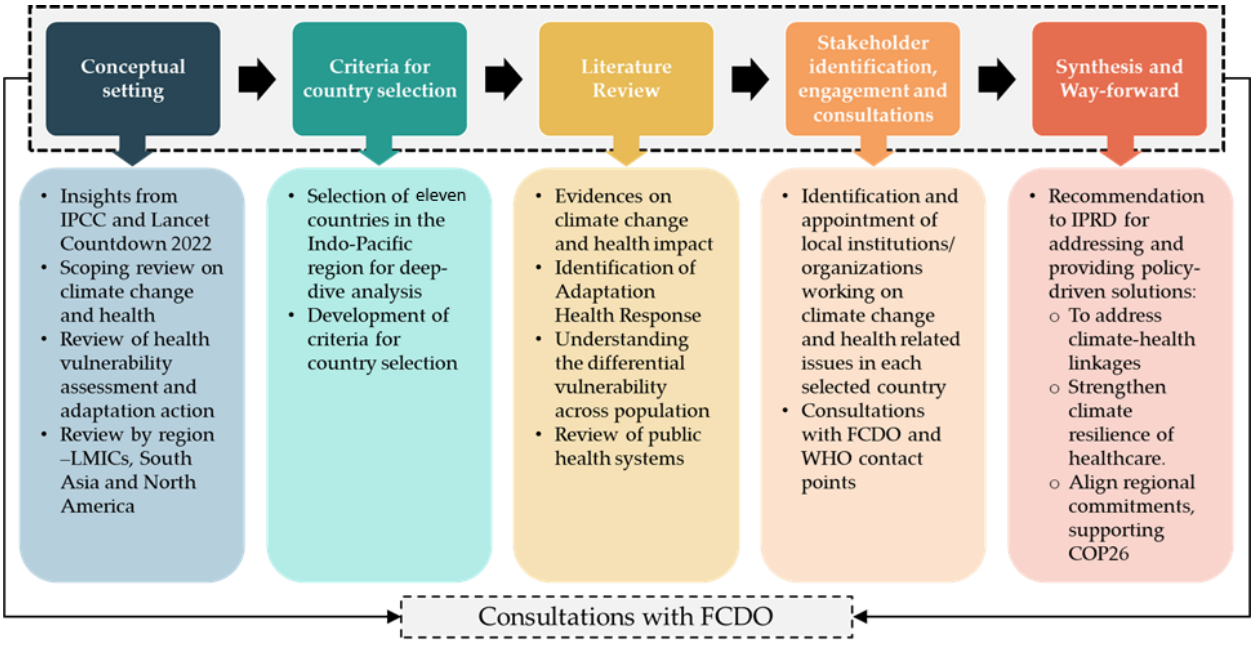

Figure 2 Methodology for the study

2.1 Research Approach

A detailed literature review of studies on climate change and human health linkages focussing on the Indo-Pacific region have been highlighted in this section. Relevant literature from different sources including journals, IPCC, World Health Organization (WHO), World Bank, Asian Development Bank (ADB) reports and websites, etc., have been reviewed which provides insights on the evidence gaps on impacts and vulnerability in the Indo-Pacific region**.** IPCC Assessment Reports and the sections discussing aspects of climate impacts on health and well-being, health vulnerability as well as the region-wise chapters for Asia, Australasia and Small Islands served as the foundation for the review. Additionally, reports by the WHO addressing the health risks of climate change were also thoroughly assessed. The objective is to identify key human health issues linked to climate change within the region, as well as to highlight any disparities in recognizing these linkages among different countries and regions. The study aims to capture

information using a 3-tier screening process, by scoping literature at the global scale, at regional scales and at the national level for the selected countries.

While understanding the climate health linkages the region is the focus in this report. Literature on adaptation and mitigation actions that address health impacts through direct or indirect interventions has been compiled and reviewed. The study also includes a review on the broad understanding of the existing public health systems in the selected countries highlighted in section 2.1 and their abilities to include response to climate-induced health risks. The literature review involved four broad steps:

a) Research scope and inclusion criteria

In the initial step of this literature review, the research scope and inclusion criteria were established. As mentioned above, both published and grey literatures have been synthesized. Key words used for the search broadly includes 'climate change', 'human health', 'impacts', 'vulnerability' and 'geographical location'. Studies published after the year 2010 were considered. Exclusion criteria were applied to exclude document types such as commentaries, letters to editors, opinions, errata, and viewpoints. Additionally, articles that discuss climate in terms of non-climate hazards resulting from geological events, such as earthquakes, or non-anthropogenic climate change, such as volcanic eruptions, have been excluded. Non-peer reviewed journals such as country profiles and reports published by international organizations such as the Asian Development Bank, World Bank, WHO, One Health, UNICEF, etc., have also been included in the study.

b) Literature search and retrieval

The academic databases—Scopus, PubMed and Google Scholar—were used for search and retrieval of potential studies for the *Interim Study*. Scopus is Elsevier's abstract and citation database that provides access to millions of scholarly abstracts and citations, along with analytical tools. PubMed comprises millions of citations for biomedical literature from MEDLINE and life science journals. An initial search in the databases with the keywords resulted in reflecting the number of papers that showed up as we were searching. Owing to a large number of papers available at the global scale, relevant papers were selected and referred to compile the information.

c) Screening and article selection

Upon conducting the initial search using the specified keywords, a considerable number of papers were identified. To ensure the quality and relevance of the review, a screening process was carried out. Articles were assessed based on their intersection with both climate change and human health, across three scales: global, regional, and for selected countries. The term "global" is defined for all countries in the world, while "regional" pertains to the countries in the Indo-Pacific region, and "selected countries" includes the 11 countries which are selected for the study, i.e., Bangladesh, Fiji, India, Indonesia, the Philippines, Thailand, Vietnam, Malaysia, Cambodia, Nepal and Tuvalu. The definition of "health" is comprehensive, covering various aspects of physical, mental, and social well-being. However, articles that examine climate change impact on other species, such as plants, animals, and fish are excluded. Only articles published in English

were included. The approach adopted ensured that most relevant papers are considered thereby enhancing quality and accuracy of the findings.

c) Compilation and synthesis

In the final step, information from the selected articles was compiled and synthesized. This involved reviewing and analysing the content of the selected studies by evaluating each article's title and abstract to assess its relevance. Following this initial screening, a more detailed assessment was conducted by analysing the abstracts and skim reading the main body of the selected literature. Relevant pieces of literature were then selected for the study based on criteria such as relevance, methodology used, and their findings.

2.2. Conceptual Setting

The initial step of the study involves establishing a conceptual setting for a comprehensive exploration of the interlinkages between climate change and health. This foundational stage encompasses a thorough search for existing research, utilizing relevant keywords across relevant databases and sources. This step helps in identifying key themes, methodologies, and research gaps in the literature and includes the following studies:

2.2.1 Climate change and health review from the literature

The impacts of climate change and environmental degradation on human health are becoming increasingly evident worldwide. IPCC AR5,[15] has categorized these health impacts into three main groups: direct impacts of climate and weather, ecosystem-mediated impacts, and impacts heavily influenced by human institutions.

- **Direct impacts of climate and weather on health:** includes impacts of floods and storms, which lead to mortality as well as health issues such as drowning, injuries, and infectious diseases (e.g., diarrhoeal disease, leptospirosis, vector-borne disease, and cholera).
- **Ecosystem-mediated impacts on health outcomes:** This includes vector-borne and other infectious diseases, food- and water-borne infections and air quality-related impacts.
- **Health impacts mediated through human institutions:** Climate change affects health through various human institutions, impacting nutrition, occupational health, and mental health. Climate-induced disruptions to livelihoods can result in stress, anxiety, and other psychological issues, while prolonged droughts can lead to an increase in suicidal tendencies.

In continuation with the findings discussed in the AR5, the latest IPCC AR6[16] emphasizes the increasing trend in climate-sensitive diseases, premature deaths, malnutrition, and adverse impacts on mental health and well-being. The report also highlights the importance of globally recognized health impact assessments, like the Global Burden of Disease study,[17] which provides scenario-based projections[18] and establishes linkages with other global priorities, including the SDGs.[19]

Lancet Report 2022,[20] acknowledges an increase in the number of detection and attribution studies being undertaken to underline the influence of climate change on weather-related

morbidity and mortality. It adds that findings of these studies are also being applied in public health to enable informed decision making. However, these studies often focus on countries with higher Human Development Index (HDI), leaving vulnerable countries understudied. Mental health impacts are recognized, with rising temperatures and disruptions to livelihoods contributing to stress, anxiety, and other psychological issues. Vulnerable populations like the elderly, women, indigenous people, and minorities are at higher risk.

Report published by World Health Organization (WHO)[21] in 2021 indicates the gaps in research and implementation that exist and need particular attention (Table 2).

Table 1 Evidence gap on climate change and human health

Health vulnerability to climate change	**Less understood impacts of extreme weather events on health, mental health implications, and well-being. Food and nutrition impacts on maternal and child health** **The impact of deteriorating air quality on respiratory and cardiological illnesses**
Health protection strategies	Lack of related literature for better planning and implementation A large share of the articles discussed the strategies in the high-income countries with limited studies from highly vulnerable regions such as Africa, South East Asia, the Pacific Islands, Central America, and the Caribbean regions. Cost-effectiveness of these actions is still to be well understood. Gaps in interventions in less understood areas including emergency response (disaster resilience and response), mental health, infectious disease outbreaks, etc., and other co-benefits
Health impacts of potential adaptation and mitigation measures	Limited research in mapping the health co-benefits of adaptation and mitigation measures though recent evidence shows an increasing body of literature emerging in this area
Decision-support and other tools	These are emerging areas of work to be supported by adequate research that can back the development of these tools
Likely financial costs and other resources	Gaps include: ▪ Financial implications of investing in preventive measures ▪ Mainstreaming elements of health and well-being into climate economics and economic evaluations ▪ Estimating the cost of inaction of financial and physical implications of mitigation and adaptation strategies

Source: Compiled by authors

Besides, a review across different regions and population highlighted the vulnerable categories where limited information and data provides scope to further enhance research and implementation (**Error! Reference source not found.**).

Table 2 Evidence gaps by vulnerable regions/population

Small Island Developing States (SIDS)	**There are studies which indicate health risks in SIDS. Most of these studies explored climate change-related health impacts of infectious diseases and few studies examined related dietary changes, impacts on mental health, air pollution, and heat-related illnesses. Quantitative research techniques such as health impact assessment and disease modelling have been used. However, there is limited information on health protection strategies and financial costs.**
Indigenous and aboriginal populations	Of the studies reviewed, a very small number assessed the impacts of climate change on the health of indigenous and aboriginal communities. Majority of this research was concentrated in the developed countries of Canada, Australia and the United States with scarce literature from low- and middle-income countries. Additionally, bulk of this research focuses on infectious diseases, issues of food security, mental health, and extreme temperatures. Lastly, the section on indigenous and aboriginal populations underscores the need to improve data availability, enhance analysis of adaptation options and strengthen vulnerability assessment tools to arrive at a comprehensive picture of the challenges faced by indigenous groups worldwide.
Migration and displacement	Research on the health impacts of climate induced displacement and migration was found to be extremely scarce. Interestingly, most of these studies discussed findings on the topic from low- and middle-income countries. Most studies focussed on reporting and documenting the effects on health but with limited information on the strategies to respond to the risks. There was a lack of research studies for the countries of America and Pacific region.
Farmers	Studies reporting on farmers' health mostly focussed on food security, mental health as well as exposure to temperature extremes. Other aspects of health that were assessed include indoor air pollution and infectious diseases. Most of the literature is of a qualitative nature than quantitative.
Age-disaggregated data, focusing on the elderly and children.	An equal but small number of studies related to climate and health were on ageing population and children respectively. The most prominent health hazard explored by these studies were temperature-related health risks, infectious diseases, such as diarrhoea, and maternal and child health concerns. In terms of regional coverage, majority of these studies were based in Asia and Africa and focussed on health vulnerability followed by qualitative research studies to understand perceptions regarding implications for maternal and child health.
Availability of gender-disaggregated data	The review concurs earlier studies regarding the scarcity of gender-specific data on how climate change affects health. A small portion of research reviewed considered gender-specific health outcomes related to climate change. Predominantly, the studies accounted for health impacts of temperature extremes with a focus on heat-related illnesses.

	Other impacts examined through a gender-specific lens included those on implications of extreme weather events, mental health, food security and nutrition, air pollution, infectious diseases, and NCDs.

Source: Compiled by authors

In addition, systematic review on health impacts of climate change indicates growth in research on this issue over time with a large focus on impacts with limited information on strategies and co-benefits.[22] Most research was concentrated in high-income countries, with fewer studies in vulnerable regions. The reviews emphasized the need for expanded research on specific population groups, health-related impacts of climate change on livelihoods and migration, and the integration of social factors into climate-health studies. Greater support for scholars in middle- and low-income countries and a broader understanding of their expertise were also highlighted as essential for a more inclusive research landscape.

2.2.2 Review of health vulnerability assessment and adaptation action

P Berry et al., 2018[23] indicate there are a complex set of impacts on health which vary across time and space. The study acknowledges the role of Vulnerability & Adaptation (V&A) assessments which foster cooperation on necessary climate action across sectors. Such collaborations are fruitful for identification of adaptation and risk management responses which are preventive, cost effective, and maximize health co-benefits. However, it reflects on the challenges in the assessments and provision of these inputs in a timely manner for decision making. *It indicates issues with regards to availability of data, the need for participatory approaches to V&A engaging relevant stakeholders as well as marginalized and high-risk population groups to account for their experiences and perspectives in the decision making process.*

The IPCC AR4, AR5 reports and DM David-Chavez et al.,[24] acknowledge the significance of indigenous knowledge systems in enhancing ability to adapt during extreme climate events. Despite this recognition, there is limited evidence in the climate science research community that accounts for these concerns. Besides, there is also a need for more inclusive approaches to be used to gather information on indigenous knowledge systems including from indigenous communities to be able to enhance the body of evidence and document good practices.

2.2.3 Literature review by region

A factsheet by ADB,[25] provides projections on morbidity and mortality for vector- and water-borne diseases in South Asia for 2030, 2050, and 2080.

A systematic review of effects on public health of climate change adaptation responses was conducted in Low and Middle-Income Countries (LMICs) by Scheelbeek et al., 2021.[26] The review identified 99 studies conducted in 66 LMICs. The authors categorized the hazards into seven categories and nine climate change response categories. The adaptation responses were grouped into three categories—enhancing community resilience; policy, governance, and finance; and disaster reduction. In terms of climate hazards, the most common ones were drought, extreme

precipitation, increased heat and variability in precipitation. Among the most prominent adaptation responses targeted changing behaviour, green infrastructure and climate smart agriculture, new technologies and infrastructure development. Further scrutiny of existing literature showed *that most research focussed on infectious diseases. On the contrary, none of the studies covered under the review focussed on maternal and child health*. The study populations covered children, environment health practitioners, low-income groups, and farmers. In terms of the geographic spread of the study, the analysis showed that majority of the studies in LMIC settings were conducted in the Asian countries of Bangladesh and India. A total of 38 studies were conducted in Africa with Ethiopia being the most frequently reported country. Lastly, one of the studies provided a comprehensive understanding of health outcomes in 57 Small Island Developing States (SIDS).

In terms of gaps, the study underscored the need to expand the existing evidence base, in LMICs. The study pointed out the gap in ex-ante evaluations of climate change adaptation requirements, with only 38 studies providing qualitative data. The evaluation of adaptation options for gradual climate change was found to be scarce. Accounting for the specific needs of vulnerable groups was found to be largely underdeveloped.

A scoping review of climate change effects on South Asian women and children's health covered 42 studies.[27] Over 50% focused on India, 14 on Bangladesh, and the rest on other South Asian nations. The most commonly studied exposure was meteorological factors, with 13 studies on extreme weather, nine on air pollution, and one on coastal area salinity. Of these, 34 studies explored impacts on children's health, while only eight examined women's health. Major health issues discussed included undernutrition, acute respiratory infections, diarrheal diseases, low birth weight, and premature mortality due to extreme weather and meteorological factors. *Literature gaps highlighted the need to study the relationships between these factors and mental health issues in women and children.*

2.3 Criteria for Country Selection

This step involves a systematic process to select a subset of countries within the Indo-Pacific region. Using the defined criteria, countries that are most affected by climate risks and have limited capacities to respond are identified. These criteria include parameters such as per capita income, Human Development Index (HDI), World Risk Index (WRI), Official Development Assistance (ODA) qualification, Inform Climate Risk index, and Global Health Security Index (GHSI) values. The goal is to narrow down the list of countries that will undergo in-depth analysis, ensuring a representative mix of vulnerabilities, demographics, and climate impacts.

The following criteria have been used to guide the selection:

a) Low Per Capita Income
b) Low Human Development Index (< 0.550)
c) High World Climate Risk Index
d) Qualifying for Official Development Assistance
e) High INFORM Climate Risk Index
f) Low Global Health Security Index

- ***Per Capita Income***

Per capita income refers to the average income earned by individuals in a particular country. It is calculated by dividing the total income of a country by its population. This indicator provides an overall picture of the economic standard of living in a country and helps to compare income levels across countries.

- ***Human Development Index[28]***

HDI is a composite measure that takes into account three dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living. It provides a broader measure of well-being than per capita income, reflecting not only economic factors but also social and development indicators.

- ***World Climate Risk Index[29]***

Germanwatch, an environmental and development organization, releases the Global Climate Risk Index (GCRI) yearly. The GCRI shows the likelihood of disasters due to extreme weather events and harmful effects of climate change for 193 nations worldwide. The geometric mean of exposure and vulnerability is computed for each country. The sociocultural domain of ascent and vulnerability is made up of three dimensions: susceptibility, adaptive capacity, and coping.[i]

- ***Official Development Assistance[30]***

ODA is financial assistance provided by governments, development organizations, and international institutions to support economic and social development in developing countries. It is an important source of funding for many low-income and middle-income countries, which do not have adequate resources to attend to critical development challenges, such as poverty, disease, and climate change.

- ***INFORM Climate Risk Index[31]***

INFORM Climate Change Risk Index is a combination of 80 different indicators grouped under the categories of hazard and exposure, vulnerability and lack of coping capacity. The INFORM Risk Index is a collaboration of the Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness and the European Commission. The risk index enables decision making at different stages of disaster management cycle such as specifically climate adaptation and disaster prevention, preparedness and response.

The value represents both human and natural disasters including climatic and non-climatic disasters as well as epidemics. Hence, it offers measurable predictions of how climate change will affect the likelihood of future humanitarian crises and disasters. The results aim to guide policymaking across climate action, adaptation, risk reduction, sustainable development, and humanitarian aid.

---

[i] **Susceptibility** describes structural characteristics and conditions of a society that increase the overall likelihood that populations will suffer damage from extreme natural events and enter a disaster situation.
Coping involves various capacities and actions of societies to counter negative impacts of natural hazards and climate change through direct actions and available resources in the form of formal or informal activities, and to minimize damage in the immediate aftermath of an event.
Adaptation, in contrast to coping capacities, refers to long-term processes and strategies to achieve anticipatory changes in societal structures and systems to counter, mitigate, or purposefully avoid future adverse impacts.

- ***The Global Health Security Index***[32]

GHSI is an evaluation and benchmarking instrument created to assess a nation's readiness and capacity to prevent, identify, and respond to threats to the global health system, such as pandemics, epidemics, and other public health emergencies. It was developed by the Nuclear Threat Initiative (NTI) in collaboration with the Johns Hopkins Center for Health Security and Johns Hopkins Bloomberg School of Public Health.

The GHSI evaluates a wide range of factors to assess a nation's capacity for health security, including its healthcare infrastructure, disease surveillance systems, laboratory facilities, emergency preparedness and response plans, risk communication, and overall health system capacity. The index provides a ranking and a numerical score for every nation, allowing for comparisons of the health security readiness of various nations. The latest GHSI report ranks 195 countries on a scale of 1–100 and results showed that no country could be categorized in the top tier with a score of 80.1–100.

It's crucial to remember that the GHSI is based on information that is made accessible to the public and self-reported information provided by governments. Although it offers useful insights about the readiness of the global health security system, its accuracy depends on the quality of the data provided by each nation.

All the countries in the Indo-Pacific region were analysed based on the above mentioned criteria along with their land area and population (provided in Annexure I). Based on the analysis, South-Asian countries (Bangladesh, Nepal and India), Southeast Asian countries (Indonesia, the Philippines, Thailand, Malaysia, Cambodia and Vietnam) and Island country (Fiji and Tuvalu) have been selected for the study.

a) Bangladesh

Bangladesh, a densely populated country with relatively small land area, is situated in a delta region prone to frequent cyclones, floods, and rising sea levels. Its low per capita income and HDI, along with its LDC status, indicate economic vulnerability. The high WRI score signifies a substantial risk from climate-related events. Bangladesh's eligibility for ODA underscores its need for external support. The INFORM Climate Risk index rates its vulnerability as high, and the low GHSI value suggests challenges in health security during climate-induced crises.

b) India

India's large population, extensive land area, and diverse climate vulnerabilities contribute to its selection. As a lower middle-income country, it faces a complex interplay of social, economic, and environmental factors that can amplify the health impacts of climate change. The country's exposure to heatwaves, air pollution, flooding, and cyclones demands attention. India's vulnerability, in spite of its development progress, coupled with its eligibility for ODA calls for a comprehensive analysis. The INFORM Climate Risk index flags it as facing high climate risks, and the medium GHSI ranking signifies potential health vulnerabilities during climate-related emergencies.

c) Indonesia

Indonesia's vast land area and population are accompanied by considerable climate risks. Its exposure to earthquakes, tsunamis, and volcanic activity (leading to air pollution) is evident from its high WRI score. Despite its UMIC status, the nation's vulnerabilities are intricately linked to its socioeconomic dynamics. The INFORM Climate Risk index categorizes Indonesia as having high climate risks, and

its medium GHSI ranking underscores the need to address potential health vulnerabilities during climate-induced disruptions.

d) The Philippines

The Philippines, with its smaller size, is exposed to significant climate risks. Its high WRI score reflects its susceptibility to tropical storms, floods, and sea-level rise. Despite being an LMIC, the country faces complex challenges due to climate impacts. The INFORM Climate Risk index identifies it as having high climate risks. The medium GHSI ranking signifies potential health vulnerabilities during climate-induced disruptions, combined with its eligibility for ODA, underscores the importance for understanding the impacts in the country.

e) Thailand

Thailand's substantial per capita income and impressive HDI value might initially suggest reduced vulnerability. However, a closer examination is essential given the country's pronounced exposure to climate risks, including severe flooding and extreme weather events, as reflected in its very high WRI score. Furthermore, Thailand's eligibility for ODA and its moderate GHSI ranking emphasize the ongoing significance of addressing health security concerns despite progress in development. The INFORM Climate Risk index highlights the importance of exploring country's climate vulnerabilities.

f) Vietnam

Vietnam's medium-sized land area, large population, and vulnerability to climate-related risks position it as a relevant case for the study. Its exposure to tropical storms, floods, and sea-level rise is indicated by its high WRI score. While it falls under the LMIC category, its medium HDI underscores that development progress hasn't completely mitigated its climate risks. The INFORM Climate Risk index categorizes Vietnam as having medium climate risks. The medium GHSI ranking indicates potential health vulnerabilities during climate-related disruptions.

g) Fiji

Fiji's inclusion in the study is driven by its vulnerability as a small island nation. With a limited land area and a unique geographic setting, Fiji is particularly susceptible to rising sea levels and extreme weather events, as indicated by its high WRI score. Despite having a higher HDI compared to other countries, underscores that even relatively developed nations remain susceptible to the impacts of climate risks. The INFORM Climate Risk index underscores its high vulnerability, and the low GHSI ranking indicates potential health-related challenges during climate-related crises. Its eligibility for ODA further emphasizes the urgency of understanding how climate change impacts health in such contexts.

h) Nepal

Nepal, a densely populated country with a relatively small land area, lies in the central Himalayas. Its steep terrain and youthful mountain ranges make it highly susceptible to landslides, floods, and other geological hazards, a risk further intensified by the impacts of climate change. With a low per capita income, medium Human Development Index (HDI), and Least Developed Country (LDC) status, Nepal faces significant economic vulnerabilities. Its high World Risk Index (WRI) score highlights considerable exposure to climate-related disasters. Nepal's eligibility for Official Development

Assistance (ODA) emphasizes its reliance on external aid. While the INFORM Climate Risk index classifies its vulnerability as medium, its low GHSI score points to challenges in managing health security during climate-induced emergencies.

i) Malaysia

Malaysia, located in Southeast Asia, faces significant risks from climate-related health impacts due to its tropical climate and geographic features. Despite being middle income country with very high and medium GHSI, the country is still at high risk of climate induced disasters and their impacts. Urbanization and air pollution further compound these health risks, especially during transboundary haze episodes caused by forest fires in the region. Malaysia's health system faces challenges in addressing these compounded risks, highlighting the need for stronger climate resilience, improved public health infrastructure, and targeted interventions to mitigate the growing health impacts of climate change which is also evident from the country's climate-related ODA.

j) Cambodia

Cambodia is highly vulnerable to climate-related health impacts due to its geographic location, socio-economic conditions, and limited health infrastructure as indicated by its high GCRI and low GHSI and a medium HDI reflecting ongoing socio-economic challenges. Additionally, the INFORM Risk Index rates Cambodia's vulnerability to climate risks as medium, emphasizing the need for strengthened resilience and adaptive measures to mitigate the health and economic consequences of a changing climate. The country's eligibility to ODA highlights the nation's need for financial assistance to meet its development goals and overcome systemic vulnerabilities compounded by climate change.

k) Tuvalu

Tuvalu, a low-lying island nation in the Pacific, is highly vulnerable to the health impacts of climate change particularly due to rising sea levels, coastal erosion, and increasing salinity of freshwater sources. Tuvalu's HDI is relatively low, reflecting challenges in economic and social development. The country's very low score on GHSI highlights limited capacity to respond to health emergencies. Additionally, Tuvalu's medium to high vulnerability on the INFORM Climate Risk Index underscores its exposure to climate-related risks and the need for robust adaptation strategies. Additionally, GCRI ranks Tuvalu as highly vulnerable to climate-induced disasters, emphasizing its exposure to long-term climate risks.

In summary, the selection of Bangladesh, India, Indonesia, the Philippines, Thailand, Vietnam and Fiji for in-depth analysis in the Indo-Pacific region is based on a comprehensive set of criteria encompassing economic, developmental, climate, and health-related factors, along with representation of diverse range of vulnerabilities, demographics, and climate impacts. Understanding the nuances of these countries' experiences can contribute significantly to the development of targeted strategies for climate adaptation, disaster preparedness, and health systems' resilience in the face of a changing climate.

The next sections will delve deeper into each of these countries, exploring their specific challenges and opportunities in addressing climate-induced health risks including desk-based reviews and expert and country-specific consultations.

2.4 Stakeholder Engagement and Consultations

Besides the literature review, a deep dive into selected countries and an understanding of their health systems and capacities with regard to the integration of responses based on exposure to climate risks has been done. This has largely been done through stakeholder engagements and interactions in those respective countries.

3. Review of Literature: Climate Change and Human Health

In the pursuit of averting catastrophic health impacts and climate-related deaths, the IPCC emphasizes the urgency of limiting global temperature rise to 1.5°C. However, past emissions have made warming inevitable, with the average global temperature in 2022 already 1.15°C above pre-industrial levels.[33] Moreover, the warming trend is predicted to intensify, with a 98% chance of breaking temperature records and far reaching consequences. Simultaneously, human-caused climate change has led to a substantial warming of the Indian and West Pacific Oceans, nearly doubling the size of the warmest waters since 1900. This can result in adverse impacts on ocean life and weather patterns, underscoring the need for prompt action to address the escalating impact of climate change on both land and sea.[34]

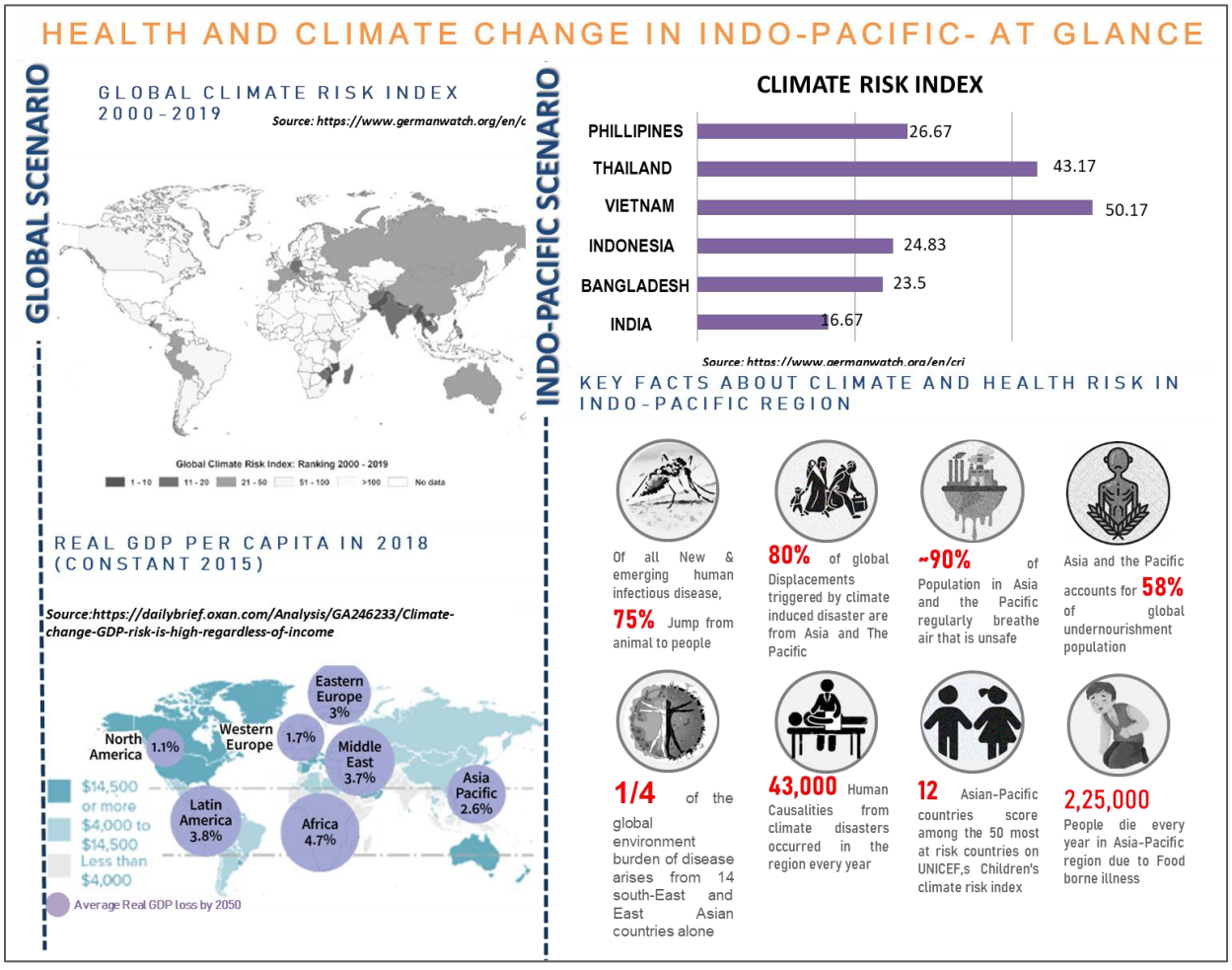

Figure 3 Current status of some countries in Asia-Pacific region
Source: Compiled by authors

Figure 3 offers glimpses into the various levels where the convergence of climate change and public health occurs. Although the risk is distinctly elevated in certain instances, its translation

into overall economic impact on GDP and its effects on the population differ significantly. This disparity can be attributed primarily to two key factors: firstly, the geographical expanse, of the Asia-Pacific region; and secondly, the diverse economic and demographic conditions.

Furthermore, the impacts of climate change are far-reaching and multifaceted, with the potential to disrupt and impede crucial development processes aimed at addressing challenges such as abject poverty, hunger, and malnutrition. As nations strive to achieve the ambitious Sustainable Development Goals (SDGs),[35] the climate crisis emerges as a significant obstacle, threatening to erode progress made in development, global health, and poverty reduction over the course of several decades. The repercussions of climate change extend beyond environmental concerns, encompassing critical areas such as healthcare access and universal health coverage. In light of the WHO's alarming statistics, where approximately 12% of the global population, amounting to more than 930 million people, allocate a substantial portion of their household budget to healthcare, it becomes evident that the most vulnerable populations, particularly the uninsured, are at heightened risk. Consequently, health shocks and stresses imposed by climate-related factors are driving around 100 million individuals into poverty each year, further exacerbating existing social inequalities.[36]

However, Le Berrang-Ford[37] reveals distinct geographic patterns in the relationship between climate change and health. Most evidence comes from high-income and upper middle-income countries, with varying topics based on national burdens of disease and research capacity. The disparities underscore the need for better representation of data and information for all countries and localized responses to climate change effects on health. Gaps are evident, especially in central Asia, north and central Africa, and South America. Regional priorities and gaps are highlighted by various means for instance Africa's emphasis on vector-borne diseases over other health impacts. Mental health, agricultural shifts, extreme events' effects on livelihood, and environmental migration are underrepresented. Social determinants of climate impacts and intervention entry points are insufficiently addressed.

The FCDO study aims to review the evidences from the Indo-Pacific region covering the following climate health diseases:

- Climate change and heat-related illnesses
- Injuries, deaths and mental health impacts due to heavy rainfall, floods, cyclones, and other climate extremes
- Climate change and infectious diseases (vector-borne diseases, water-borne diseases, and zoonotic diseases)
- Climate change and air pollution-related illnesses
- Climate change and food-related illnesses

3.1 Major Pathways between Climate Change and Human Health

The impact of climate change on human health is increasing with increasing instances of negative health outcomes such as communicable and non-communicable diseases which vary across different geographic areas. The complex relationship between climate change and human health involves a combination of physical, biological, and socio-economic factors that interact to create

various health risks and challenges. There are mainly three types of impacts due to climate change (Figure 4):

1. Direct impact
2. Indirect impacts due to ecological mediators
3. Indirect impacts due to social mediators

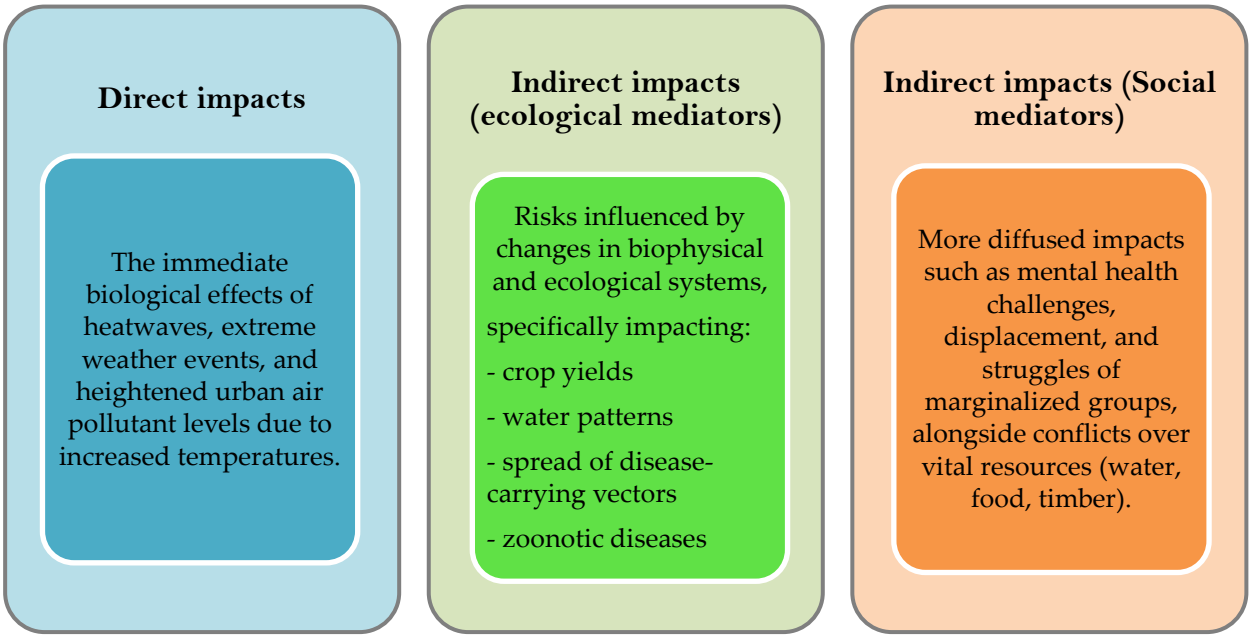

Figure 4 Health risks due to climate change, categorized based on causal pathways[38]

3.1.1 Global evidence of causal pathways linking climate change and health

A global study by Le Berrang-Ford[39] used machine learning to map the extensive literature on climate change and health worldwide. The research identifies and visualizes key factors like hazards, health impacts, pathways, and responses across different regions. Notably, there is substantial research demonstrating causal connections, especially in hazard-related areas. For example, studies on infectious diseases often link them to factors such as precipitation variability and heat, focusing on the relationship between rainfall and diseases such as malaria and dengue. Similarly, research on respiratory health frequently coincides with discussions about emissions due to the connection between air quality and respiratory risks. Chronic diseases and healthcare demand are commonly associated with heat hazards.

More specific topics reveal that air pollution frequently co-occurs with temperature variability, while wildfires and dust storms often coincide with studies on respiratory health and asthma, especially in children. Drought literature often aligns with discussions about water quality, food insecurity, and agriculture impacts, primarily due to decreased rainfall. Heatwaves, heat-related issues, and health system demands are often discussed in conjunction. Mental health research commonly relates to extreme events like hurricanes and floods. Age and sex are frequently linked to topics concerning child and maternal health, owing to unique risks faced by women and children. Urban studies tend to focus on air pollution and heat, while rural household studies

address topics such as food, agriculture, child health, and water quality. Studies on building design often coincide with discussions on heat and air pollution, considering the role of infrastructure in indoor comfort. Social vulnerability studies often concentrate on food, agriculture, water quality, and also intersect with heat stress and infectious disease topics.

Responses to the health impacts of climate change include the co-benefits of mitigation, particularly related to respiratory health, all-cause mortality, chronic diseases, and infectious diseases. Energy policy often connects with short-term health benefits, while discussions about greenhouse gas pathways are more closely related to longer-term effects like heat stress. Mental health is strongly associated with adaptation topics, especially those related to disaster risk reduction and community resilience. Maternal and child health, as well as occupational health, frequently co-occur with discussions about disaster risk reduction due to the unique risks faced by women and children. Adaptation policy and practice are closely related to healthcare system demands, while topics like chronic diseases, water, sanitation, hygiene, and food and nutritional health often coincide with adaptation policy.

3.1.2 Regional evidence for Indo-Pacific region on causal pathways linking climate change and health

The DPSEER framework outlines causal pathways within environmental systems. The DPSEER framework follows a chain of links: 'driving forces' (economic sectors, human activities) lead to 'pressures' (emissions climate change), resulting in 'states' (physical, chemical, biological), 'impacts' on ecosystems' health. Establishing this framework is complex due to intricate cause-effect relationships and environmental changes rarely having single causes. The causal pathways of climate change and health are elucidated in Figure 5, illustrating the interconnected flow of influences and impacts.

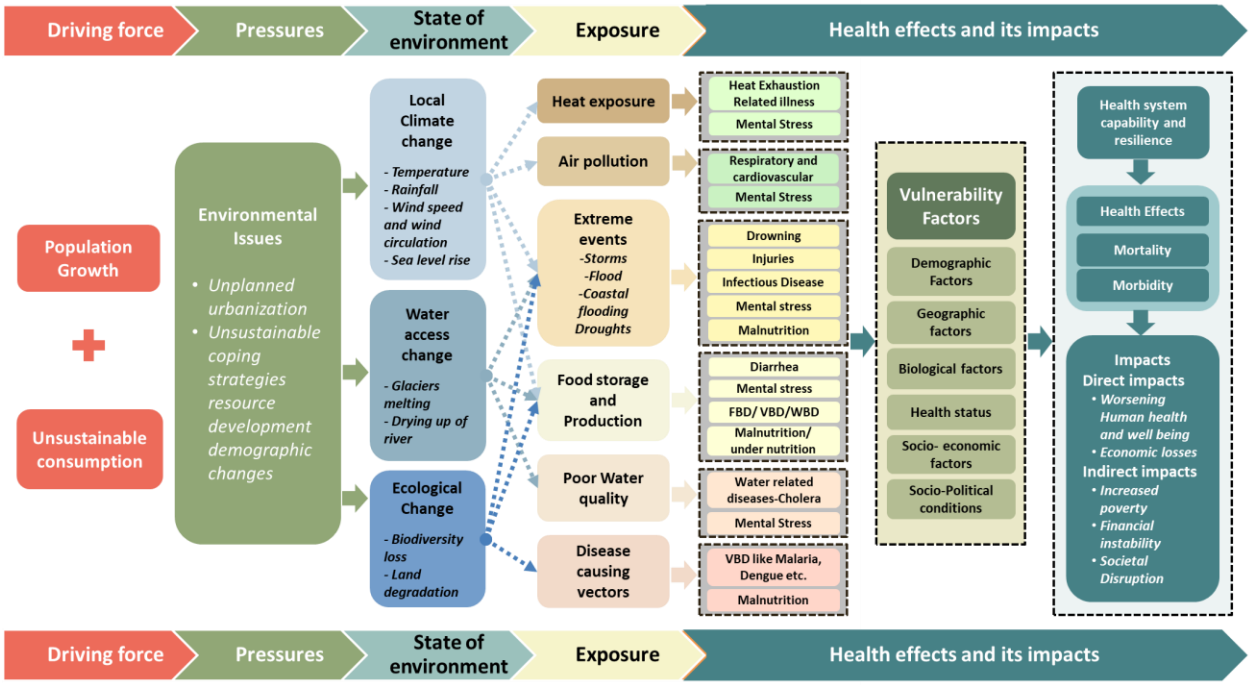

Figure 5 Flow chart explaining causal pathways of climate change and health
Source: Compiled by authors

One of the most direct and visible impacts of climate change on human health is through extreme temperatures. Both low and high temperatures can alter the ability of the human body to maintain the required temperature. In the case of extreme heat, loss of this ability may result in heat cramps, heat exhaustion, heatstroke, and hyperthermia. Campbell et al. (2018), argue that there is limited evidence on the impact of heatwaves on health for tropical countries. Relationship between heatwaves and all cause hospitalizations has been studied in Vietnam,[40] India[41,42] and China. Hot days have also been linked to higher rates of depression, anxiety, and suicide.[43] Besides, the direct impacts of heat the WHO map the indirect impacts under the broad categories of vector- and water-borne diseases, food-related illnesses. Temperature's influence on vectors and pathogens is profound, as evidenced by their effects on vector survival, population growth, feeding behaviour, susceptibility to pathogens, and transmission dynamics.[44] Elevated temperatures accelerate pathogen activity, expanding their geographical range while compromising human immunity, ultimately intensifying morbidity and mortality.[45] Heatwaves escalate the spread of vector-borne diseases, particularly those transmitted by mosquitos, ticks, and fleas.[46, 47] Relationship between rising temperatures and mosquito-borne disease outbreaks have been found to peak in south and southeast Asia.[48] The Pacific region highlights this effect, where elevated temperatures, extended rainfall, and high humidity offer a thriving environment for *Aedes* mosquitoes, known carriers of dengue, Zika, and chikungunya viruses.[49]

There are multiple factors responsible for food crisis in different regions of the world and any changes in the climate system such as increasing temperatures are likely to worsen food production, access, and availability. Research has shown that increase in global mean temperatures on average will negatively impact yields of wheat, rice, maize and soyabean and

these impacts will vary across geographies and crops.[50] Additionally, climate change's impact on declining crop yields is expected to contribute and exacerbate child stunting in many Asian countries, including India. These examples illustrate the multifaceted and complex implications of climate change on agriculture, human health, and nutrition in the region.[51] Studies also show there is a significant positive correlation between temperature during India's main agricultural growing season and annual suicide rates. The findings support the hypothesis that heat damages crops, leading to economic difficulties, increased mental stress and subsequently, an increase in suicide rates among farmers and agricultural workers.[52] In contrast, colder temperatures can increase the risk of cardiorespiratory issues and hypothermia, even leading to traffic accidents.[53,54] Some of these linkages have been reported for East Asian countries of China, Japan, South Korea, Taiwan and India where the polar vortex caused poor visibility, hypothermia, and deaths in 2023.[55,56]

Both floods and tropical storms also affect access to safe water and the overall functioning of health systems, especially those located in vulnerable areas such as the coastline. This impact of extreme events on health systems infrastructure, water and sanitation facilitates can hamper access to safe drinking water and resulting in outbreak of diseases such as diarrhoea and gastroenteritis caused by drinking contaminated water as witnessed during Super Cyclone Odetta in the Philippines.[57] While the evidences linking the outbreaks of dengue in cyclone-affected areas are weak, in a unique study the possibility of vector-borne diseases outbreaks such as dengue in the post cyclone period has been studied in Guangzhou, China.[58] Similarly, there is evidence on children affected by tropical cyclone Harold, and consequent infrastructure damage and flooding. Water sources were contaminated and posing challenges for wastewater removal. Crowded shelter homes also served as a potential cause for the spread of dengue.[59] Along with the above-mentioned infectious diseases, systematic reviews also highlight malnutrition as health outcomes in flood-affected areas. There is evidence on the adverse impact of floods on food security in India,[60] Thailand,[61] Fiji,[62] and Indonesia.[63,64] Food security was found to be an issue resulting from loss of crops, rising food prices after disasters, difficulty in food access as well as loss of livelihoods and affected incomes. There is evidence of flooding events being associated with mental distress as documented for the city of Chennai, India[65] and provinces of Vietnam.[66,67] Flood exposure in the first year of life was associated with greater levels of chronic malnutrition in children. In flood-prone communities, long-term malnutrition prevention programmes should be put into place after floods.[68] Similar evidence has been documented in the Philippines after the Super Typhoon Haiyan after which instances of Post-Traumatic Stress Disorder (PTSD), depression, and anxiety were reported.

Air pollution has been co-related with exacerbation of COPD and onset of asthma, increase the respiratory morbidity and mortality. These health effects are directly related to the components and sources of pollutants, which vary across countries, seasons, and time.[69] Globally, the link between air pollution and autism, lower cognitive function, ADHD and behavioural issues in children, and increased risk of dementia in adults, notably Alzheimer's dementia is also receiving attention.[70] Emission of primary pollutants in Asia has increased over the past 50 years and is driven by economic activity in the region as illustrated by several authors.[71,72,73] Along with air pollution due to emissions from transport, industries and crop burning, indoor air pollution due

to the use of traditional fuels for cooking and their impacts on health have been studied in India,[74,75] Bangladesh,[76] Indonesia,[77,78] the Philippines,[79] and Vietnam.[80,81] Emphysema, asthma, allergy issues, and chronic bronchitis are some of the respiratory conditions that these air pollutants can induce.

Along with the direct impacts there are also impacts in health due to slow onset events such as sea-level rise, land degradation, etc. Sea-level rise which is primarily driven by global climate change can also have significant impacts on human health. Rising sea levels can contaminate freshwater sources and affecting the availability of drinking water. For instance, in the Pacific Islands and Asia-Pacific nations and territories, inadequate access to WASH is particularly prevalent.[82] Rising sea levels due to increased warming and glacial melting is leading to flooding and inundation like in case of Tuvalu and Greater Suva Area Suva in Fiji.[83] Another slow onset event is land degradation and desertification which can lead to issues of food and water insecurity and trigger socio-economic impacts such as unemployment, gender inequality, conflict, and migration. Any environmental consequences from land degradation and desertification, either individually or collectively, is likely to have an influence on human health and well-being.[84,85,86,87]. Climate change has been associated with soil erosion on degraded land further exacerbating the risk of forests fires. It can alter the distribution of invasive species, vectors, pests and pathogens thereby impacting the occurrence of emerging diseases such as zoonotic infections and emergence of vector-borne diseases in non-endemic areas. Sena and Ebi (2021),[88] describe how land degradation can affect food, water, air and soil resources and result in 19 health outcomes broadly categorized as infectious, parasitic, nutritional diseases, injuries, and non-communicable diseases. In the South Asian context, the impact of land degradation has been studied in terms of its impact on food security.[89] Research from PICs points out that due to land degradation, food production has now been pushed to marginal land areas thereby exacerbating food security issues in these countries.[90] There is evidence from Southeast Asia regarding the prevalence of zoonotic diseases.[91] Evidence from Pacific Island Countries shows the region is affected by several zoonotic diseases many of which are linked to livestock. Leptospirosis is a common zoonotic disease common to the region, largely because populations reside near animals and thereby making the prevalence of animal diseases a key concern in the emerging One Health approach.[92]

3.1.3 Mediating factors for climate change and human health

Climate change threatens energy, water, and food security, leading to vulnerabilities in energy supply, agriculture, and access to water, which directly impact the livelihoods of millions of people. The poor, who have limited resources and often work in the agriculture sector, are particularly vulnerable to these impacts despite contributing[93] least to climate change. Poverty, combined with dependence on natural resources, is identified as a critical factor for the occurrence of violent conflicts. Changes in the natural environment, such as droughts, can exacerbate existing socioeconomic tensions among impoverished groups. Urban poverty is also affected, with informal settlements lacking basic services being highly vulnerable to climate change impacts due to weak governance and a barely climate-resilient infrastructure. In areas with weak governance and high poverty rates, organized crime groups may exploit the situation, leading to increased violence and societal friction. In Karachi, Pakistan, rising sea levels and inadequate infrastructure put further pressure on the urban poor, potentially leading to social

disorder and political instability. The nexus of urban poverty, climate change, and violence requires further research to gain more insights into its complexities and implications for human well-being in Asia.

Climate change has significant implications for human health, particularly migration in Asia. Vulnerabilities in energy, water, and food security threaten livelihoods, especially for socially deprived populations. For instance, increased resource scarcity and damaged infrastructure affect those who are already impoverished, exacerbating the potential for conflict. Studies highlight that poverty combined with dependence on natural resources can lead to violent conflicts. For example, competition for limited resources like water and land may cause tensions in agrarian societies, as seen in Kazakhstan, Uzbekistan, and Turkmenistan. Climate change disproportionately affects the poor, who have limited resources to adapt, leading to migration as a means of coping. For instance, farmers in Pakistan's Punjab province face climate-related risks, worsened by existing constraints on freshwater, income, and infrastructure. In contrast, climate impacts on urban poverty, particularly in megacities like Karachi, Pakistan, can lead to social disorder and instability due to weak governance and inadequate infrastructure. Climate-induced migration is influenced by temperature, heat stress, floods, and storms, with studies showing a non-linear relationship between local temperature and migration. For example, warmer temperatures in Indonesia may increase permanent migration, whereas colder temperatures may reduce it. Projections indicate that certain regions like Bangladesh, the Philippines, China, and small island states in the Pacific are particularly prone to climate change-related migration flows due to the vulnerability of their ecosystems and populations. A global warming of 1.5°C–2°C will significantly alter physical and biological processes influencing human mobility, potentially leading to humanitarian disasters and unmanageable migration flows. Understanding these causal pathways and their examples is crucial for developing effective policies and interventions to protect human health and well-being amidst climate change's impact on migration in Asia.

4. Health Impacts and Vulnerabilities of Climate Change

The Indo-Pacific region is witnessing a significant impact from the extreme temperature events. South Asia, for instance, has suffered a substantial loss of life due to heat exposure, with a total of 3,775 reported deaths spanning from 2015 to 2019.[94] This phenomenon isn't confined to South Asia alone; other parts of the Indo-Pacific, including East and Southeast Asia, are expected to experience an increase in extreme weather events such as heatwaves, flash floods, and stronger tropical cyclones, with potential intensification ranging from 10% to 20%. This predicament not only poses a threat to human lives but also jeopardizes decades of progress in development, global health, and poverty reduction.[95] Moreover, existing health inequalities are likely to widen due to the climate crisis. Rising sea levels, projected to increase by about 3 millimetres annually, further compound the region's challenges, impacting health of people in coastal areas and necessitating adaptive measures. Disturbingly, 42 million people have been displaced in the Asia-Pacific area due to climate-related factors, including storms, floods, extreme heat, and sea-level rise, leading to significant human movement within and across borders.[96] The following section details the impact and vulnerability for the selected countries.

4.1 Bangladesh

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Bangladesh faces rising temperatures and erratic weather due to climate change increasing risk of respiratory diseases, water-borne illnesses, dengue, and mental health issues.[97] • Increasing temperature and humidity have a substantial impact on public health, with a 1°C temperature rise increasing the likelihood of respiratory infections by 5.7 percentage points, and higher humidity increasing the chances by 1.5 percentage points (World Bank report).[98] • Temperature and humidity changes impact mental health, increasing anxiety by 0.8% for every 1°C temperature rise and 0.3% for every 1% humidity increase. Conversely, a higher temperature reduces depression risk by 1.6%.[99] • The readymade garment industry, which employs over four million workers (80% women), faces heat stress and productivity losses in Bangladesh.[100]	Severe climate-related health effects are observed in coastal areas,[101] flood plains, riverine Charlands, Haor basin, hilly regions, drought-prone uplands, and urban slums disproportionately affecting vulnerable populations, including women, children, and the elderly.[102,103] - Men face higher heat-related mortality due to outdoor labour, while women in agriculture and the informal sector also experience heat exposure, with limited protection and adaptation options. [104]

Climate change and extreme events related injuries, death and mental health impacts	• Bangladesh confronts a high share of cyclone-related deaths[114] (60% in the last 20 years), flooding affecting almost a million people, [115, 116] and climate-driven public health issues, including respiratory illnesses, mosquito-borne diseases, and approximately 3,272 cholera-related[117,118,119] deaths annually during floods and droughts. • Rahman et al. (2019) examine climate change's impact on various health factors in Bangladesh, including salinity intrusion, diseases, and food security, considering both direct and indirect effects. They highlight the role of social factors attributing health issues to climate change.[120] • Research on climate change worsening mental health[121] especially in case of women[122] in disasters and adolescent [123] girls in shelter homes, despite ongoing research, highlighting a lack of attention in the health sector.[124]	- Women face disproportionate impacts of climate change due to their need for sanitary and reproductive health products, limited access to female doctors, and the risks associated with migration after disasters. [105] - Urban slum dwellers, particularly in Dhaka, seasonal floods and waterlogging aggravate the unsanitary conditions which arise from the discharge of industrial waste and raw sewage into the river ponds and nearby water bodies causing health issues.[106]
Climate change and infectious diseases (vector-borne diseases)	• The combination of humidity (60–80%), temperatures (25–35°C), and rainfall (200–800 mm) creates optimal mosquito breeding conditions, affecting malaria transmission within the thermal range of 17–34°C. • The study estimated that a temperature increase of 3.3°C without any adaptation measures or changes in socio-economic conditions may result in an additional 16,030 dengue cases in Dhaka by the end of the century. • Bangladesh is also vulnerable to other emerging climate-sensitive vector-borne diseases, for example, Chikungunya—an arboviral disease. However, the evidence is less and poorly documented. • Malaria is endemic in 13 of 64 districts especially in the western districts in Bangladesh. About 14 million people are at risk.[125]	- Demographic characteristics, including age structure, gender relations, and population dynamics, are linked to climate-related health risks, often exacerbated by existing vulnerabilities.[107,108,109,110] - There is evidence [111] also on positive association between shocks related to climatic events and the incidence of child marriage in coastal areas of Bangladesh. - A recent UNICEF 2016 report warned that children in Bangladesh will suffer the effects of climate change longer than adults. [112]
Climate change and infectious diseases (water-borne diseases)	• Inadequate access to clean water and sanitation leads to water-borne diseases, worsened by floods and coastal salinity. • Droughts and heat stress intensify the water crisis, particularly affecting vulnerable groups.	- Studies on indigenous communities in the Chittagong

	• Climate change is expected to raise the incidence of diarrhoea which is expected to increase by 5.2%, typhoid fever by 5.7%, and cholera by 6.7%.	Hill Tracts face a water crisis, reproductive health issues, and disrupted food security due to climate stress. [113] Water-borne diseases increase during floods in these areas.
Climate change and infectious diseases (zoonotic diseases)	• Bangladesh is a hotspot for zoonotic diseases spillover to humans.[126] • In 2017, the Government of Bangladesh prioritized six diseases, namely anthrax, brucellosis, nipah virus, rabies, zoonotic influenza, and zoonotic tuberculosis, through a one-health zoonotic disease prioritization workshop. • Limited studies and surveillance on the burden of zoonotic diseases.	
Climate change and air pollution-related illnesses	• For Bangladesh, the World Bank in its report titled "Breathing Heavy" highlights the state of air pollution.[127] Dhaka, the capital city, ranked as one of the world's most polluted cities.[128] • In 2019, air pollution was the second leading cause of death and disability in Bangladesh, resulting in 78,145 to 88,229 deaths, 1.0 to 1.1 billion lost days and economic losses equal to 3.9–4.4% of the country's GDP. Notably, the western regions, such as Khulna and Rajshahi, had higher pollution levels than the eastern regions like Sylhet and Chattogram.[129] • Research explores how indoor air pollution affects health revealing that it leads to respiratory issues in girls, stunting (from prenatal exposure). [130,131,132]	
Climate change and food-related illnesses	• Increasing salinity in water sources leads to diarrhoea and health risks, heightened risk of (pre)eclampsia and gestational hypertension, and high miscarriage rates, impacting pregnant women.[133] • In northeast Bangladesh's Haor region, rice production has declined due to shorter cultivation periods (15–20 days, down from 30 days a decade ago), leading to increased poverty and food insecurity.[134,135] • Projected global carbon dioxide emissions may reduce the nutritional value of staple crops, exacerbating nutrient deficiencies.[136]	

4.1.2 Emerging gaps from literature review

The evidence on climate change impacts in Bangladesh underscores critical gaps that require further attention and research. Some of the key gaps are listed below.

- Limited research exists on how climate change impacts affect the elderly population and those with existing co-morbidities.

- There is a notable absence of studies examining the vulnerabilities and impacts of climate change on disabled individuals, highlighting the need for research in this area.
- While some research delves deeper into gender disparities, there is a need for more studies to explore the interlinkages between climate change, early marriages, and exacerbating health risks among women.
- Although air pollution's health impacts are acknowledged, there is a lack of detailed studies that explore how it affects at risk populations—children, pregnant women, lactating mothers, populations with co-morbidities and the elderly. Moreover, studies need to include both indoor and outdoor air pollution.
- The need to conduct studies with intersectional approaches that consider age, gender, economic factors, caste, ethnicity, etc., in climate and health studies is warranted.
- Marginalized populations like Rohingyas and migrant communities are insufficiently studied in terms of their climate change vulnerabilities and health impacts, leaving these groups relatively understudied.
- Studies focusing on mental health conditions of populations affected by climate change are scarce.
- Given Bangladesh's status as a hotspot for zoonotic diseases, there is scope for more comprehensive research on the burden, public health impact, and factors contributing to the emergence of zoonotic diseases in the context of climate change.
- Majority of studies are limited to a province or city, and there are very few studies spanning across the entire country of Bangladesh. It becomes challenging to understand whether they can be considered to be representative of the entire country.
- Research identifies gaps in long-term data, adaptation measures, and impact assessment on vulnerable populations and economic aspects in the context of water-borne diseases (WBDs). Hossain et al. reveal the lack of long-term data and limited research on WBD impacts.
- Limited studies and surveillance exist on the burden of zoonotic diseases, which poses a risk due to high-risk practices involving domestic livestock and poultry, alongside low awareness among the population about zoonotic disease transmission risk.

4.2 India

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Heat-related illnesses vary from heat exhaustion to life-threatening heat strokes in the country.[137] • Urban areas are more exposed to heat due to the urban heat island effect, which causes temperatures in cities to be typically 3.5–12°C higher than outside city limits.[138,139] • Severe heat waves have led to hospitalizations, drought [140] and GDP Loss[141]. • India already loses around 101 billion labour hours a year on account of heat and expected to lose more in the coming years.[142]	Several studies have explored the relationship between income vulnerability and vulnerability to vector-borne diseases in India. These include studies by Singh et al. (2020)[143], Das et al. (2019)[144] and Adams et al. (2018).[145] Likewise, vulnerability of women to climate change impacts on human health in India includes studies on air pollution, heat, extreme weather events by several authors. [146,147, 148, 149] While there are studies focussing on the health vulnerabilities of children there are fewer studies mapping specific vulnerabilities of the elderly population in the country. Vulnerable groups include young individuals and the elderly.[150]
Climate change and extreme events related injuries, death, and mental health impacts	• India experienced 117 cyclones between 1970 and 2019, leading to more than 40,000 fatalities. Over the same period, the country endured 7,063 extreme weather events, causing 141,308 deaths, including 28% from cyclones (40,358) and over 46% from floods (65,130).[151] • Floods and cyclones result in casualties[152], deaths[153,154] and economic losses.[155] • Emerging diseases due to climate change and COVID-19's increases the burden.[156] • Floods cause health issue and also lead to food security.[157,158] • Research also highlights the incidence of post-traumatic stress disorder (PTSD) due to flood.[159]	
Climate change and infectious diseases (vector-borne diseases)	• India faces a significant malaria burden with 2% of the global malaria case burden, 2% of global malaria deaths and 85.2% of the malaria burden in Southeast Asia.[160] • Research has found malaria outbreaks correlated with rainfall and temperature.[161,162] • Dengue cases in India have been rising over the last few decades indicating that its transmission has been steadily increasing.[163] • Temperature, humidity,[164] and rainfall impacts the transmission of dengue;[165,166,167] accelerating mosquito development and reducing the virus's incubation period, thus heightening transmission rates.[168] • Along with dengue and malaria, Chikungunya cases vary annually. [169], with lower positivity rates in summer and higher rates during the rainy season and	

	winter[170], strongly linked to temperature and rainfall fluctuations[171]. • Climate changes impact diseases like Kala-azar and Japanese Encephalitis, as rising temperatures favor disease-carrying vectors. Temperature affects parasite growth. [172]	The review found that there is a lack of research on the health impacts of heat stress in vulnerable populations, such as outdoor workers, pregnant Women and children. There is a gap in studies on impacts of climate change on women's reproductive health, particularly in the context of extreme weather events.
Climate change and infectious diseases (water borne diseases)	• Waterborne diseases affect 37.7 million millions annually,[173],[174] impacting 73 million work days lost and economy.[175] • Coastal areas have a higher prevalence of waterborne diseases [176] due Coastal areas are more prone to flooding and water contamination from natural disasters. • Diarrhea is the third leading cause of death in children under five years of age, responsible for 13% of all deaths. • WBDs in both urban and rural populations was found to be 12.2% over the past six month hence need to improve access to safe drinking water and sanitation.[177] • Disaster recovery efforts must address water supply and sanitation.[178]	
Climate change and infectious diseases (zoonotic diseases)	• Climate change increases the prevalence of vector-borne and waterborne zoonotic diseases, transmission of airborne zoonosis, with warmer and more humid conditions potentially increasing the risk of respiratory diseases.[179],[180] • In India, major zoonotic diseases of public health importance include Rabies, Brucellosis, Toxoplasmosis, Cysticercosis, Echinococcosis, Japanese Encephalitis (JE), Plague, Leptospirosis, Scrub typhus, and Kyasanur Forest Disease (KFD). New emerging diseases of public health significance in the country include Avian Influenza, Nipah Virus, Trypanosomiasis, Crimean-Congo Haemorrhagic Fever (CCHF), and H1N1 influenza.[181],[182],[183]	
Climate change and air pollution-related illnesses	• Exposure to ambient pollutants in air links to various health issues such as COPD, respiratory illnesses as well as a high rate of hospitalizations and visits.[184] • Air pollution negatively impacts life expectancy by 5 years in India.[185] It also leads to economic losses.[186] • Research on Indo-Gangetic plains, home to 510 million people constituting 40 percent of the country's population are likely to lose an average of	

	7.6 years of life expectancy with current pollution levels are particularly affected.[187] • Air pollution can disproportionately affect disadvantaged communities.[188]	
Climate change and food-related illnesses	• Very few and mostly old studies on climate change linkages to food related illness. • Climate change affects food security also lead to foodborne diseases.[189] • Findings from research suggests that exposure to floods, especially during the first year of life, could lead to enduring malnutrition among newborns, posing a significant risk.[190] • Rising temperatures and changing precipitation affect agricultural productivity.[191,192] • Floods and extreme weather events lead to foodborne disease outbreaks.[193]	

4.2.1 Emerging gaps from literature review

Research gaps

- Impact of pollutants other than SO_x and NO_x on health and impacts across demographics such as pregnant women and elderly populations.
- Linkages between climate change and infectious diseases especially water, food borne and food related diseases
- One health approach in climate change and health research
- Spatial and temporal distribution of infectious diseases especially WBDs
- Documentation of mental health impacts of climate change in India
- Impact on reproductive health of women.
- Outdoor workers

Policy gaps

- National Adaptation Plan
- Health-National Adaptation Plan
- Data monitoring to understanding impacts of climate change

Other gaps

- Early warning systems for infectious diseases
- Nature of advisories issued-colour coded systems used for air quality and heat related advisories
- Capacity of healthcare workers to manage climate sensitive diseases
- Public awareness on climate sensitive diseases

4.3 Indonesia

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Indonesia experiences high temperatures with a monthly maximum of around 30.6°C, especially in October. • A Heat Index threshold of 35°C is considered extremely hazardous, and specifically, in a high emissions scenario. By 2080, it is projected that heat-related deaths among the elderly could surge to approximately 53 deaths per 100,000, contrasting sharply with the earlier estimated baseline of less than 1 death per 100,000 annually between 1961 and 1990.[194] • Labour productivity is expected to decline, particularly in labour-intensive occupations.[195]	A Vulnerability, Risk Reduction, and Adaptation study for climate change was conducted in 2011 for Indonesia.[196] The study provided a country overview, key sectors, baseline and projections for climate variables and sectoral recommendations for climate risk. The report highlighted the need for assessment of appropriate locations and information to provide early warnings on floods in the western region of Indonesia and on droughts in the dry zones in some eastern provinces which have a long history of coping with recurring floods and droughts.
Climate change and extreme events related injuries, death, and mental health impacts	• From 1998 to 2018, Indonesia witnessed a majority of climate-related disasters, including floods (39%), heavy windstorms (26%), landslides (22%), and droughts (8%), with 2017 alone recording over 2000 such events, including 198 health crises, affecting over 300,000 people and causing 198 deaths, injuries, and a refugee crisis.[197,198] • The World Bank and Asian Development Bank have developed a Climate Risk Country Profile for Indonesia. The risk profile highlighted the urgent need for adaptation measures without which population exposed to extreme flood events will raise to 1.4 million by 2035–2044.[199]	
Climate change and infectious diseases (vector-borne diseases)	• Each year, Indonesia's 230 million people experience several million malaria cases, with notable outbreaks on Sebatik Island and in Zimbabwe, driven by temperature (25.0–26.5°C) and rainfall (5.6-6.5 mm/month).[200] • A 1 mm increase in precipitation leads to a 0.08% increase in cases after a 3-month lag and 0.09% after a 12-month lag. Factors such as altitude, land use, humidity, and rainfall determine regional vulnerability in South Sumatra and Purworejo, Indonesia.[201] • As of December 31, 2022, there were 125,888 reported dengue cases and 1,082 deaths, with an increase of 31,533 cases and 229 deaths since October 1, 2022.[202,203] • Dengue incidence is influenced by temperature, humidity, and rainfall, with optimal temperature for infection, humidity above 70%, and increased rainfall being key factors in dengue outbreaks.[204]	

Climate change and infectious diseases (water-borne diseases)	• According to research Indonesia's vulnerability to climate change increases water-borne diseases (e.g., diarrhoea), with a 1.9% to 3.8% expected rise, exacerbated by inadequate infrastructure.[205,206] • Research gaps exist in understanding climate change's impact on water-borne diseases and the effectiveness of adaptation measures, particularly in rural areas and among disadvantaged populations.[207,208,209]
Climate change and infectious diseases (zoonotic diseases)	• Limited studies on climate change and burden of zoonotic diseases.
Climate change and air pollution-related illnesses	• Indonesia is the 12th most polluted country, with air pollution reducing average life expectancy by 2 years, and some regions experiencing reductions of over 6 years. Nearly 91% of the population lives in areas with pollution exceeding WHO standards.[210] • Jakarta's air quality, with particulate levels six times WHO guidelines, may lead to a 5.5-year life expectancy loss. [211, 212] Vehicle emissions contribute, potentially causing 2.3 to over 4 years of life expectancy reduction. • Forest fires,[213] exacerbated by factors like El Niño, significantly impact air quality, children's health, and increase respiratory issues and lung cancer cases. The economic cost of air pollution exceeds $16 billion, significantly impacting the economy.[214,215]
Climate change and food-related illnesses	Escobar et al. (2022) found that in Indonesia, urban poor communities face heightened acute health issues and prolonged negative mental health impacts post-floods, unlike their rural counterparts. The affluent urban population showed no health effects from flood exposure. The study implies that worsened economic conditions, without adequate safety nets, might prolong the recovery of previous socioeconomic status, taking decades to rebuild.[216]

4.3.1 Emerging gaps from literature review

The evidence on climate change impacts in Indonesia highlights evidence gaps that require further attention and research.

- Further research is warranted on climate change and health using an intersectional lens which can adequately capture vulnerabilities.
- Studies capturing underlying vulnerability of children, women and elderly populations are inadequate. For robust policy and decision making an understanding of these vulnerabilities is necessary.

- Likewise, there are very few studies which explore the interlinkages between climate change and food-borne diseases as well as climate change and water-borne diseases.
- The impact of air pollution on human health needs to be studied with respect to SO_x and NO_x along with particulate matter.
- Studies on air pollution and human health must delve deep into the impacts on at-risk populations—outdoor workers, pregnant women, children, and elderly.
- Studies exploring the mental health impacts of climate change are few, the inter-linkages between the two need to be studied to arrive at effective response mechanisms.
- Evidence also highlights absence of gender disaggregated data sets. Data sets also do not provide information across demographic groups such as women, children, elderly individuals, and disabled populations.

4.4 The Philippines

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Research assessed heat risk in 139 Philippines cities. Manila had an extremely high Heat Health Risk Index (HHRI) of 0.81, with 5 Metro Manila cities also at high risk. Exposure was the primary factor, with high population density contributing to Manila's elevated risk.[217] • While heatwave research in urban areas is common, 53% of the Philippine population lives in rural areas, where more studies are required to understand the impact of high temperatures. Rural communities work outdoors and directly face prolonged heat. Unlike China, Australia, and many EU countries, the Philippines have not yet introduced workplace temperature limits.[218]	The Philippines, with over 7,640 islands, faces climate risks, particularly in coastal urban areas where 51% of the population resides, vulnerable to flooding and rising sea levels.[219] Children's education is disrupted by

Climate change and extreme events related injuries, death, and mental health impacts	• The Philippines faces a high frequency of typhoons, causing mortality,[222,223,224] mental health (heightened depression, anxiety, and PTSD), property loss and large-scale displacement.[225, 226, 227] Country's vulnerability to stronger typhoons is exacerbated by environmental degradation, especially in Metro Manila.[228] • Research by Gray et al. (2022) reveals that typhoon mortality disproportionately affects emerging urban centres, with higher per capita deaths among men and older age groups, mainly due to drowning.[229] • Research limitations include recall bias, small sample sizes, and limited demographic representation.[230]	extreme climate events, leading to missed school days and decreased academic performance. (UNICEF, 2021) After Typhoon Haiyan, women were 50% more likely to die due to social structures, with caregiving roles putting them at risk during food shortages.[220] Air pollution is identified as the third highest risk factor for death and disability, with $PM_{2.5}$ linked to cardiovascular and respiratory issues, causing approximately 66,230 deaths in 2019, including 1,310 child deaths.[221]
Climate change and infectious diseases (vector-borne diseases)	• The Philippines has significantly reduced the incidence of malaria by 87% from 48,569 in 2003 to 6,120 cases in 2020. The studies on malaria incidence revealed associations with air temperature and rainfall.[231] • The Philippines is facing a severe dengue outbreak with over 115,000 cases,[232] an 85% increase from 2018. Research suggests that dengue incidence is linked to air temperature, rainfall, and climate conditions, with specific impacts in the Iloilo province,[233,234,235] but no comprehensive framework exists to assess dengue risk at a national level.	
Climate change and infectious diseases (water-borne diseases)	• The Philippines faces high vulnerability to climate change, leading to increased risks of water-borne diseases due to contaminated water sources from floods and typhoons.[236] • A study by Chau et al. (2021)[237] utilized a modeling approach to estimate the climate change impact on diarrhoea and dengue fever transmission in the country, while inadequate water and sanitation infrastructure, particularly in rural areas and informal settlements, exacerbates the situation, as noted by Cruz et al.[238]	
Climate change and infectious diseases (zoonotic diseases)	• Limited national-level evidences regarding the linkage between climate change and zoonotic diseases is available within the country.	

Climate change and air pollution-related illnesses	• The per capita greenhouse gas (GHG) emissions in the Philippines are among the lowest in East Asia at 2.2 tCO_2e, lower than countries like Indonesia, Vietnam, and China. GHG emissions are on the rise, expected to reach 399 $MtCO_2e$ by 2030, with the energy sector responsible for over 50% of emissions. • Air quality in the Philippines exceeds WHO guidelines for $PM_{2.5}$ concentration by five times, and traditional cooking fuels contribute to poor air quality, resulting in 32% of heart-related deaths linked to air pollution.[239] • The economic cost of air pollution in 2019 was approximately PHP 2.32 trillion (US$ 44.8 billion), equivalent to 11.9% of the country's GDP, with a significant portion attributed to premature deaths.[240] • Major pollutants, especially $PM_{2.5}$ and NO_2, have severe health implications, leading to respiratory and cardiovascular diseases, with $PM_{2.5}$ responsible for around 3,900 premature deaths annually in Quezon City.[241]	
Climate change and food-related illnesses	Limited national-level evidences regarding the linkage between climate change and food-related illness is available within the country.	

4.4.1 Emerging gaps from literature review

The evidence on climate change impacts in the Philippines highlights several evidence gaps that demand further attention and research.

- Despite the diversity of research topics such as mental health impacts of climate change on health workers, investigating the double burden of diseases (COVID-19 and typhoons), coping mechanisms adopted by female students in shelter homes, many of these studies were based on small sample size.
- While there is research on heat-related health risks in urban areas, there are limited studies focused on rural communities.
- Evidence also highlights absence of gender disaggregated data sets. Data sets also do not provide information across demographic groups such as women, children, elderly individuals, and disabled populations.
- Lack of evidence on the impact of climate change on food-related illnesses and the interlinkages between zoonotic diseases and climate change in the Philippines.
- While some studies mention efforts to improve water and sanitation infrastructure, there's a gap in research that evaluates the effectiveness of these interventions in reducing the incidence of water-borne diseases in areas affected by climate change.

4.5 Thailand

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Heat-related morbidity and mortality is high in Thailand. [242] Between 2017 and 2021, Thailand experienced an average of 2500–3000 cases of heat-related illness.[243] • A lot of studies have focused on understanding the associations between HRI and outdoor occupation[244] as outdoor workers particularly have been found to be more vulnerable, such as farm workers including sugarcane and salt farm workers[245,246,247,248,249,250,251] and soldiers.[252,253] Northern and Central Thailand were the regions vulnerable to heatwaves.[254] • In Thailand, the highest incidence rates of heat-related illnesses were 3.8, 2.3, and 1.6 per 100,000 person-years for individuals aged 65 and above, 55-65, and 45-55, respectively. These illnesses included heat rash, heat edema, heat cramps, heat syncope, acute decay muscle stribe (rhabdomyolysis), heat exhaustion, and heat stroke. Additionally, during heatwaves, there was a significant increase in deaths from infectious diseases and neoplasms.[255] • Urban Heat Island (UHI) effect exacerbates heat stress in Thai cities, where low and middle-intensity heatwaves have a greater cumulative effect on deaths than high-intensity heatwaves.[256,257] • Heat stress has adverse physical health outcomes, including increased mortality and morbidity, and it also negatively impacts daily activities, resulting in negative mental health and well-being outcomes.[258,259,260]	Studies in Thailand have explored women's vulnerability to climate change, but specific research on gendered health impacts is lacking. [261,262,263] Research has shown that climate-related disasters, such as the 2011 floods in Thailand, can lead to displacement during pregnancy, affecting foetal growth and impacting infant birth weight. [264,265] Women and girls face a higher risk of climate-induced heat stress due to the gendered division of labour.[266,267] Under a high emissions scenario, heat-related deaths in the elderly (65+ years) are projected to increase to about 58 deaths per 100,000 by 2080, compared to the baseline of about 3 deaths per 100,000 between 1961 and 1990. A rapid reduction in emissions could limit these deaths to just fewer than 11 per 100,000 by 2080.[268] Flooding in Thailand is associated with an increased risk of respiratory infections in school children.[269]
Climate change and extreme events related injuries, death, and mental health impacts	• A recent report by Thailand's National Economic and Social Development Council (NESDC) reveals that climate change-induced floods have resulted in over 2,000 fatalities and inflicted damage worth 12.59 trillion baht (363 billion USD) on the country in the last three decades.[272] • Evidence regarding association between mental disorders (such as post-traumatic stress syndrome, major depressive disorder) and tsunami, [273] in both children [274 , 275 , 276] and adults, there is a huge gap regarding studies that enhance our understanding of climate change-related extreme event impacts on mental health in Thailand.	

	• Only very few studies could be found that highlighted the mental health impacts of flooding including on health service providers [277] and the flood victims.[278,279,280,281,282]	Women and children are at a greater risk of trafficking following disasters like the 2011 floods.[270]
Climate change and infectious diseases (vector-borne diseases)	• Thailand has witnessed high number of dengue cases with more than 24,030 infections and 20 deaths reported between January and June 2023. Even the infection rate is observed to be 4.2, which is higher than the previous year.[283] • Dengue is more common in semi-urban or urban areas with abandoned water storage. It follows a cyclical pattern in Thailand every 1.5 to 5 years, strongly influenced by ENSO. Peak incidence coincides with the monsoon season, and annual mortality is highest for dengue shock syndrome (DSS), particularly among 15-24-year-olds.[284,285,286,287,288] • Dengue brings substantial economic burdens to the country, costing between USD 41 to USD 261 per case and totalling around USD 440.3 million annually. Workdays lost due to dengue fever range from 6.6 to 7.6 days on average.[289] • The mean relative vectorial capacity for dengue fever transmission is projected to increase in Thailand from 0.75 to 0.8 by 2070 under a high emission scenario (RCP 8.5), and approximately 0.78 under RCP 2.6.[290] • Factors like temperature,[291, 292] rainfall,[293, 294, 295], and humidity [296] are significant predictors of dengue incidence. • Malarial infection prevalence in Thailand depends on rainfall,[297] temperature, and relative humidity. Flooding can lead to other infectious diseases like melioidosis and leptospirosis, with rainfall and temperature playing a role in their incidence.[298,299].	Seasonal patterns of diarrhoeal diseases in Thailand are linked to daily mean temperature and precipitation, with more marked seasonality in some affluent urban populations.[271]
Climate change and infectious diseases (water-borne diseases)	• Water tested microbiologically during the 2011 flood crisis in Thailand revealed contamination, showing a crossover between floodwater and water intended for human consumption.[300]	
Climate change and infectious diseases (zoonotic diseases)	• Limited national-level evidences regarding the linkage between climate change and zoonotic diseases is available within the country.	
Climate change and air pollution-related illnesses	• In 2022, Thailand faced a severe air quality crisis, with $PM_{2.5}$ levels averaging 64 $\mu g/m^3$, over six times higher than the WHO guidelines[301]. In 2021, $PM_{2.5}$ pollution was responsible for 29,000 deaths in Thailand.[302,303]	

	• The State Of Global Air report from 2019 indicated that over 32,000 deaths in Thailand were attributed to $PM_{2.5}$ pollution that year, with an economic cost of 2.17 trillion THB (11% of GDP).[304,305] • Air pollution has been an ongoing crisis, leading to around 49,000 premature deaths and costing $95 billion or 6.6% of GDP in 2018, with an estimated 33,000 deaths in 2016.[306] • Different pollutants, such as O_3, NO_2, SO_2, PM_{10}, and CO, have been linked to hospital admissions for cardiovascular and respiratory diseases, especially affecting the elderly population.[307,308,309,310,311,312]	
Climate change and food-related illnesses	Limited national-level evidences regarding the linkage between climate change and food-related illness, zoonotic diseases is available within this nation.	

4.5.1 Emerging gaps from literature review

Research gaps

- Limited number of studies that provide evidence on impacts of climate change on human health.
- A lot of studies focus on outdoor workers, however, it is equally important to study extreme heat impacts on indoor industrial workers.
- More studies are required to understand climate change health vulnerabilities and impacts on vulnerable populations using disaggregated data.
- With increasing urbanization in Thailand, the country needs to conduct more research understanding the impact of urban heat islands.

Policy gaps

- Heat Action Plans missing
- Health needs to be mainstreamed into climate change policies
- Economic implications of health impacts of climate change should be explored and communicated to inform policy and generate public awareness
- Poor public awareness of climate-related health impacts

Infrastructural gaps

- Poor public health surveillance of climate sensitive diseases—lack of good record keeping of heat and other climate change impacts related deaths.
- Early warning systems need to be developed for climate health hazard events

4.6 Vietnam

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Studies found that heat waves significantly increase the risk of mortality and hospitalization, particularly among the elderly and those with respiratory diseases.[313] • Research found that every 1-square-kilometre increase in green space per 1000 people can prevent 7.4 deaths caused by heat every year.[314] • A study in Ha Tinh province found that 83.4% of farmers experienced heat-related illness symptoms, with risk factors including age, chronic diseases, and work conditions.[315]	The Mekong Delta exemplifies geographic vulnerability, with mining activities exacerbating sea-level rise and erosion.[316,317,318] Poor households in various regions, including the Northern Midlands and Mountains, North Central, Central Coastal, and Mekong Delta, face different climate-related exposures.[319] Hanh et al. (2020) emphasize the need for urgent adaptation actions in the health sector to reduce climate-related vulnerabilities.[320] Extreme weather events can damage infrastructure and disrupt health systems, impacting the quality and accessibility of healthcare, especially in rural areas. The World Bank's Vietnam country report acknowledges that ethnic minorities are more exposed and vulnerable to climate impacts. Explicitly identify the at-risk ethnic groups or delve into the nature and extent of their vulnerability.[321]
Climate change and extreme events related injuries, death, and mental health impacts	• The Mekong River Delta is experiencing various climate change effects, including increased rainfall, temperature rise, and sea-level rise, leading to flooding dangers.[322,323] • Low-lying coastal and river delta regions are vulnerable to sea-level rise, with millions at risk of coastal flooding and reduced labour productivity.[324] • Climate change-related disasters can lead to the spread of infectious diseases, such as diarrhoea, with a focus on vulnerable areas and communities.[325,326] • Mental health issues are emerging, linked to both direct impacts and indirect factors like financial stress, highlighting the need for comprehensive support.[327] • Projections show that inadequate adaptation could harm 6-12 million from coastal flooding by 2070-2100, while climate change may put millions more at risk from riverine floods by 2035-2044, resulting in a 13% drop in labor productivity.[328]	
Climate change and infectious diseases (vector-borne diseases)	• Malaria cases in Vietnam are associated with temperature and rainfall and increase in cases found at 19^{0}C and at 86 mm, respectively and climate projections suggest changes in malaria distribution.[329] • Dengue cases increased significantly in 2022, with seasonal and weather-related patterns in transmission.[330, 331] • Research on extreme events, including El Niño and hot summers, can influence dengue incidence rates. [332] • Southern Vietnam is recognized as a hyper-endemic region where dengue transmission is ongoing throughout the year.[333]	

Climate change and water-borne diseases	• Climate change impacts water quality, sanitation, and hygiene, contributing to water-borne diseases.[334] • Temperature and climate variability are positively associated with water-borne diseases.[335] • Vulnerable populations face higher risks, and there's a need for comprehensive approaches to address poor water quality and sanitation.[336]	
Air pollution-related illnesses	• Vietnam faces air pollution challenges, especially in cities like Hanoi and Ho Chi Minh.[337] • Major air pollution sources include transportation, industry, construction, and energy demands.[338,339] • Air pollution is linked to respiratory and cardiovascular diseases, with gender differences in sensitivity.[340,341] • Perceptions of air quality are related to behavioural responses, such as wearing masks and opposition to coal plants.[342]	
Food-related illnesses and climate change	• Climate change's increased temperature and humidity create favourable conditions for food-borne pathogens.[343] • Inadequate food safety practices, coupled with changes in precipitation patterns and crop impacts, increase the risk of food-borne illnesses.	
Climate change and zoonosis	• Vietnam is at high risk for zoonotic diseases[344] due to factors like population density, urbanization, and livestock trade.[345] • The government has identified priority zoonotic diseases and established a One Health framework.[346,347,348] • There's a need for further investigation into the links between zoonosis and climate change, considering rising temperatures and extreme events.[349]	

4.6.1 Emerging gaps from literature review

- **Limited research** on climate change impacts on the **elderly** and those with **co-morbidities**.
- Absence of studies on climate change vulnerabilities and **impacts on disabled individuals**.
- Need for more research on **gender disparities, early marriages,** and **health risks among women** due to climate change.
- Lack of detailed studies on air pollution's effects on at-risk populations like **children, pregnant women, lactating mothers,** those with **co-morbidities,** and the **elderly,** both **indoors** and **outdoors**.
- Call for intersectional approaches in climate and health studies considering factors like **age, gender, economics, caste,** and **ethnicity**.

- Insufficient research on climate change vulnerabilities and health impacts among **marginalized groups** such as Rohingyas and **migrant communities**.
- Scarce studies on **mental health conditions** in populations affected by climate change.
- Potential for comprehensive research on the **burden** and **emergence of zoonotic diseases**.
- Majority of studies limited to **specific provinces** or **cities**, with few covering the **entire country**, making it challenging to assess their representativeness.

4.7 Fiji

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Under a high emissions scenario, the frequency of heat waves is projected to increase significantly, rising from approximately 25 days in 1990 to an average of around 350 days in 2100. However, rapid emissions reduction could limit the occurrences of heat waves to approximately 160 days on average by 2050.[350] • A study by Honda et al. in 2014, based on the A1B emissions scenario, suggested that without adaptation measures, annual heat-related fatalities in the Australasia region could increase by 211% by 2030 and 437% by 2050. This highlights potential risks for regions like Fiji's Melanesia, where data is currently limited.[351]	Climate change-related disasters can disrupt healthcare services and increase the risks of disease and death, particularly among vulnerable groups, including young children, women of reproductive age, older people, and individuals with disabilities.[352,353,354]
Climate change and extreme events related injuries, death, and mental health impacts	• Under a high emissions scenario and without substantial adaptation investments, an estimated 4,200 individuals per year could be affected by sea-level rise-induced flooding between 2070 and 2100. However, with rapid global emissions reduction and increased protective measures, the annual affected population may be reduced to fewer than 100 people.[359] • Fiji faces the risk of Inland River flooding, with projections indicating that by 2030, an additional 2,000 individuals may face annual river flood risks due to climate change, and another 1,600 due to socio-economic shifts. This is in addition to the roughly 4,700 people affected annually in 2010. Flooding can also lead to long-term consequences like post-traumatic stress and population displacement.[360,361,362] • Extreme weather events, such as cyclones and floods, have the potential to induce psychological trauma, anxiety and depression within affected populations.[363,364,365,366] • Climate change-related displacement and loss of traditional lands and resources can lead to a loss of	Climate change poses health risks, especially during extreme events, affecting reproductive, menstrual, newborn, and child health. Gender-based violence, reported by 72% of women, and violence against children are concerns, with climate change potentially worsening these issues.[355] Coastal communities in Fiji, both rural and urban, in low-lying regions, are highly vulnerable to climate impacts like sea-level rise, inundation, and

	cultural identity and a sense of belonging among the population.[367,368,369]	flooding, threatening their livelihoods. Poverty limits their ability to recover, impacting food security and health.[356] Women face additional climate risks due to gender-based barriers, potentially exacerbating gender disparities and domestic violence.[357] Vulnerable populations, including children, people with disabilities, and the elderly, have limited capacity to cope with environmental and climate risks, with those facing multiple challenges, such as poor, single women with disabilities in remote areas, being particularly affected.[358]
Climate change and infectious diseases (vector-borne diseases)	• Vector-borne diseases, water and food security (including water-borne diseases, malnutrition, food-borne diseases) and zoonosis have been highlighted as key concerns by McIver et al. (2016).[370]	
Climate change and water-borne diseases	• Leptospirosis is a bacterial disease that is spread through contact with animal urine and is also becoming more common in Fiji due to climate change.[371,372,373]	
Air pollution-related illnesses	• In 2012, WHO reported that nearly 42% of around 50 child deaths in Fiji were linked to acute lower respiratory infections caused by indoor air pollution. Fiji's air quality was deemed moderately unsafe according to WHO guidelines, with annual $PM_{2.5}$ levels exceeding the recommended maximum of 10 $\mu g/m^3$.[374]	
Food-related illnesses and climate change	• Fiji struggles to meet global nutrition targets due to more frequent extreme weather events linked to climate change.	
Climate change and zoonosis	• Storms and cyclones disrupt crop production, causing shortages of fresh, nutritious foods and leading households to rely on unhealthy, processed, and canned foods.	

4.7.1 Emerging gaps from literature review

- Limited data exists to understand the specific health impacts of climate change in Fiji's Melanesia region, indicating a need for localized research.
- While there is recognition of climate-related mental health impacts, the extent of psychological stress, anxiety, and depression remains unquantified, requiring further investigation.
- Air pollution contributes to child mortality, but specific data on the prevalence of air pollution-related illnesses is lacking, necessitating further research. The research findings highlight the link between air pollution and child mortality, with a substantial percentage of child deaths attributed to acute lower respiratory infections related to household air pollution. However, the report lacks specific data on the prevalence of air pollution-related illnesses, making it essential to conduct further research to determine the extent of the problem and identify strategies for mitigating air quality issues in Fiji.
- Climate change poses risks to reproductive, menstrual, and child health, but detailed statistics are needed to assess the extent of these impacts.

- The potential rise in gender-based violence due to climate change is acknowledged, but specific data on prevalence and intervention effectiveness is needed.
- Vulnerable groups like children, people with disabilities, and the elderly face unique health challenges, requiring more research to understand their specific needs.
- The effectiveness of adaptation measures in Fiji's healthcare system needs further investigation, along with an assessment of potential gaps in addressing climate-related health challenges.

4.8 Malaysia

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Under a high-emissions scenario, the country's mean annual temperature is projected to increase by approximately 4°C from 1990 to 2100. [5]. The southwest of the country is more vulnerable to severe heatwaves [8]. Malaysia braced more heatwaves particularly after 2000 with 8.98 km2/decade increase in heatwave-affected area in the peninsular Malaysia. The duration of heatwaves in the country has also increased by 1.54 days/decade. The central south region of the peninsular Malaysia has been the area with highest population affected. • According to the highest emissions scenario of RCP8.5, Malaysia's average temperatures are expected to rise by 3.11°C by the 2090s, which is 0.6°C lower than the global average. However, under RCP2.6, the low emission pathway, this increase will be 0.8°C [5]. By 2050, the country is expected to face 200 days of heat waves each year [14]. This is expected to further worsen the public health scenario with respect to heat related illnesses in the country.	With climate change the threats of sea-level rise, coastal erosion, and increased storm surges will adversely impact livelihood and health in coastal areas including coastal cities such as Kuala Lumpur, Penang, and Johor Bahru [62]. Low-lying regions, such as the Klang Valley and parts of the states of Selangor and Perak as well as river deltas and floodplains, are also at risk of flooding due to sea-level rise and more intense rainfall events associated with climate change [6]. These climate threats will also pose public health risks in islands of Pulau Langkawi and Pulau Pangkor [63]. Women may be disproportionately affected by the climate change related health
Climate change and extreme events related injuries, death, and mental health impacts	• Between 2070 and 2100, it is estimated that an average of 234,500 people per year could be impacted by flooding in Malaysia due to rising sea levels under a high-emissions scenario. However, if emissions are significantly reduced and adaptation measures are scaled up, this number could be drastically reduced to 300 people annually [5]. • By 2030, an estimated 85,800 more people could be affected by river floods each year due to climate change, and an additional 89,300 people due to socio-economic factors, on top of the 307,700 people affected annually in 2010 [15]. As per [5], by 2030, climate change is projected to increase the number of people	

	affected by a 1-in-25-year event by 70,000, each year with damages rising by $1.8 billion under the high emissions scenario.	risks due to factors such as their roles in caregiving and their greater vulnerability to poverty. However, in some cases due to their occupational exposure, men are more vulnerable to the particular disease/s. Elderly individuals and children are especially susceptible to the health effects of climate change. According to UNICEF's Climate Change Risk Index, Malaysia is ranked 61st among countries where children are most vulnerable to the projected impacts of climate change. Additionally, a National Youth Climate Change Survey in Malaysia, conducted by UNICEF and UNDP, revealed that 9 out of 10 young people have experienced effects related to climate and the environment [67]. Socio-economic conditions also determine the level of vulnerability of an individual or the population to health impacts of climate change.
Climate change and infectious diseases (vector-borne diseases)	• With climate change, increase in temperature will cause shortening of the extrinsic incubation period (EIP) in cooler places like Cameron Highlands and Kinabalu Park, increasing the transmission intensity and malaria risk in these regions in Malaysia [26]. Studies have shown a strong correlation between heavy rainfall and malaria in Malaysia, raising significant public health concerns about a potential resurgence of malaria due to climate change [27]. • Increasingly, human *Plasmodium knowlesi* infection are being reported [24] with malaria transmission occurring from animals to humans in the rural, forested areas [25]. Public health experts are expressing concern over the rising malaria cases in various regions of Malaysia, attributing climate change as a contributing factor. • Projection studies indicate that between 2020 and 2040, the dengue incidence rate in Malaysia would rise from 628 to 940 cases per 100,000 population [41]	
Climate change and water-borne diseases	• A future projection study indicates that climate change will impact the marine ecosystem, leading to higher temperatures that create more reservoirs for *Vibrio cholerae*. As a result, by the end of the 21st century, the maximum monthly incidence rate of cholera in Sabah is expected to rise by 41.0% compared to baseline levels [46].	
Air pollution-related illnesses	• With the intricate connection between air quality and climate change, the impact of climate change on air quality in Malaysia is a significant concern, particularly in Peninsular Malaysia [49], [50]. Droughts and forest fires caused by climate change negatively affect air quality in Malaysia, leading to harmful consequences for public health.	
Food-related illnesses and climate change	• It has been found that for a 1.0°C increase in temperature, the excess risk of food poisoning in Malaysian states can increase up to 74.1% [55]. Even though, the incidences of food poisoning in Malaysia have been significantly increasing, the foodborne cases in general in Malaysia are underestimated as most of the incidences are not reported [52]. • Climate change is also projected to negatively impact the agriculture sector, threatening the country's food	

	security. Extreme weather events in the country are anticipated to decrease rice yields by as much as 31% over the next ten years. Under RCP 4.5 scenarios, average yields are projected to drop by 18% in the early part of the century, 21% in the middle, and 24% by the century's end, compared to 2021 yield data. For RCP 8.5, average yields could decline by 19% in the early century, 22% in the middle, and 26% by the end of the century [56]. The two states of Kelantan and Sabah heavily agrarian inhabit the most vulnerable populations in the country.	

4.8.1 Emerging gaps from literature review

- Some of the research areas that need immediate focus and attention from policy makers and researchers alike include health impacts of air pollution, understanding the vulnerabilities of different sections, health impacts of extreme heat and heat waves in the country, how is climate change altering the distribution of vectors to help government prepare future action plans to manage various VBDs.
- Research on climate change and health in Malaysia is characterised by limited empirical research, in comparison to modeling studies that simulate scenarios.
- Limited data available on vulnerable populations such as women, older people, and displaced.
- There is a lack of studies that focus on social health determinants, such as food insecurity and nutrition-related issues.
- Studies on non-communicable diseases specifically with respect to climate change are greatly lacking in Malaysia.

4.9 Nepal

	Impacts	Vulnerability
Climate change and heat-related illnesses	• If emissions remain uncontrolled, the mean annual temperature is anticipated to rise by about 6°C from 1990 to 2100. Additionally, the number of warm spell days is expected to increase from fewer than 20 to approximately 245 days each year by the century's end.	Vulnerabilities are influenced by various factors, including demographics, socio-economic conditions such as economic status, education, race, ethnicity, religion, gender, age, class or caste, as well as disability and overall health status[375]. Growing frequency and intensity of
Climate change and extreme events related injuries, death, and mental health impacts	• Climate scientists predict that Nepal will face an increase in the frequency of floods, landslides, and inundations in the near future. Dr. Indira Kandel, a senior divisional meteorologist at the Climate Analysis Section of the Department of Hydrology and Meteorology, emphasizes the growing trend of erratic weather patterns in the country.	

Climate change and infectious diseases (vector-borne diseases)	• As temperatures rise and rainfall patterns become increasingly erratic, Nepal faces greater risks of diseases such as dengue, malaria, and other waterborne and zoonotic illnesses. The spread of disease vectors, such as mosquitoes, along with the contamination of water sources due to extreme weather events, exacerbates the burden of infectious diseases in the country. According to the 2022 Vulnerability and Adaptation Assessment of Climate-Sensitive Diseases and Health Risks in Nepal, a total of 12 climate-sensitive diseases (CSDs) were identified, including seven vector-borne diseases (malaria, kala-azar, Japanese encephalitis, scrub typhus, dengue, Zika, chikungunya), two food and waterborne diseases (cholera and acute gastroenteritis), one respiratory disease (severe acute respiratory infections), as well as undernutrition and mental illness.	heatwaves, which pose significant health risks, particularly for the elderly population. Studies indicate a substantial increase in heat-related fatalities among the elderly, with projections estimating approximately 53 deaths per 100,000 by 2080, compared to around 4 deaths per 100,000 annually from 1961 to 1990[376]. The vulnerability rank analysis from the Vulnerability and Adaptation Assessment (VAA) 2022 identified significant regional disparities. Nine districts in the Tarai region (Dang, Dhanusha, Kailali, Kanchanpur, Kapilvastu, Mahottari, Saptari, Sarlahi, and Siraha), one district in the Hill region (Salyan), and five districts in the Mountain region (Bajhang, Bajura, Humla, Kalikot, and Mugu) exhibited high vulnerability across all four disease categories: vector-borne diseases (VBDs), waterborne and foodborne diseases
Climate change and water-borne diseases	• Diarrheal diseases remain a major challenge in Nepal due to inadequate safe water supply, poor sanitation, and unhealthy living conditions. Annually, at least 30,000 children die, and each child experiences an average of 3.3 episodes of diarrhoea.[377] There is a significant association between childhood diarrhoea and increased maximum temperature and rainfall in Kathmandu.[378]	
Air pollution-related illnesses	• Air pollution concentrations in Nepal surpass WHO guidelines by fivefold, leading to approximately 133 deaths per million annually.	
Food-related illnesses and climate change	• Nepal's heavy reliance on agriculture, contributing over 40% of GDP, makes it vulnerable to climate variability, threatening food production, access, and livelihoods.[379] • Extreme weather events like floods and droughts, exacerbated by climate change, further strain food security, particularly impacting subsistence farmers and rural mountainous households.[380] The 2008-2009 winter droughts severely affected farming, with climate change identified as a significant driver.[381]	

	(WBDs/FBDs), severe acute respiratory infections (SARI), and issues related to malnutrition and mental illness. Women, elderly and children are particularly more vulnerable to health impacts of climate change.

4.9.1 Emerging gaps from literature review

- Although existing studies have examined the health impacts of climate change in Nepal, there is a pressing need for more quantitative measurements, particularly concerning productivity loss and specific health outcomes such as respiratory diseases, vector-borne diseases, and mental health issues.
- While studies have identified women, children, and the elderly as vulnerable groups, there is insufficient analysis of specific gender disparities in vulnerability. Further research is essential to understand how gender dynamics intersect with climate-related health risks and impacts.
- There is a lack of understanding regarding the differential health impacts of climate change between urban and rural populations, particularly in terms of access to healthcare, infrastructure, and adaptation strategies.
- Although some studies have addressed the mental health effects of natural disasters, there is limited research on the broader psychological and social impacts of climate change, especially among vulnerable populations. The increasing phenomenon of "climate anxiety" is only starting to receive attention.
- More studies are needed to explore coping mechanisms, social support systems, and community resilience in response to climate-related challenges.
- The absence of known health effect coefficients related to various climate-sensitive diseases, such as waterborne and vector-borne diseases, has hindered understanding of the extent of health impacts attributable to major environmental risk factors like temperature and climate change in Nepal.
- There is an urgent need for additional research on vector-borne, waterborne, and other climate-sensitive diseases, including noncommunicable diseases, to inform evidence-based health adaptation planning.

- Limited research and surveillance of dengue have been significant barriers to effective prevention and management strategies.
- Due to the lack of spatially explicit research in Nepal, there is a poor understanding of the current spatial distribution of dengue risk areas and potential shifts in risk due to future climate change.
- A research gap exists regarding the health impacts of climate change in Nepal, particularly in determining how changes in climatic variables trigger health effects.
- Additional research is required on the social impacts of compound environmental shocks to inform adaptation strategies that enhance well-being in the context of climate change.
- There is a notable lack of research focusing on zoonotic diseases in Nepal. Understanding the prevalence, transmission dynamics, and impact of zoonotic pathogens on both human and animal health is crucial for implementing effective prevention and control measures.
- Research often overlooks the inclusion of disabled individuals and tribal communities, resulting in a lack of studies examining the socio-economic, environmental, and health-related challenges faced by these populations in Nepal.
- Despite the growing threat of vector-borne diseases due to climate change, there is a scarcity of research articles investigating the direct relationship between climate change and vector-borne diseases.

4.10 Cambodia

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Under the RCP6.0 scenario, Cambodia lost an estimated 4.3 percent of daylight working hours in 2015 on the account of extreme temperature (UNDP, 2016). As per ILO (2019), amongst South-East Asian countries, Cambodia's working hour loss to heat stress stood at a total of 7.53 percent for a full-time workforce of 3,94,000 in 1995 and is projected at a total of 7.83 percent for an estimated 7,69,000 full-time workforce for the year 2030 (figure 1). • Heat stress is projected increase the productivity loss under all sectors significantly under the RCP6.0 scenario against the RCP2.6 scenario • As per ASEAN (2021), heat mortality rate in Cambodia is expected to rise 4.11 (RCP8.5) and to 4.26 (RCP 4.5) by 2050	Cambodia is geographically vulnerable due to its coastline, particularly the Mekong delta region. Climate change is having deleterious impact on children and women in Cambodia. Factors such as access to infrastructure, institutional support could devoid or limit women of the

Climate change and extreme events related injuries, death, and mental health impacts	• Storms, flooding, and drought are Cambodia's most significant disasters, affecting large populations and incurring high costs. Climate change is expected to exacerbate these challenges, with projections of drier dry seasons and increased rainfall and more severe storms during the wet season[382]. These changes are likely to lead to more frequent and intense floods and droughts, further straining communities and resources[383]. • While not as frequent as floods or droughts, tropical cyclones are among the costliest meteorological disasters in Southeast Asia, with an average of 27 cyclones affecting the region annually.	opportunities. Additionally, lack of data availability further restricts policy reforms (World Bank Group, 2016). Climate change is predicted to have asymmetrical impacts on the low-income groups in Cambodia.
Climate change and infectious diseases (vector-borne diseases)	• Dengue outbreaks, historically seasonal and urban, have been expanding to the rural areas of the country. Climate change and human behaviour, such as storing water near homes, are seen as contributing factors.	
Climate change and water-borne diseases	• An altering rainfall pattern has not only impacted the quality and supply of water for consumption but has also induced changes in the location and degree of spread of water-borne diseases in Cambodia such as diarrhoea (World Bank Group, 2024; Davies et al., 2014). Several water-borne diseases such as leptospirosis, viral hepatitis, typhoid fever, schistosomiasis, melioidosis and diarrhoea have increased due to the extreme conditions.	
Air pollution-related illnesses	• Air pollution is one of the leading cause of disabilities and deaths in Cambodia since 2009, irrespective of the change in number of deaths per day, which have decreased	
Food-related illnesses and climate change	• Food-borne diseases contribute to the leading causes of death and illness in Cambodia (World Health Organisation, 2017).	
Climate change and zoonosis		

4.10.1 Emerging gaps from literature review

4.11 Tuvalu

	Impacts	Vulnerability
Climate change and heat-related illnesses	• Global climate models project that surface air temperatures in Tuvalu could increase by up to 1°C by 2030, relative to 1995 levels, and by as much as 1.9°C by 2050 under high emissions scenarios. This rise in temperature will also lead to a corresponding increase in the number of extremely hot days, which is expected to rise by approximately 0.5°C by 2030 under a low emissions scenario, and by 0.7°C under a high emissions scenario.[384] •	The geographic characteristics increase the vulnerability of communities living on the outer islands of Tuvalu, where access to resources and infrastructure is limited.[385] The key vulnerable groups include women and adolescent girls, children, elderly people, PwD, indigenous people and socio-economically marginalized groups.[386]
Climate change and extreme events related injuries, death, and mental health impacts	• As sea levels rise and extreme weather events become more frequent, Tuvaluans experience acute anxiety stemming from both immediate environmental changes and broader global climate narratives.[387]	
Climate change and infectious diseases (vector-borne diseases)	• As temperatures rise and rainfall patterns become more erratic, Tuvalu faces heightened risks of diseases like dengue, malaria, waterborne and zoonotic diseases. The proliferation of disease vectors, such as mosquitoes, and the contamination of water sources due to extreme weather events contribute to the burden of infectious diseases in the country.	
Climate change and infectious diseases	• The impacts of climate change, including rising temperatures, higher tides, flooding, and more frequent tropical cyclones, are expected to increase the risk of both vector-borne and waterborne diseases in the coming decades. • Consequently, the combination of drought, sea level rise, and flooding amplifies the potential for waterborne diseases and other health problems in Tuvalu	
Air pollution-related illnesses	• As temperatures rise and air quality worsens, more Tuvaluans suffer from air pollution-related health problems. Though relatively less intense than in industrialized nations, air pollution in Tuvalu, is increasing due to factors like increased vehicle use,	

	reliance on fossil fuels for energy, and poor waste management.	
Food-related illnesses and climate change	• Climate change is increasingly undermining the traditional food systems in Tuvalu. As local food production becomes less reliable due to climate change, Tuvaluans are increasingly dependent on imported, processed foods that lack essential nutrients.[388]	

4.11.1 Emerging gaps from literature review

- Mental Health and Climate Anxiety: While climate-related anxiety is recognized, further research is needed on long-term mental health impacts and appropriate interventions, particularly in the context of pre-traumatic stress disorder.
- Displacement and Migration: The health impacts of displacement, including mental health, nutrition, and access to healthcare, are underexplored.
- Food Security and Malnutrition: More research is required on the nutritional health impacts of climate change-induced food insecurity, especially for at-risk populations such as children and pregnant women.
- Air Pollution-related Illnesses: Limited research and data on air pollution in Tuvalu hinder assessing its public health impacts amid changing climatic conditions.
- Zoonotic Diseases: There is limited evidence linking climate change to zoonotic diseases, highlighting the need for research in this area.
- Vulnerable Populations: Longitudinal studies on the differential impacts of climate change on women, children, the elderly, marginalized groups, and people with disabilities are lacking.
- Impact on Maternal and Child Health: There is insufficient evidence on how climate change affects maternal and child health in Tuvalu, particularly in terms of nutrition, disease susceptibility, and healthcare access during pregnancy and early childhood.
- Limited Geographical Specificity: Research in Tuvalu is largely focused on the capital, Funafuti, with little attention to other regions. This lack of localized data may overlook specific health vulnerabilities and impacts in different areas of the country.

5. Health Systems and Adaptation Health Response

The increasing frequency of extreme weather events not only affects the financial and structural aspects of healthcare systems but also contributes to carbon emissions.[389] While climate change poses significant risks to public health, viable strategies exist to mitigate these health burdens, encompassing environmental and social measures targeting climate-sensitive diseases and reinforcing healthcare systems for both prevention and treatment in the face of changing climate conditions. Collaboration among various sectors, including water, sanitation, and nutrition, is crucial to manage and mitigate climate-related risks, as health systems serve as the foundation of individual and community resilience. They play an integral role in preventing adverse health outcomes and safeguarding public well-being. They serve as the first line of defence and offer accessible, affordable, accountable, and dependable healthcare and public health services. However, it is imperative that healthcare and public health services are restructured to ensure that they are equipped to meet immediate and future challenges.[390] Governments worldwide recognize the urgency of addressing climate change and are prioritizing it across multiple agencies. Coordinated efforts between the health sector and other stakeholders under a unified climate change strategy are essential. Implementing a comprehensive "health in all policies" approach seamlessly integrates climate change considerations into relevant policy areas**.**

Furthermore, various national and international organizations, including WHO, are actively involved in the development of frameworks to strengthen health systems, such as "Health Systems Strengthening" (HSS). HSS aims to enhance a country's capacity to perform essential healthcare functions, focusing on building capacity, sustainability, equity, effectiveness, and efficiency in both public and private healthcare sectors.[391] Robust health systems are critical for addressing diseases and non-communicable diseases, especially in the context of a changing climate.[392,393,394] WHO also defines health systems as comprising organizations, individuals, and actions aimed at promoting, restoring, or maintaining health. The "10 Essential Public Health Services" defined by the Centers for Disease Control and Prevention provide a framework for promoting equitable public health.[395]

The 2021 and 2024 Lancet Countdown on Climate Change and Human Health reports emphasized climate change as the largest global health threat of the 21st century, highlighting it as a public health emergency. Climate change has a direct impact on the factors that determine both environmental and social health outcomes. It is estimated that 250,000 additional deaths per year are likely to occur due to malnutrition, malaria, diarrhoea, and heat stress during the period 2030–2050. [396] Furthermore, there is evidence of multiple climate hazards occurring simultaneously. Additionally, non-climate risks also interact which exacerbate the overall risk faced by all sectors. For the health-sector these risks will be heightened to meet the need for care due to poor air quality, rising heat stress, and poor nutrition outcomes. Additionally, as described in earlier sections certain demographic groups are highly vulnerable and would face greater risk due to their biological make-up, weaker immune systems as well as limited access to affordable and high quality of care.[397]

The 2020 Lancet Countdown report revealed that half of the surveyed countries had developed plans for health and climate change,[398] yet only 9% had adequate funding for implementation. Pre-existing financial challenges for meeting United Nations Sustainable Development Goals were exacerbated by the COVID-19 pandemic, leading to reduced healthcare financing.[399] Despite the availability of global climate funds, like the Global Environment Facility, the Adaptation Fund, and the Green Climate Fund, limited funding is allocated for health-related issues. Effective climate risk management necessitates government-level coordination, emphasizing the importance of proper representation of the health sector in adaptation planning. Ensuring adequate coordination between sectors can maximize health co-benefits across areas such as energy, agriculture, housing, and water. The National Action Plan for Health Security (NAPHS)[400] is a country-owned, multi-year planning process that aligns with the broader national health strategy and other sectoral plans, allowing countries to tailor specific steps to their unique context for the development and implementation of NAPHS.

The sections ahead, illustrate the health systems infrastructure in South and Southeast Asia and Pacific Island Countries. The vertical extent of these systems as well information regarding the health workforce is also discussed. Furthermore, challenges and limitations of health systems which are likely to limit their ability to respond to climate emergencies are also highlighted.

5.1 Public Health Systems at a Glance

Most healthcare systems are organized into three tiers, with the central ministry holding the highest authority. However, each system has its unique characteristics; for example, India has implemented a three-tiered system that incorporates the private sector to improve healthcare accessibility. In contrast, Bangladesh follows a hierarchical structure with five tiers, which faces challenges related to equitable access and limited resources. Indonesia heavily relies on primary care facilities and is striving to achieve universal health coverage while addressing non-communicable diseases and health impacts from climate change. Vietnam, on the other hand, utilizes a referral-based system with various financing sources, dealing with issues associated with an aging population and a shortage of healthcare professionals. There is evidence from Vietnam suggesting improved access to universal healthcare by prioritizing the underprivileged, providing comprehensive services to all, and reducing urban-rural healthcare spending disparities. Lastly, the Philippines adopts a three-tiered approach involving both public and private sectors, with a strong focus on combating non-communicable diseases and expanding healthcare coverage through the Universal Health Care Bill.

Table 3 Overview of health indicators in the selected countries

Indicators	India	Bangladesh	Indonesia	Philippines	Vietnam	Thailand	Fiji	Nepal	Malaysia	Cambodia	Tuvalu
Physicians per 1000 population[401]	0.7	0.7	0.6	0.8	0.8	0.9	0.9	0.9	1.7	0.2	1.2
Nurses and mid-wives per 1000 population[402]	1.7	0.5	4.0	5.4	1.4	3.2	4.0	3.5	3.4	1.0	3.7
Beds Occupancy per 1000 inhabitants[403]	0.5	0.8	1.0	1.0	2.6	2.1	2.0	0.3	2.0	1.2	4.2 (2001)
Total health expenditure[404,405] (% of GDP)	3.27	2.63	3.41	5.61	4.68	4.36	3.75	5.4	1.9	7.53	20.0
Out-of-pocket expenditure as percentage of current health expenditure (CHE) (%)[406]	50.59	74.00	31.79	45.03	39.60	10.54	13.66	57.7	31.5	60.4	0.35

Source: Compiled from various sources (World Bank, MoHFW, WHO)

In **India,** the public healthcare system is structured with three levels:[59] Primary Health Care, Secondary Health Care, and Tertiary Care Health Care (Figure 6). Primary Health Centres (PHCs) serve as the initial point of patient-doctor contact. Community Health Centres (CHCs) offer more comprehensive services, including specialist care. Sub-District Hospitals (SDHs) provide secondary care and serve as referral units, reducing the load on district hospitals. District Hospitals (DHs) offer a broad range of services, including specialized care.[407] The number of facilities varies across states and union territories, and some areas lack Sub-District Hospitals. At the national level in India, the Ministry of Health and Family Welfare formulates health policies and funds national health programmes. At the state level, each state has its Department of Health and Family Welfare, which collaborates with autonomous State Health Societies. District Health Missions and City Health Missions play essential roles in implementing healthcare programmes at the local level. The private sector is also involved in healthcare service delivery.[408,409]

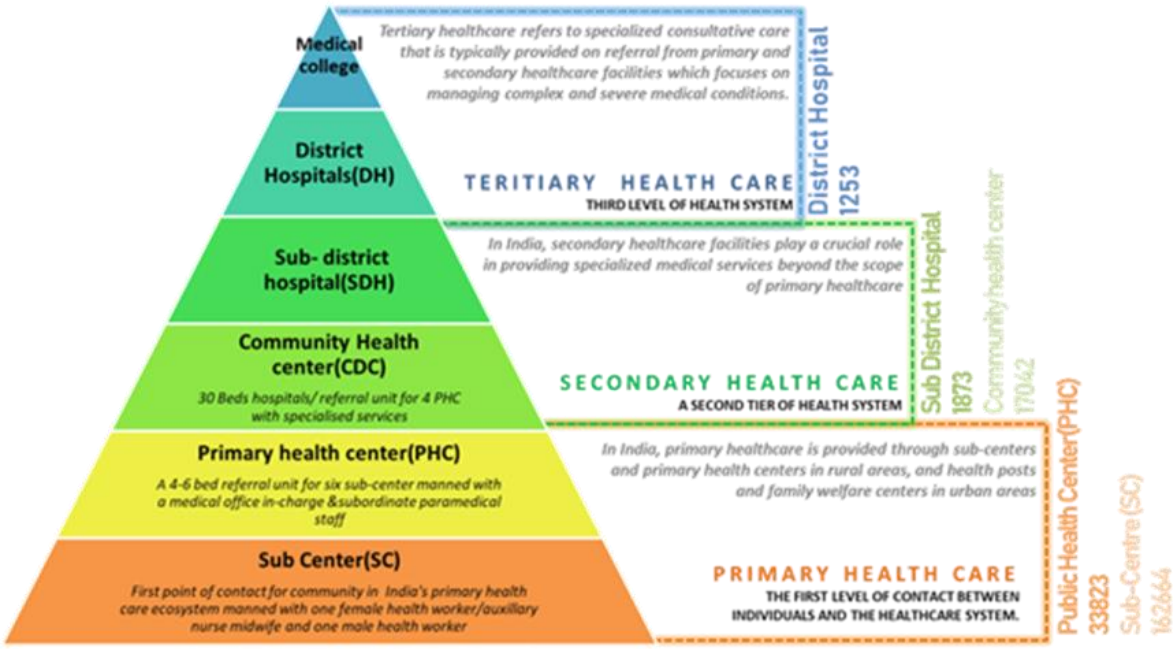

Figure 6 Three-tier health system in India
Source: Compiled by authors

Bangladesh's healthcare system features a five-tier hierarchy, starting with ward-level health facilities and moving up to union health centres, Upazila Health Complexes, district hospitals, and medical colleges.[410] However, despite this structure, many in the population, especially in rural areas, face limited access to healthcare services.[411] The healthcare system involves various stakeholders, with the government taking the lead in policymaking, regulation, and providing comprehensive healthcare services.[412] Challenges such as resource constraints, institutional limitations, and healthcare provider issues can impact service quality.[413] To bridge these gaps, the private sector and NGOs have established their own healthcare facilities, often filling the void in rural areas.[414]

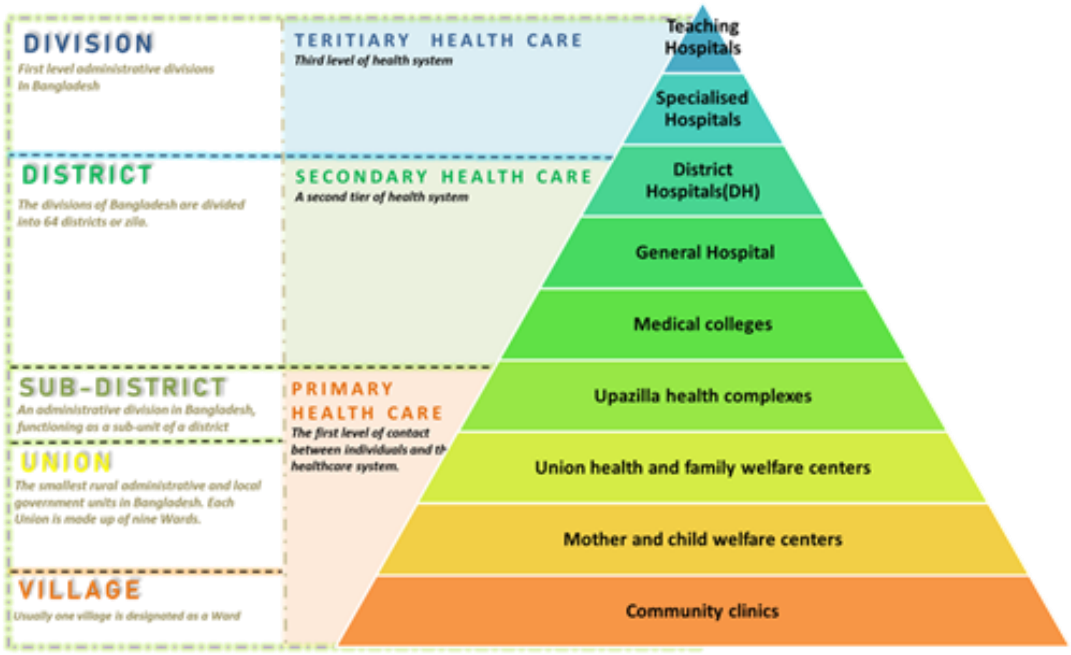

Figure 7 Five-tier health system in Bangladesh
Source: Compiled by authors

In **Indonesia**, the primary entry point for healthcare is through primary care facilities known as "puskesmas."[415] These facilities provide a wide range of services, including preventive measures, maternal and child health care, and family planning. However, patients often need referrals to access higher levels of care, and emergency cases can bypass this requirement. The healthcare system is structured into three tiers: primary care, secondary care for specialized services, and tertiary care for highly specialized treatments. Traditional and alternative therapies are also commonly used. The Ministry of Health and the Ministry of Home Affairs share responsibilities for organizing the healthcare system across different levels of government.[416] Public and private sectors play key roles, with public health services provided through various entities. The government's aim is to achieve universal healthcare through a social security agency called "Badan Penyelenggara Jaminan Sosial Kesehatan." This system, known as "Jaminan Kesehatan Nasional," covers various categories of individuals, contributing to the goal of universal health coverage.[417]

In **Vietnam**, the healthcare system is divided into three levels: primary care, secondary care, and tertiary care. The referral system ensures that patients receive the appropriate level of care.[418] The healthcare system also includes specialized services like mental health care and rehabilitation also. The healthcare system in Vietnam is a mix of public and private providers.

The healthcare facilities in the **Philippines** are structured into three tiers.[419] The primary level consists of rural health units, private clinics, and community hospitals that provide basic healthcare services. The secondary level includes smaller hospitals and regional facilities, offering more specialized care. The tertiary level comprises advanced medical centres and large hospitals, providing highly specialized treatments. Within the primary healthcare system, there are three levels of primary health workers: Village or Grassroots Health Workers, Intermediate Level Health Workers, and First-Line Hospital Personnel. These levels ensure a coordinated healthcare

system with a two-way referral system for patients. The healthcare system is divided into two sectors: public and private healthcare. The Department of Health[420,421] oversees the regulation of health facilities in the public sector, while local government units are responsible for delivering primary and secondary care. The private sector primarily handles hospital care and maternity services.

In 1977, **Fiji** adopted a village-based primary healthcare approach.[422] The Ministry of Health and Medical Services oversees healthcare provision.[423] Fiji's healthcare system comprises three tiers, including public and private facilities and traditional healers. The Global Health Security Index ranks Fiji 169th out of 195 countries. While Fiji excels in health response, there's room for improvement in areas like emergency preparedness and healthcare capacity.[424]

The **Malaysian healthcare system** is a two-tiered system, consisting of a government-funded public sector and a private sector. The public sector is the primary provider of healthcare services to most of the population, while the private sector serves to those who can pay for it [425]. The public sector is funded through general taxation and provides a wide range of healthcare services, including primary care, secondary care, and tertiary care [426]. Primary care is provided through a network of health clinics, while secondary care is provided through district hospitals. Tertiary care is provided through a network of specialist hospitals. The private sector is made up of a variety of providers, including hospitals, clinics, and traditional Chinese medicine practitioners. Private healthcare is generally more expensive than public healthcare, but it often offers shorter waiting times and higher quality care.

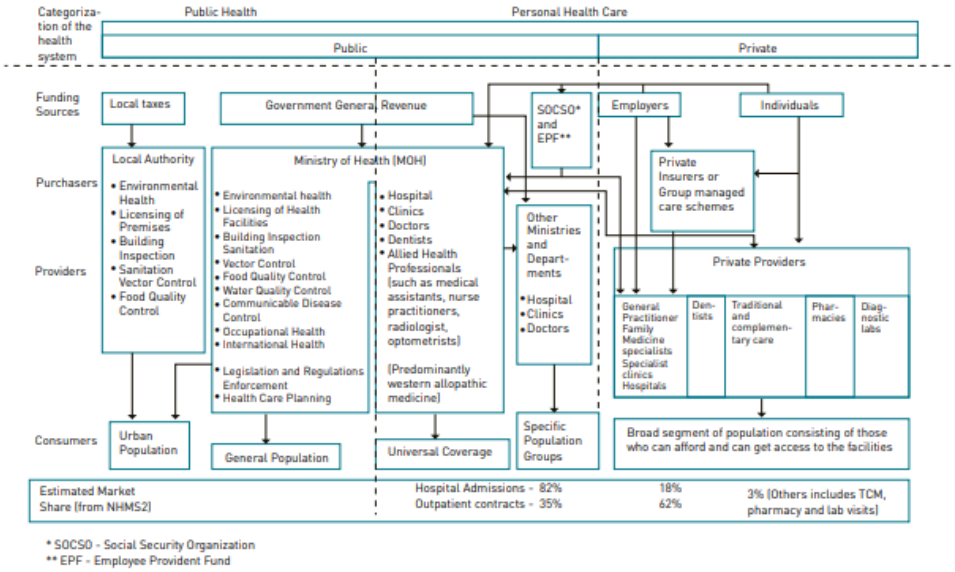

Figure 7: Schematic Overview of Malaysian Healthcare System[427]

In 2015, **Nepal's** new Constitution was established that assigned health as a fundamental human right, ensuring that every citizen has the right to free basic health services and cannot be denied emergency care. The federal government retains responsibility for overall health policy formulation, budget provision, development of national standards and regulatory frameworks,

and delivery of specialized healthcare through national hospitals. The seven provincial governments are tasked with delivering basic hospital services and coordinating with both local and federal governments. The 753 local governments (rural and urban municipalities) are responsible for providing primary health services. These changes aimed to make the health system more responsive to local needs and accountable to citizens.
Health sections in local governments are overseen by health coordinators, responsible for creating health policies, designing programs, and monitoring health facilities. Under the federal structure, local governments are tasked with delivering basic health services, possessing the authority to set priorities, allocate resources, manage services, and evaluate outcomes.

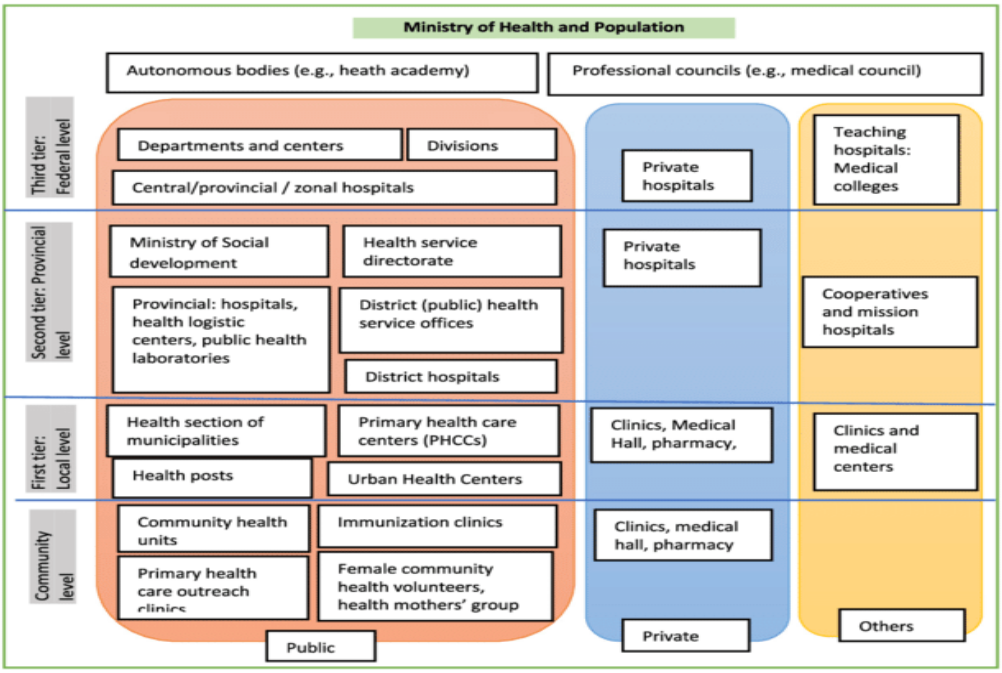

Figure 8: Health system organogram of Nepal

Healthcare model in **Cambodia** encompasses private and public infrastructure under for-profit and not-for-profit corporate mechanisms. The functions of the private and public sector are divided as per their designation and functions into the **Central Tier (**Ministry of Health (MoH), Training Centres, National Centres, and 8 National Hospitals), **Provincial Tier** (25 Health Department), and **Local Level Operational Tier** (Health centres, Hospitals, Reproductive health centres). However, despite the growing scale of facilities, a large percentage of population place their trust in the facilities in international institutions based on Thailand, Singapore, and Vietnam [428].

The public health system in **Tuvalu** operates under the Ministry of Health (MOH) and primarily emphasizes primary care, preventive services, and health education to address both communicable and non-communicable diseases and ensuring accessible healthcare. Key services in Tuvalu's public health system include maternal and child health, disease surveillance and control, primary healthcare and NCD management. Tuvalu's healthcare structure is centralized

around the Princess Margaret Hospital (PMH) in Funafuti, which serves as the only referral hospital in the country.[429] For lower-level, primary healthcare, Tuvalu's structure is organized as National Level, Sub-national Level (Island Health Centers) and Local Level. While this structure is intended to provide a framework for healthcare access, however, health services on outer islands are limited. Travel between islands is often required for more intensive treatments, which can delay care and exacerbate health conditions.

The private healthcare sector in Tuvalu is almost non-existent due to the small population, limited market, and reliance on the public healthcare system. Given that healthcare is heavily subsidized by the government and funded through international aid, private facilities have not emerged. However, for most of the Tuvalu's population, public healthcare remains accessible and sufficient for basic health needs.430 Non-governmental organizations (NGOs) play a supportive but significant role in Tuvalu's healthcare system, often providing expertise, financial assistance, and resources in collaboration with the Ministry of Health.

5.2 Health System Response and Adaptation

The countries are actively addressing the impact of climate change on health. India's comprehensive approach involves early warning systems, healthcare capacity enhancement, and sustainability measures. Bangladesh integrates climate change into development and disaster management, with a focus on community-based adaptation and air quality control. Vietnam strengthens resilience and air quality management, while Indonesia combines adaptation and mitigation efforts, setting ambitious emission reduction targets and addressing air pollution. The Philippines takes a whole-of-government approach to combat climate-related health challenges and has ambitious emissions reduction goals. Thailand focuses on low-carbon and climate-resilient development through a master plan and national adaptation policies. These countries collectively demonstrate a strong commitment to mitigating climate change and enhancing public health.

Country	Air Pollution			WASH			Climate Change
	Existence of legal standards for PM2.5	Compliant with WHO Air Quality Guidelines	Existence of national policy on household energy	Financial resources available for implementation of national plans			Existence of national health and climate change plan or strategy
				Drinking water	Sanitation	WASH	
INDIA	✓	✗	✓	Insufficient Data			✓
BANGLADESH	✓	✗	✓	In urban and rural 50-74% of what is needed		For Healthcare facilities: Insufficient data For Schools: 90-100% of what is needed	✓
NEPAL	✓	✗	✓	In urban and rural <50% of what is needed	In urban <50% of what is needed In rural 75-94% of what is needed	For Healthcare facilities and Schools <50% of what is needed	✓
INDONESIA	✓	✗	✓	In urban and rural <50% of what is needed		For Healthcare facilities: 50-74% of what is needed For Schools: <50% of what is needed	✓
VIETNAM	✓	✗	Insufficient Data	Insufficient Data			Insufficient Data

Figure 9 Summary of policies taken under air pollution, WASH and climate change
Source: Environmental Health 2022 country profile

Figure 8 illustrates an overview of the policies outlined in the WHO's Environmental Health Country Profile for 2022. It encompasses both the policies that have already been implemented and those that are still under consideration for future implementation.

India's approach to addressing climate change and its impact on health is directed by the Prime Minister's Council on Climate Change, with the Ministry of Environment, Forest and Climate Change (MoEFCC) serving as the primary coordinating body at international, national, and state levels.[431] The MoEFCC plays a vital role in implementing India's National Action Plan for Climate Change (NAPCC) and the National Action Plan on Climate Change and Human Health (NAPCCHH).[432,433] This comprehensive approach addresses the health impacts of climate change by establishing health early warning systems, enhancing healthcare system capacity, and strengthening surveillance systems. Collaboration with the Ministry of Health and Family Welfare (MoHFW) and the National Centre for Disease Control (NCDC) is integral to implementing these strategies. Beyond climate change and health, India has a range of national programmes to combat vector-borne diseases, ensure safe drinking water access, promote sustainable agriculture, enhance urban health, strengthen disease surveillance, address mental health, and advance digital health. The greening of healthcare facilities and reduction of carbon footprints, along with multi-stakeholder initiatives, contribute to India's broader efforts in building a climate-resilient and sustainable healthcare system.[434,435,436,437]

Bangladesh has been proactive in addressing climate change adaptation and its impacts, with the Ministry of Environment and Forests (MoEF) leading the way.[438] The country has established significant policies and institutional mechanisms, such as the National Adaptation Programmes of Action (NAPA), the Bangladesh Climate Change Strategy and Action Plan (BCCSAP),[439] and the Climate Change Unit (CCU) to mitigate climate change effects. The government also recognizes the importance of community-based adaptation and has integrated climate change into national development plans and disaster management efforts.[440] High-level committees and organizations, like the Inter-ministerial Committee on Climate Change, play key roles in overseeing and guiding these adaptation processes. Furthermore, Bangladesh has developed a Health National Adaptation Plan (HNAP) focusing on water and food security and the spread of infectious diseases, including initiatives like rainwater harvesting, disease surveillance systems, and measures to prevent malaria transmission.[441] However, while progress has been made in policy development, there's a need to enhance institutional capacity and mainstream climate adaptation.[442,443] The country also addresses air pollution issues, with measures ranging from reducing short-lived climate pollutants (SLCPs) in various sectors to citywide initiatives for cleaner air. [444] Recommendations from the World Bank emphasize strengthening disease surveillance, vector control, mental health support, and air quality management to combat climate change-related health challenges.[445,446,447]

Vietnam has shown substantial commitment to enhancing its climate change adaptation policies and strengthening community resilience. The government initiated the National Target Programme to Respond to Climate Change in 2008,[448] emphasizing adaptation. International assistance has also been instrumental in implementing these strategies. Despite these efforts, there are areas that need improvement. Vulnerability and risk considerations in adaptation and disaster prevention strategies, particularly in infrastructure development, require better integration. Financing and international aid have not kept pace with the country's needs. To address air pollution, Vietnam adopted the National Action Plan on Air Quality Management in 2016, involving measures like stricter vehicle emission standards and improved traffic control. However, long-term national policies and stricter enforcement are needed to address pollution comprehensively. Vietnam has also embraced the National Adaptation Plan (NAP) and is focusing on priority policy packages for adaptation goals, including the Mekong Delta Plan, coastal resilience investment, air pollution reduction, clean energy transition, and protecting vulnerable populations.[449] Other initiatives include the National Target Program to Respond to Climate Change, the Green Growth Strategy, climate scenarios, community-based adaptation, and the Mekong Delta Plan. The Climate Change Coordination Office (CCCO) is instrumental in coordinating adaptation efforts across sectors and government levels.[450]

The Philippines aspires to achieve a high-income economy by 2045, but it faces growing climate risks, impacting economic activities and infrastructure development. Annual losses from typhoons amount to approximately 1.2% of the country's GDP.[451] Projections by the IPCC suggest that temperatures in the Philippines will continue to rise, with increasing variability and intensity in rainfall and extreme events. Without prompt climate action encompassing adaptation, mitigation, and disaster management, the nation could incur significant economic and human

costs. In response, the Philippines has implemented an extensive set of policies using a whole-of-government approach. Notably, the National Policy on Universal Health Coverage is a significant policy reform in the health sector, focusing on financial risk protection, improved access to quality healthcare, and the achievement of health-related Millennium Development Goals. The country has also integrated climate change and disaster-related challenges into various policies and programmes, bolstered by the National Disaster Risk Reduction and Management Act. Initiatives such as malaria eradication, disaster management, and mental health programmes overlap with the impacts of climate change on health. In addition, the Philippines renewed its Nationally Determined Contributions (NDCs) in 2021, aiming to reduce cumulative emissions by 75% from 2020 to 2030.[452] This commitment recognizes the role of the private sector in driving economic growth and transformation and has introduced ambitious programmes to scale up renewables and phase out new coal-fired plants, although timelines for phasing out existing coal-based plants remain to be established.[453,454,455]

Indonesia confronts a growing number of natural disasters, such as floods and landslides, exacerbated by climate change impacts, causing considerable economic and human losses. To address these challenges, the government has implemented a range of climate change policies and strategies. [456] Their National Action Plan for Climate Change Adaptation prioritizes integrating climate concerns into national development, with a particular focus on enhancing health sector resilience.[457] Additionally, the National Adaptation Plan outlines strategies in four key categories: infrastructure, technology, capacity building, and governance, including programmes to combat vector-borne diseases like dengue haemorrhagic fever. Indonesia is also committed to mitigation efforts, as seen in its Long-Term Strategy for Low Carbon and Climate Resilience, aiming to promote sustainable development with low emissions and minimal resource exploitation. These strategies align with their updated NDCs, which set ambitious emissions reduction and restoration targets. Moreover, Indonesia addresses air pollution with clear permissible thresholds for air quality. However, these guidelines do not align with WHO standards, and enforcing them remains challenging. [458] The government has set emission standards for various industries and introduced regulations to prevent open burning, yet illegal forest fires continue to be a significant concern. Disaster risk reduction is another focal point, with the country having a comprehensive network of early warning systems, although they face constraints such as power failures and limited telecom network coverage at the local level. Public awareness and self-evacuation capacities are recognized as areas for improvement. Indonesia's multifaceted approach demonstrates its commitment to mitigating climate change impacts and bolstering resilience in various sectors.[459,460,461,462]

In **Thailand**, the National Economic and Social Development Board (NESDB) is a Thai national economic planning agency that formulates a plan once every five years. The objective outlined in the 11th NESDB plan (2012–2016) aimed to transition Thailand towards becoming a society that is both low-carbon and resilient to climate change (National Economic and Social Development Board 2011). [463] Following the issuance of this plan, the Office of Natural Resources and Environmental Policy and Planning (ONEP), operating under the Ministry of Natural Resources and Environment (MoNRE), developed the Climate Change Master Plan 2015–2050 (ONEP

2015).[464] This master plan served as the basis for the establishment of the Climate Change Action Plan and the National Adaptation Plan (NAP). The NAP mandates that each government agency create and execute an adaptation policy for the period spanning from 2018 to 2021. The NAP focuses on six key sectors: water management, agriculture and food security, tourism management, public health management, natural resource management, and human settlement and security (Sakhakara, 2017, ONEP 2018a). The implementation process for these policies is scheduled for completion by 2021, with the support of eight international organizations and projects that collaborate with ONEP in carrying out these activities.[465,466,467]

Fiji has taken significant steps to address the impact of climate change on public health. The country has established a dedicated focal point for climate change within the Ministry of Health and has implemented various policies and strategies related to climate resilience and health adaptation. These include the National Climate Change Policy, health adaptation projects, and the creation of climate-resilient healthcare facilities.[468,469] Collaborative efforts with organizations like the World Bank[470,471,472] and Asian Development Bank[473,474] aim to strengthen health systems, improve connectivity, and enhance climate resilience.

The Constitution of **Nepal**, adopted in 2015, establishes the fundamental right of every citizen to live in a clean and healthy environment (Article 30). Additionally, Article 35 guarantees access to free basic health services, clean drinking water, sanitation, and hygiene for all citizens. Nepal also has several national policies and strategies, such as the Health National Adaptation Plan (H-NAP) 2023, the National Health Policy 2019, and the National Climate Change Policy 2019 (DoHS, 2020/21). Recently, the health sector in Nepal has begun to incorporate climate change considerations into its plans, policies, and programs. The Nepal Health Research Council (NHRC), supported by the WHO Country Office for Nepal, identified climate change as a priority research area in 2006[475].

The National Health Policy of Nepal aims to develop an inclusive health system that guarantees access to quality healthcare for all citizens, based on principles of social justice and good governance. The policy includes integrated preparedness and response measures for combating communicable diseases, climate change impacts, and disaster management. The country has the Nepal Health Sector Strategy (NHSS) 2015-2020 designed to navigate the health sector over this period by promoting multi-sector collaboration to tackle social determinants of health. Nepal has Health- National Adaptation Plan (HNAP) 2023-2030 which is a policy level response to climate change induced floods, heatwaves and diseases. The HNAP targets health infrastructure improvement with focus on realignment of climate policies into the health systems. NHSSP and MoH have adopted Standard guidelines for construction and design of infrastructure facilities for health called Nepal Health Infrastructure Development Guidelines 2017[476]. Additionally, Nepal has several multi-stakeholder initiatives in this context including Nepal Quality Health Systems Program (NQHSP) with World Bank[477], Country Partnership Strategy (CPS) formed by the Asian Development Bank in collaboration with the government of Nepal for the 2020-2024[478], to mention a few.

Malaysia has been implementing a range of policies and initiatives to tackle climate change. These include National Policy on Climate Change (NPCC, 2009), Nationally Determined Contribution (NDC), and Long-Term Low Emissions Development Strategy (LT-LEDS). The Government also launched the National Energy Transition Roadmap (NETR), highlighting Malaysia's initiatives to build a sustainable and inclusive energy system by advancing a low-carbon energy sector and promoting renewable energy and energy efficiency. Additionally, the government is working on formulating a National Adaptation Plan (MyNAP) on climate change, focusing on a long-term measures and plan for different sectors including the health[479]. The Ministry of Health has been developing programs to address climate-sensitive diseases like dengue fever, waterborne illnesses, and respiratory problems linked to air pollution. Regarding air pollution, the government established Malaysian Air Quality Guidelines, the Air Pollution Index, and the Haze Action Plan to improve air quality[480].

Cambodia has taken significant efforts to overcome climate change related health risks, including United Nations Development Program (UNDP) and World Health Organisation (WHO) that envisioned a four-year project (2019-2023), with funding from the Global Environment Facility (GEF) to reinforce the healthcare system capacity and autonomous capabilities through institutional capacity enhancement of six least developed countries (LDCs) namely, Bangladesh, Lao People's Democratic Republic, Myanmar, Nepal and Timor-Leste including Cambodia, The Cambodia Applied Veterinary Epidemiology Training (CAVET) Programme funded by the U.S. Centres for Disease Control and Prevention and the Defence Threat Reduction Agency – Biological Threat Reduction Program (DTRA BTRP) was established in the year 2012 to tackle the spread of zoonotic diseases in Cambodia, particularly influenza as well as reinforce the health system on the animal, human and environmental fronts. Other initiatives are by the Asian Development Bank and the World Bank Group. Other government policies and plans include the Health Strategic Plan 2016-2020, and complementary documents like the Health Information System Master Plan and the Health Workforce Development Plan focusing on strengthening data quality and addressing potential healthcare worker shortages.

In recognition of the challenges posed by climate change, **Tuvalu** has taken steps to develop policies and plans aimed at building resilience and adapting to the health impacts of climate change. Through national and regional frameworks, Tuvalu is addressing immediate and long-term health concerns by focusing on enhancing healthcare systems, improving disaster preparedness, securing water and food supplies, and educating communities about climate-related health risks. The country's commitment to addressing climate-related health impacts is evident in its various national adaptation programs and strategic action plans, which align with regional frameworks such as the Pacific Islands Framework for Action on Climate Change. The existing climate change adaptation health response in Tuvalu include Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015, the National Climate Change Policy 2021-2030, titled Te Vaka Fenua o Tuvalu, has been developed to respond to the needs of the people. This policy advances the national priorities set out in the National Strategy for Sustainable Development 2021-2030 Te Kete. The Tuvalu National Strategic Action Plan (NSAP) for Climate Change and Disaster Risk Management is a joint strategic plan designed to address both climate change adaptation and

mitigation as well as disaster risk management. Serving as the operational (implementation) plan for Tuvalu's Climate Change Policy (2011), also known as Te Kaniva, the NSAP outlines a framework for tackling the country's vulnerabilities to climate change and disaster risks. The National Climate Change Policy (2012-2021), titled Te Kaniva, prescribes the strategic policies of the Government and the people of Tuvalu for adapting to and responding to climate change impacts and related disaster risks over a 15-year period. Other relevant policies and plans include National Adaptation Programme of Action (NAPA), Environmental and Social Impact Assessment and Management Plan (ESMP), Tuvalu Coastal Adaptation Project (TCAP) and a number of multi-stakeholder initiatives.

5.3 Major Challenges Faced by Public Health Systems

According to a study by the WHO in 129 countries which aimed to study the extent of disruptions caused by COVID-19 found that in more than 50% of countries primary care, community care and rehabilitative services were disrupted. Almost 30% of countries reported facing disruptions in extending emergency services, critical and operative care. Apart from resulting in increase of mortality for COVID-19 cases disruptions also resulted in backlog in the management of non-communicable diseases.[481] In India, health experts have brought to light experiences of pregnant women, individuals on dialysis as well as people requiring mental health support who faced difficulty in accessing medicines and care. The primary reasons for these disruptions were identified as lack of healthcare resources and policies that resulted in reduced services and reduction in care seeking.

Lugten and Hariharan, (2022)[482] have identified three priority areas to ensure development of resilient health systems to withstand climate stress. Mobilizing domestic resources and private capital combined with strong management but flexible process is necessary to ensure quick responses to climate emergencies. Similarly, there is a need for improving access to and use of integrated climate and health data through which stakeholders can be intimated about the rising climate and health risks. These systems can facilitate redistribution of resources-health workers, supplies for emergency response, and ensure availability of evidence for informed policy decisions. Making primary healthcare and health system response plans context-specific is the fundamental pillar for effectively addressing health emergencies. Customized and integrated response mechanisms, designed to address specific local needs, must involve all actors, including indigenous people, vulnerable groups, and marginalized populations. This inclusivity enhances responsiveness, promotes equity, and improves healthcare quality. Engaging the community not only bolsters social capital but also builds resilience at both individual and community levels.
Likewise, Mosadeghrad et al. (2023),[483] have identified 87 interventions to build a Climate Resilient Health System (CRHS) which were categories into the 6 WHO building blocks—governance, financing, workforce, equipment and medicine, information systems, and health services delivery processes. According to authors, building CRHS hinge on several factors along with those identified by the WHO including climate change mitigation efforts, emergency preparedness, and support for research. Authors underscore the role of multi-sectoral cooperation with integration of health concerns in sectoral policies and plan as a priority area. These pillars are also discussed by Shweta Narayan from Healthcare Without Harm, who stresses

on low carbon pharmaceuticals and vaccines, sustainable production of food being used by the health sector, zero carbon health facilities, zero carbon transport facilities and improving the efficiency of health systems which revolves around better network of health facilities and strengthening of tele-medicine.

5.3.1 South Asian region — India, Nepal and Bangladesh

The risk of climate change in the South Asian countries of India and Bangladesh is illustrated in the impacts and vulnerability sections. The key climate risks to human health include the increasing temperatures and consequent heat waves, the issues of air pollution as well as the looming threat of infectious diseases such as malaria and cholera. It is worth noting that South Asia is home to a burgeoning population of 2,034,805,031 as of Tuesday, October 31, 2023, based on the latest United Nations estimates with their health systems facing multiple challenges. Despite these elaborate structures, the health systems in these countries face several challenges, such as:

- **Shortage of healthcare workers:** For instance, Bangladesh is grappling with a shortage of healthcare professionals, with approximately one registered physician for every 1,410 individuals, resulting in a doctor-patient ratio significantly higher than the WHO-recommended 1:1,000.[484]
- **Regional disparities in the distribution of healthcare facilities and also workforce:** Some of these disparities in healthcare worker distribution can be attributed to healthcare professionals' preference for better-equipped urban facilities, which leaves rural areas underserved. This situation is worsened during disasters. For instance, nearly 900 healthcare facilities in Pakistan were damaged due to flooding, resulting in reduced healthcare access and shortages of medical supplies.[485] It is also observed that pregnant women in rural Sindh are particularly affected, as inundated healthcare institutions leave them without proper facilities.
- **Informal healthcare providers lack formal education and training, among the informal workers** especially in rural areas raising concerns about the quality of care and accurate diagnosis especially in the diseases related to climate change. For example, in India the case of heat-related illness, many PHCs and CHCs in the country have established cold rooms for patients affected by heat strokes. However, there are key concerns arising from the lack of knowledge regarding the purpose and proper utilization of these facilities. In many cases especially in rural areas, it has been observed that these cold rooms were constructed merely for nominal purposes, with limited understanding of their intended use.
- **High out-of-pocket costs**: High out-of-pocket costs for healthcare services and treatments can be a major burden on households, especially in regions where health insurance coverage is limited. For instance, The Government Health Expenditure (GHE), including capital expenditure, amounts to INR 271,544 crore, or 41.41% of the GHE. Households' out-of-pocket expenditure (OOPE) on health constitutes 47.07% of the GHE, while private health insurance expenditure accounts for 6.99% of the GHE.[486] Whereas in Indonesia the current healthcare spending was forecast to continuously increase between 2023 and 2028

by in total 14,860 million USD (+34.07%). The spending is estimated to amount to 58.5 billion USD in 2028 according to WHO.[487]

- **Health insurance coverage:** While initiatives to improve health insurance coverage are underway in India with the government launching the Ayushman Bharat (Pradhan Mantri Jan Arogya Yojana), which provides health coverage of up to INR 5 lakh per family per year for secondary and tertiary care hospitalization to Economically Weaker Sections (EWS). Despite these recent developments, estimates indicate that only 37% of people in the country were covered under this scheme in 2021.[488]
  The PWC in its report on insurance coverage flags health insurance as a crucial area that needs development. Health insurance was reported to be almost non-existent with also the lowest expenditure on health in South Asia estimated at 2.64%.[489]
- **Lack of coordination and siloed approaches:** While countries have put in place climate and health programmes, there is a considerable gap in coordination among different actors, institutions, and departments. This gap can be attributed to limited scope and opportunities for inter-departmental and sectoral coordination, competing priorities and scarce resources. Existing siloed approaches have also resulted in inefficiency, duplication of efforts and gaps in services' delivery.[490]
- **Data availability and disease surveillance:** India and Bangladesh have disease surveillance systems with features enabling data and trend analysis as well as other relevant resources. In India, under the Integrated Disease Surveillance Programme (IDSP) data is collected on epidemic-prone diseases on a daily basis through the Integrated Health Information Platform (IHIP) portal. Efforts are underway to enhance the data quality as well as integrate data from the NPCCHH under the system to enable progress monitoring and mapping. Along with the availability of data, the quality of data continues to remain a key concern across several LMICs. The lack of data digitization can serve as a significant barrier to improving health outcomes.[491]
- **Lack of public awareness:** Evidence from surveys in India reveals that a mere 9% of the population professes to be adequately informed about global warming, with 32% having some knowledge, 20% claiming only a basic understanding, and 35% admitting to never having heard of it. This knowledge gap poses a significant threat to public health especially considering rising temperatures, air pollution, and extreme events.[492]

5.3.2 Southeast Asian region—Indonesia, the Philippines, Thailand, Malaysia, Cambodia and Vietnam

The study delves into the specific challenges faced by the region taking the case of four Southeast Asian countries, namely Indonesia, the Philippines, Thailand and Vietnam in the context of their healthcare systems and climate-related risks. These nations collectively constitute a combined population of 688,770,658 as of October 31, 2023, according to the latest estimates from the United Nations. They account for 8.54% of the total global population, but grapple with major challenges in this regard. The region is vulnerable to climate risks, including extreme weather events, heatwaves, sea-level rise, and infectious diseases, which have placed immense strain on their healthcare systems. The following are the major challenges:

- **Shortages of healthcare facilities and workers:** Indonesia faces a severe shortage of hospitals and hospital beds, with just 2,925 hospitals serving a population of nearly 270 million.[493] During the COVID-19 pandemic, the inadequacy of intensive care unit (ICU) beds was evident, with just 2.7 critical care beds per 100,000 people.[494] The Philippines also experiences a shortfall in the density of doctors compared to neighbouring countries. In Vietnam, while there has been an increase in healthcare workforce, there is still a shortage, with lower numbers of doctors and nurses per 10,000 people than the global average.[495] This shortage can lead to overburdened healthcare facilities and reduced access to quality care.
- **Lack of comprehensive long-term care policies:** The Philippines and Thailand lack comprehensive long-term care policies to address the evolving health needs of their aging populations, which can lead to challenges in providing adequate care for the elderly.
- **Urban healthcare imbalance:** In Thailand, the healthcare system is heavily oriented towards hospitals and private clinics, with limited focus on primary healthcare for managing chronic non-communicable diseases. Enhancing urban primary healthcare services and engaging private clinics in preventive and health promotion efforts is needed.
- **Financial sustainability and governance:** Vietnam projects an annual increase in healthcare expenditures per capita, reaching USD 262 by 2025.[496] The financial sustainability and governance of healthcare systems are crucial challenges that need to be addressed.
- **Resilience of health systems**: The COVID-19 pandemic exposed vulnerabilities in health systems, with disruptions in primary care, community care, and emergency services in many countries, resulting in increased mortality for COVID-19 cases and backlogs in the management of NCDs. The main reasons for these disruptions were identified as a lack of healthcare resources and policies that led to reduced services and care-seeking.
- **Insurance coverage**: The countries of Indonesia, Vietnam and the Philippines have designed National Health Insurance (NHI) to advance their Universal Health Coverage. The countries finance their NHIs through a combination of general tax revenue as well as individual coverage. These three countries target government revenue for the poor and selected vulnerable populations. This is in contrast with the countries of China and Thailand where general tax revenue is used to offer coverage to individuals outside formal employment sector. Despite continuous efforts to implement these insurance schemes, these countries continue to face challenges in achieving comprehensive coverage. For instance, as of October 2018, only 76% of the Indonesian population was covered by NHI as reported by Agustina et al. (2019).[497] Estimates from 2015 reflect that insurance coverage in the Philippines was only available to 63.2% of the households.

Vietnam has witnessed a notable increase in health insurance enrolment with figures increasing from 65% in 2011 to 77% in 2015.[498,499]

- **Data collection and surveillance:** In Vietnam, the utilization of big data in public health surveillance holds significant potential. However, this comes with its own set of challenges. The foremost challenge is the integration of data from various sources, making it difficult to consolidate diverse data streams effectively. Additionally, ensuring data quality, including accuracy, completeness, and timeliness, is a critical concern for meaningful analysis. Data privacy issues must be addressed to protect sensitive health information, and promoting data sharing among different stakeholders remains a complex task.[500]

  In contrast, Indonesia's decentralized health information system, operating at subnational levels like districts/cities and provinces, presents unique challenges. Variations in the availability and capability of human resources for assessing data quality hinder consistent data evaluation across different regions. The absence of standardized data quality assessment protocols and tools further complicates data quality assurance. Data fragmentation, stemming from the decentralized structure, makes it challenging to integrate and analyse health data cohesively. These prominent challenges result in suboptimal utilization of routine data for decision-making and resource allocation. Integrating routine health data becomes complex, leading to difficulties in data assessment, requiring collaboration among health programme managers and stakeholders at various levels to ensure data reliability and usability.[501]

5.3.3 Island region – Fiji and Tuvalu

- **The financial requirements for climate adaptation in Fiji are substantial, estimated to be equivalent to 100% of the country's GDP over the next decade.**[502] This poses a considerable financial challenge for the government in implementing necessary climate-resilience measures.
- **Understanding the non-linear causality between climate change and health is a complex and evolving field.** Officials struggle to differentiate health issues caused by climate change, such as additional diarrhoeal mortality, from pre-existing cases. This challenge highlights the need for improved data quality and guidance to assess the impacts of climate risk on health outcomes effectively.
- **Communicating and promoting disaster preparedness and climate adaptation** among communities in remote areas is difficult. These communities often have limited access to information and resources, making it challenging to ensure their preparedness and resilience to climate-related challenges.[503]

- **Social protection systems** in Fiji are not effectively linked to climate change adaptation policies and practices. This lack of integration hinders coordinated efforts to protect vulnerable populations from the health impacts of climate change.[504]

These collective challenges emphasize the necessity for a thorough and flexible healthcare and policy development approach within these countries. This approach is crucial for addressing the effects of climate change on the well-being of their populations as they have to cope with the changing demands. Therefore, the following section delves into the adaptive health responses adopted by these nations to mitigate the impact of climate change on public health.

6. Synthesis and Way Forward: Recommendations for the Indo-Pacific Region

While there is an increasing recognition of the health impacts of climate change and the importance of climate resilient healthcare, the conceptual foundations and practical expertise required for the shift towards environmentally sustainable healthcare are not widely understood and imparted to healthcare professionals. Educating and training the healthcare workforce, which includes imparting tangible technical skills, is widely recognized as a crucial priority in current strategies for the transition to environmentally sustainable healthcare.

Additionally, findings highlight the absence of any local or national policy for inclusion of internal and external surge (doctors, paramedics, etc.) in any health facilities during acute phase of emergency remains a gap area in Health Sector Emergency Preparedness for Response. As of now, the integration of external surge in the health system is absent, which impedes delivery of transitional services during extreme disaster events.

A major point emphasized by stakeholders was the role of Early Warning Systems (EWS) in the realm of public health. There is necessity for a more sophisticated approach to disease surveillance, stressing that current programmes are often overly general and do not sufficiently consider climatic factors. This gap highlights the importance of enhancing the incorporation of climate-related data into disease surveillance initiatives, thereby enhancing our ability to comprehend and address health risks influenced by shifting climatic conditions.

Further suggestions were made to ensure existing Disaster Information Systems capture essential information about the available health facilities. Based on discussions with experts, recommendations are identified for the region.

6.1 Sensitization of Public on Climate and Health

Promoting public awareness through Information, Education, and Communication (IEC) initiatives on climate change's intersection with human health is vital for bolstering preparedness and response efforts, ultimately reducing casualties. Effective IEC strategies must stem from a comprehensive understanding of the public's existing knowledge and beliefs, while addressing prevalent misconceptions, skepticism, and opposition. Elevating public awareness about the profound impact of climate change on human health is essential to drive proactive measures, mitigate its adverse effects, and ultimately minimize casualties.

6.2 Capacity Building of Health Workers

The prominent challenge to the management of climate sensitive diseases in the Indo-Pacific region is the limited research on impacts of climate change on health. There is a need for prompt response on this front, with health professionals occupying a central position. First and foremost, health professionals are expected to protect individual and community health in the face of emerging health risks. Secondly, these professionals can play a pivotal role in communicating

climate-related risks and potential solutions to patients, the general public, and policymakers. Thirdly, their knowledge and skillsets are indispensable in transforming health systems and communities to become climate resilient and sustainable.

With health professionals constituting a key force in the climate crisis, countries have identified capacity building initiatives for health professionals as a top priority. As countries engage with health professionals, it is important to ascertain these initiatives can increase communication with the health sector on climate change impacts on health, equip knowledge and skills of health professions which can be readily translated into practice, engage with health professionals and support staff working at the primary healthcare level to cater to requirements at the grassroots level, evaluate effectiveness of these courses and introduce refresher courses at regular intervals, incorporating latest research and findings.

Case study: Training and capacity building programme in the Philippines

The collaborative initiative known as 'Climate Resilient and Healthy Barangays,' jointly undertaken by the German Red Cross and the Philippine Red Cross, was executed in four provinces within northern Luzon, namely Benguet, Ifugao, Ilocos Sur, and La Union. In close partnership with the Department of Health, this project brought together over two dozen health officials and workers from the participating provinces to formulate key messages for the development of informative materials, including posters and flipcharts, addressing the impact of climate change and climate-sensitive diseases such as dengue fever, diarrhoeal diseases, respiratory illnesses, leptospirosis, and measles. Following official approval from the Department of Health, these educational materials were distributed and are now prominently displayed in municipal and barangay health centres throughout the targeted provinces. Moreover, an innovative curriculum centred on the intersection of climate change and health was designed, and nearly three dozen Red Cross staff and health officials from the participating provinces were equipped as trainers. These trainers, in turn, conducted comprehensive training sessions for more than 550 Red Cross volunteers, midwives, and barangay health workers, equipping them with the necessary knowledge and skills to effectively facilitate educational sessions on climate change and its implications for health within their respective communities. These trained facilitators engaged with nearly 9,000 individuals, with over 80% of them being women, through informative and awareness-raising sessions designed to illuminate the profound impacts of climate change on public health, thereby strengthening community resilience and preparedness.[505]

6.3 Climate and Health Surveillance Systems

There is a need to integrate multiple surveillance systems, in this case disease surveillance and weather surveillance. This integration can help in using information for detecting, investigating, and responding to public health threats. These solutions can help in identification of at-risk populations of climate-sensitive diseases and improve prevention, control, and elimination programmes by mapping the geographic range of vectors and pathogens using environmental and climate variables. Some countries in the Indo-Pacific region have initiated such projects. For example, satellite systems in Myanmar support the integration of climate and environment information into health surveillance in Myanmar and development of early warning system for

dengue fever in Vietnam. These systems are extremely crucial for small island countries in the pacific region wherein countries such as Fiji, enhanced risk monitoring and climate early warning systems have helped populations get prepared and respond to climate change resulting in reductions in morbidity and mortality from climate sensitive diseases.[506]

Case study: Resilient health systems in Vietnam

In the southern region of Vietnam, specifically in Cu Lao Minh, a general hospital faces significant challenges in securing its water supply. Situated in the Mekong Delta area, this hospital is particularly susceptible to annual issues such as droughts, floods, and saltwater intrusion, all of which pose a threat to its water availability. To address these challenges, the WHO Country Office in Vietnam has collaborated with the Health Environment Management Agency (VIHEMA) under the Ministry of Health to initiate customized solutions aimed at reducing the risks associated with water supply at three hospitals in the region.[507]

6.4 Relocation and Retrofitting of Critical Health Infrastructure

In the midst of a pandemic, and with merely a few years left to expedite advancements towards SDGs, it is essential that countries strive to transform healthcare systems to effectively serve the most challenging regions. While some degree of progress has been made in this regard, nevertheless there is need for further financial and technical assistance. The Sendai Framework for Disaster Risk Reduction 2015–2030 aims to enhance the safety of health facilities during emergencies and disasters. It targets a significant reduction in disaster-related harm to crucial infrastructure, prioritizing services like healthcare and education. The framework focuses on bolstering resilience in these facilities by 2030.

Strategies for existing critical facilities in disaster-prone areas include relocation, strengthening, retrofitting, adding redundancy, revising operations, and adopting emergency preparedness, response, and recovery programmes.[508] These strategies can help ensure that critical health infrastructure remains intact, accessible, and functioning at maximum capacity before, during, and immediately following an emergency or disaster.

6.5 Climate Health Vulnerability Risk Assessment

Vulnerability and adaptation (V&A) assessments play a vital role in enhancing our understanding of the interconnections between climate change and health. By pinpointing populations at risk, particularly those more susceptible to health issues stemming from climate change, health authorities can implement precise public health interventions to mitigate adverse health impacts. These assessments also provide a baseline for monitoring changes in disease risks and protective measures. Furthermore, they offer an opportunity for capacity building and bolster the case for investing in climate and health programmes.

Some regions have already initiated such risk assessments, as seen in India, where Climate and Health Vulnerability Assessments have been prioritized under NPCCHH. At the national level, a climate and health vulnerability assessment has commenced, with plans to extend similar assessments to sub-national and district levels.

6.6 Alerts and Warnings

A colour-coded system of alerts and warnings can establish a standard system for communicating risks associated with extreme weather events. This system can be used by different agencies and organizations to communicate risks to the public and to trigger public health interventions designed to reduce harm to people.

The Indian Meteorological Department (IMD) issues colour-coded alerts during the summer season to inform people about the severity of weather conditions, including heatwaves. The alerts are categorized into three levels: red, orange, and yellow, based on the intensity of the weather phenomenon. The alerts are based on several factors, including temperature, humidity, wind speed, and the probability of precipitation. The National Institute of Disaster Management (NIDM) in India has recommended establishing similar system for issuing alerts to public and disaster managers to communicate the risks associated with climate-related hazards. These systems can help people understand the risks associated with extreme weather events and take appropriate measures to protect themselves.

6.7 Develop Heat Action Plans

Given the increased frequency and severity of heatwaves, countries in the Indo-Pacific should create and implement Heat Action Plans (HAPs). The review found that the countries of Bangladesh, Vietnam and Thailand covered in the study do not have HAPs. However, in India these HAPs have been put in place.

In India, addressing heat-related illnesses has been given a prominent place within NPCCHH. Notably, HAPs have been meticulously developed and are being implemented. States such as Gujarat have led the way by pioneering HAPs, with cities such as Surat and Rajkot serving as models for the rest of the nation. In Delhi, the HAP focuses on various critical measures, including the distribution of water and oral rehydration solutions at public locations, supplying water tankers to informal settlements during heatwaves, ensuring uninterrupted power supply to vital facilities, enhancing access to night shelters, and installing LED display boards to provide real-time temperature forecasts. The HAP also places a high priority on implementing cool roof programmes for informal settlements.

Expanding and scaling up HAPs is crucial, especially in the region where extreme heat poses significant health risks. Actions are needed to ensure continued government commitment to the expansion of HAPs, and allocate the necessary funding and resources to support these efforts. Within the region, the focus must be to encourage collaboration between countries and actors at various scales—regions, states and municipalities to share lessons learned and best practices.

6.8 Inclusion of Health in National Adaptation Plans

All relevant actors in the climate and health sector must advocate for the inclusion of health as a key sector in NAPs. These plans should specifically outline targeted interventions as well as the financial sources to address climate-related health risks, including strengthening healthcare infrastructure, ensuring access to clean water, and promoting vector-borne disease control.

6.9 Establish Climate and Health Programmes at the Country Level

While some countries have plans to combat the health impacts of climate change, it is imperative to call for the development of dedicated climate and health programmes at the country level within the Indo-Pacific region. These programmes should facilitate inter-agency collaboration, research, and the implementation of evidence-based interventions to protect public health from climate impacts.

Besides, formulation of a network of state-level actions with a focus on climate and health may facilitate knowledge sharing between states, provinces, and local authorities to share best practices, resources, ensuring that health adaptation efforts are tailored to regional needs.

6.10 Mainstream Health in Climate and Sectoral Policies

Encourage governments in the Indo-Pacific region to prioritize public health by incorporating health considerations into climate and sectoral policies. This would mean recognizing the far-reaching health impacts of climate change in various sectors and ensuring that health is a core component of policymaking.

6.11 Green Health Infrastructure

A collective set of measures are listed below to define an integrated framework for promoting sustainability within healthcare systems.

1. **Invest in Zero-Emissions Health Infrastructure:** Allocate resources towards the development of health infrastructure that produce zero emissions, rely on renewable energy, and depend on energy efficient devices and promote climate resilience in healthcare facilities.
2. **Reliance on sustainably procured food:** Ensure that food within healthcare facilities is sourced sustainably while striving for minimal food waste generation, thereby promoting eco-friendly dietary practices. Kitchen gardens in hospitals are becoming increasingly popular as a way to promote health and well-being among hospital staff and patients.
3. **Circular Healthcare and Sustainable Waste Management:** Establish a comprehensive approach to healthcare by sourcing sustainable supplies, deploying clean technologies, minimizing the volume and toxicity of healthcare waste, and managing waste in an ecologically sustainable manner.
4. **Energy Efficiency and Auditing Requirements for Healthcare Facilities:** Healthcare facilities have to be mandated to perform energy audits on their structures and create detailed plans for these assessments to gauge energy consumption within the facility. Notably, in India, certain states have initiated energy audits for select hospitals. However, due to limited funding and a shortage of experts for doing this, this practice is implemented only in a limited number of healthcare institutions.

Models of green and zero carbon healthcare facilities from India

- *Amrita Hospital (Faridabad)[509]: The hospital housing 2,600 beds and 81 specialty departments has been designed with its environmental impact at the forefront. This healthcare project in India stands as one of the largest green-building initiatives, boasting a minimal carbon footprint. Additionally, it operates as a completely paperless facility and maintains a zero waste discharge system.*
- *Aravind Eye Care System[510]: Aravind Eye Hospital and the Postgraduate Institute of Ophthalmology have implemented strategies to reduce air pollution. High efficiency cooling devices, pumps and LEDs, are installed to reduced electricity consumption by 25% to 30%. It also uses renewable energy sources such as hydro, wind, and solar.*
- *Bhagat Chandra Hospital[511]: The hospital has installed energy efficient electrical equipment and facilities along with solar power generation and has been able to bring down their carbon footprint.*
- *Kerala Directorate of Health Services[512]: It is mostly healthcare facilities or centres that have joined the 'Race to Zero', however, Kerala Directorate of Health Services is one large health system that has become part of this initiative.*

6.12 Integration of Traditional Medicine Systems for Management of Climate Sensitive Diseases

The integration of traditional medicine systems may also serve as potential avenue for addressing climate-sensitive diseases by serving as a complement to modern healthcare practices and western medicine. As climate change continues to exacerbate health challenges, it is crucial to harness the wisdom and knowledge of traditional healers and herbalists. Key recommendations for this integration include fostering collaboration and knowledge sharing between traditional healers and healthcare practitioners, promoting research to validate the efficacy and safety of traditional remedies, and providing education and training to traditional healers on climate change's impact on health and disease prevention. Additionally, establishing regulatory frameworks to ensure the quality and safety of traditional medicines is vital, as it can protect patients and preserve the integrity of traditional healing practices. Community engagement is essential, involving local communities in decision-making processes related to healthcare to foster cultural appreciation and ownership of healthcare initiatives. By embracing traditional medicine systems in the management of climate-sensitive diseases, we can tap into a wealth of generational knowledge, enhancing our ability to tackle health challenges exacerbated by climate change while simultaneously preserving cultural heritage and promoting holistic well-being.

In addition to the existing recommendations, further measures to enhance the healthcare response to climate change involve expanding insurance coverage to ensure vulnerable populations have access to essential health services in the face of climate-related disasters. Furthermore, promoting the digitization of data collection and bolstering surveillance systems will enable more efficient monitoring of climate-induced health impacts, facilitating early intervention and response. These initiatives contribute to building resilience within healthcare

systems, aiding in the mitigation of climate-related health risks and promoting better preparedness for the evolving challenges posed by a changing climate.

7. Annexure-I: Key attributes of selected countries

Country	Land area (sq.km) *Source: CIA World Factbook (Last updated August, 2023)*	Population (thousands) *Source: World Bank (Year 2022)*	Income Group *Source: World Bank*	World Risk Index (WRI) Year: 2019* *Source: Germanwatch*		ODA eligibility (2022–23) *Source: OECD*	Human Development Index Year: 2021 *Source: UNDP*			Inform Climate Risk Year: 2023 *Source: Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness and the European Commission*		Global Health Security Index (GHSI) Year : 2021 *Source: Nuclear Threat Initiative (NTI) in collaboration with the Johns Hopkins Center for Health Security and Johns Hopkins Bloomberg School of Public Health*	
				Score	**Ranking**		**HDI Values**	**Index Category**	**Life expectancy at birth** (years)	**Index value**	**Index Category**	**Score**	**Rank**
Bangladesh	148,460	171,186	LDC	23.5	13	Eligible	0.661	Medium	72.4	5.5	High	35.5	95
Fiji	18,274	930	UMIC	73	75	Eligible	0.730	High	67.1	3.2	Low	25.8	169
India	3,287,263	1,417,173	LMIC	16.7	7	Eligible	0.633	Medium	67.2	5.5	High	42.8	66
Indonesia	1,904,569	275,501	UMIC	74	72	Eligible	0.705	High	67.6	4.4	Medium	50.4	45
Philippines	300,000	115,559	LMIC	26.7	17	Eligible	0.699	Medium	69.3	5.3	High	45.7	57
Thailand	513,120	71,697	UMIC	43.2	34	Eligible	0.800	Very high	78.7	4.1	Medium	68.2	5
Vietnam	331,210	98,187	LMIC	50.2	38	Eligible	0.703	High	73.6	3.7	Medium	42.9	65
Nepal	143,351	30,548	LDC	20	12	Eligible	0.601	Medium	71.74	4.5	Medium	34.0	107
Cambodia	176,515	16,768	LMIC	75.8	84	Eligible	0.6	Medium	69.9	4.6	Medium	31.1	126

Malaysia	328,657	33,938	UMIC	87.3	99	Eligible	0.803	Very High	76.3	3.4	Low	56.4	27
Tuvalu	26	11	UMIC	118	130	Eligible	0.653	Medium	64.9	2.7	Low	20.0	188

8. Annexure-II: List of stakeholders in country level consultations

S.No	Country	Name of Participant	Organization	Designation
1	India	Dr RC Dhiman	Senior Consultant, Former Scientist 'G' (Director Grade)	ICMR National Institute of Malaria Research, Delhi
2	India	Dr Soumya Swaminathan	Former Chief Scientist of World Health Organisation (WHO), and	Chairperson of M S Swaminathan Research Foundation (MSSRF)
3	India	Dr Jugal Kishore	Director Professor and Former Head	Department Vardhman Mahavir Medical College and Safdarjung Hospital
4	India	Dr Anil Kumar Gupta	Strategist - Resilience, DRR & Sustainability, Consortium Player & Leader, HoD, Director of Projects & COE, International Cooperation	NIDM
5	India	Dr Sarabhjeet Singh Sahota	Disaster Risk Reduction Specialist	UNICEF India
6	India	Dr Manjeet Saluja	Environment and Public Health Specialist	WHO, India
7	Bangladesh	Dr Iqbal Kabir	Director of the CCHPU, MoHFW	MoHFW, GoB
8	Bangladesh	Ms Roufa khanum	Asst. Director	C3ER, BRAC University
9	Bangladesh	Mohammad Mahmudul Hasan	Manager Resilience & Climate Justice	Action Aid BD
10	Bangladesh	Dr Mostofa Monwar Kawshik	Medicin Specialist	Comilla Medical College
11	Bangladesh	Dr Ishrat Jerin	Gynecological Specialist	Dhaka Medical College
12	Bangladesh	Ms Nazia Islam	Learning, Evaluation and Documentation Specialist	BRAC James P Grant School of Public Health, BRAC University

13	Bangladesh	Ms Sumaiya Binte Selim	Programme Coordinator	ICCCAd
14	Bangladesh	Mr Mirza Shawkat Ali	Director (Climate Change & International Convention)	Department of Environment, BD
15	Bangladesh	Mr Zakir Hossain Khan	Climate Change Expert	Change Initiative
16	Bangladesh	Ms Armana Ahmed	Head, Research Administration	ICDDR, Bangladesh
17	Bangladesh	Dr Motiul Islam	General Practitioners	FRF Diagnostic Center
18	Bangladesh	Mr Khandaker Mainuddin	Sr. Fellow	Bangladesh Centre for Advanced Studies
19	Bangladesh	Dr Muhammad Muniruzzaman Khan	Associate Professor	Department of Disaster and Vulnerability Studies , Dhaka University
20	Bangladesh	Dr Nitish Debnath	Coordinator, ONE Health Bangladesh	ONE Health Programme
21	Bangladesh	Taslima Akhter	Programme Manager	ADPC
22	Nepal	Dr. Mahesh Maskey	Executive Chief	Nepal Public Health Foundation
23	Nepal	Dr. Meghnath Dhimal	Chief Research Officer	Nepal Health Research Council
24	Nepal	Dr. Anup Bastola	Director	Curative Service Division
25	Nepal	Dr. Megha Raj banjara	Associate Professor	Central Department of Microbiology
26	Nepal	Dr. Suresh Tiwari	Country Director	Oxford Policy Management
27	Nepal	Dr Mangal Rawal	Vice Chancellor	KAHS, Jumla, Nepal
28	Nepal	Dr. Suneeta Chaudhary	Ecosystem Expert	ICIMOD
29	Nepal	Dr. Bimal Regmi	Climate Change Expert	OPM/Department of Foreign Affairs and trade, Australia
30	Nepal	Dr. Bishnu Bhatta	Director	Partnership for Sustainable Development Nepal
31	Nepal	Mr. Raja Ram Pote	National Professional Officer	World Health Organization
32	Nepal	Ms. Tika Dahal	Chairperson	Nepal Disability Women Association

33	Nepal	Ms. Manju Singh Rana	GESI Expert	Freelancer previously, JICA
34	Nepal	Dr. Manu Karki	Entrepreneur	Ecosathi Nepal, Ama Surakhsysa
35	Nepal	Ms. Lila Khanal	Deputy Director	Junior and Youth Service Department, Nepal Red Cross
36	Nepal	Ms. Punya Suwal	Assistant Professor	Nepal Institute of Health Sciences
37	Indonesia	Amanda Katili Niode PhD	Director	Climate Reality
38	Indonesia	Laetania Belai Djandam	Climate Officer	Health Care Without Harm Southeast Asia
39	Indonesia	Gabriela Fernando	Associate Professor, Public Health	Monash University, Indonesia
40	Indonesia	Dr Imran Pambudi	Director of Communicable Disease Prevention and Control	Ministry of Health
41	Thailand	Leo Braack, PhD	Senior Specialist	Malaria Consortium Asia
42	Thailand	Chawarat Rotejanaprasert	Researcher	Mahidol-Oxford Tropical Medicine Research Unit
43	Thailand	Massaya Sirimatayanant	Researcher	Mahidol-Oxford Tropical Medicine Research Unit
44	Thailand	Sazid Ibna Zaman	Researcher	Mahidol-Oxford Tropical Medicine Research Unit
45	Thailand	Suwat Chariyalertsak	Dean- Faculty of Public Health	Chiang Mai University
46	Thailand	Kannikar Intawong	Researcher	Chiang Mai University
47	Thailand	Waraporn Boonchieng	Researcher	Chiang Mai University
48	Thailand	Pallop Siewchaisakul	Researcher	Chiang Mai University
49	Thailand	Warangkana Naksen	Researcher	Chiang Mai University
50	Thailand	Niparueradee Pinyajeerapat	Public Health Specialist	USAID
51	Thailand	Dr Karoon Chanachai	Regional Animal Health Advisor	USAID
52	Thailand	Clarisse Veylon-Hervet	Global Health Regional Advisor	Embassy of France to Thailand
53	Thailand	Dr Wanna Hanchaoworakul	Senior Expert in Preventive Medicine	Ministry of Public Health. Department of Disease Control
54	Thailand	Vincent Herbreteau	Health Geographer	Institut Pasteur

55	Vietnam	Dr Pawin Padungtod	Senior Technical Coordinator Emergency Centre for Transboundary Animal Diseases	FAO
56	Vietnam	Nguyen Van Huan	Nutrition Consultant	Global Health Advocacy Incubator
57	Vietnam	Nguyen Anh Vu	Technical Program Manager - Health and Nutrition	World Vision
58	Vietnam	Tran Thi Tuyet Hanh	Head- Climate Change and Health Research Group	Hanoi University of Public Health
59	Vietnam	Nguyen Thanh Ha	Climate-Health Nexus Portfolio	UNDP
60	Vietnam	Nguyen Hong Diep Anh	Climate-Health Nexus Portfolio	UNDP
61	Cambodia	Kiririthpanha Sothy	Health Lead	British Embassy Cambodia
62	Cambodia	Chris Williamson	Head of Political and Development	British Embassy Cambodia
63	Cambodia	Dr Hero Kol	Director	Department of Preventive Medicine, Ministry of Health, Kingdom of Cambodia
64	Cambodia	Rikard Elfving	Principal Social Sector Specialist	Asian Development Bank
65	Malaysia	Aaron Kual	Health Adviser	British High Commission Kuala Lumpur
66	Malaysia	Sam Beckwith	Regional Director, Health, SEA	FCDO
67	Philippines	Liz Bautista	Health Advisor	Foreign, Commonwealth and Development Office, British Embassy Manila
68	Philippines	Ted Herbosa	Secretary	Department of Health
69	Philippines	Kezla Lorraine Rosario	Head. Health Promotion Unit	Department of Health
70	Philippines	Glenn Fernandez	Associate Professor	Rabdan Academy
71	Philippines	Emman Serrano	Program Officer	University of the Philippines. Resilience Institute
72	Philippines	Luis Cruz		Department of Health
73	Philippines	Philip Ruiz	Development Manager	Department of Health
74	Philippines	Blenn Huelgas	WASH Coordinator	Action Against Hunger
75	Philippines			

76	Philippines	Arnel Capili	Director. Operations Center	Philippines Disaster Resilience Foundation
77	Philippines	Edwin Salonga	Philippines Country Representative	ADPC
78	Philippines	Zen Delica Willison	President	Center for Disaster Preparedness, Philippines
79	Philippines	Seposo Xerses	Associate Professor	Hokkaido University
80	Philippines	Lea Serrano	Science Research Specialist	University of the Philippines, Resilience Institute
81	Philippines	Marj Romero	Communication Associate	Center for Disease Preparedness
82	Philippines	Mayfourth Luneta	DRRM Focal Point	Center for Disease Preparedness
83	Philippines	Monica Mendoza		Department of Health
84	Philippines	Jenilyn Ann Dabu	Physician	Department of Health
85	Philippines	Shelley Medina		Department of Health
86	Philippines	Veronica Gabaldon	Executive Director	Philippines Disaster Resilience Foundation
87	Fiji	Dr Sheetal Kumar	Lecturer (Psychiatry)	Fiji National University, Fiji

9. References

[1] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

[2] Arvind Kumar, D.P. Singh, Heat stroke-related deaths in India: An analysis of natural causes of deaths, associated with the regional heatwave, Journal of Thermal Biology, Volume 95, 2021, 102792, ISSN 0306-4565, https://doi.org/10.1016/j.jtherbio.2020.102792.

[3] Rajak, R. and Chattopadhyay, A., 2020. Short and long term exposure to ambient air pollution and impact on health in India: a systematic review. International journal of environmental health research, 30(6), pp.593-617.

[4] Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., Nguyen, M., Nguyen, N. H., Manh, C. D., & Nguyen, T. H. (2015). Association between climate factors and diarrhoea in a Mekong Delta area. International journal of biometeorology, 59(9), 1321–1331. https://doi.org/10.1007/s00484-014-0942-1

[5] Razafindrabe, B.H., Kada, R., Arima, M. and Inoue, S., 2014. Analyzing flood risk and related impacts to urban communities in central Vietnam. Mitigation and adaptation strategies for global change, 19, pp.177-198.

[6] Mirsaeidi M., Motahari H., Taghizadeh Khamesi M., Sharifi A., Campos M., Schraufnagel D.E. Climate Change and Respiratory Infections. Ann. Am. Thorac. Soc. 2016;13:1223–1230. doi: 10.1513/AnnalsATS.201511-729PS.

[7] WHO Climate change and health: Key facts. [(accessed on 18 September 2019)]; Available online: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health [Ref list]

[8] Wertheim-Heck, S., Raneri, J. E., & Oosterveer, P. (2019). Food safety and nutrition for low-income urbanites: exploring a social justice dilemma in consumption policy. *Regional environmental change*, *31*(2), 397–420. https://doi.org/10.1177/0956247819858019

[9] Pollack, A.A., Weiss, B. and Trung, L.T., 2016. Mental health, life functioning and risk factors among people exposed to frequent natural disasters and chronic poverty in Vietnam. BJPsych open, 2(3), pp.221-232.

[10] Bankoff, G., 1999. A history of poverty: The politics of natural disasters in the Philippines, 1985–95. The Pacific Review, 12(3), pp.381-420.

[11] Cinco, T.A., de Guzman, R.G., Ortiz, A.M.D., Delfino, R.J.P., Lasco, R.D., Hilario, F.D., Juanillo, E.L., Barba, R. and Ares, E.D., 2016. Observed trends and impacts of tropical cyclones in the Philippines. *International Journal of Climatology*, *36*(14), pp.4638-4650.

[12] Rocha, I.C.N., dos Santos Costa, A.C., Islam, Z., Jain, S., Goyal, S., Mohanan, P., Essar, M.Y. and Ahmad, S., 2022. Typhoons during the COVID-19 pandemic in the Philippines: impact of a double crises on mental health. Disaster Medicine and Public Health Preparedness, 16(6), pp.2275-2278.

[13] Berrang-Ford, L., Sietsma, A.J., Callaghan, M., Minx, J.C., Scheelbeek, P.F.D., Haddaway, N.R., Haines, A. and Dangour, A.D., 2021. Systematic mapping of global research on climate and health: a machine learning review. The Lancet Planetary Health, [online] 5(8), pp.e514–e525. https://doi.org/10.1016/s2542-5196(21)00179-0.

[14] Canada, G. A. (2023, July 24). *Canada's Indo-Pacific Strategy*. GAC. https://www.international.gc.ca/transparency-transparence/indo-pacific-indo-pacifique/index.aspx?lang=eng

[15] Smith, K. R., Chafe, Z., Woodward, A., Campbell-Lendrum, D., Chadee, D. D., Honda, Y., ... & Haines, A. (2015). Human health: impacts, adaptation, and co-benefits. In *Climate Change 2014 Impacts, Adaptation and Vulnerability: Part A: Global and Sectoral Aspects* (pp. 709-754).

[16] Cissé, G. (2022). Health, Wellbeing, and the Changing Structure of Communities in Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth *Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al. Cambridge, UK and New York, NY, USA.*

[17] James, S. L., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., ... & Briggs, A. M. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, *392*(10159), 1789-1858.

[18] Foreman, K.J., et al., 2018: Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. Lancet, 392(10159), 2052–2090, doi:10.1016/s0140-6736(18)31694-5.

[19] Fullman, N., et al., 2017: Measuring progress and projecting attainment on the basis of past trends of the health-related Sustainable Development Goals in 188 countries: an analysis from the Global Burden of Disease Study 2016. Lancet, 390(10100), 1423–1459, doi:10.1016/s0140-6736(17)32336-x.

[20] Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., ... & Costello, A. (2022). The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. The Lancet, 400(10363), 1619-1654.

[21] World Health Organization. (2021). Climate change and health research: current trends, gaps and perspectives for the future.

[22] Berrang-Ford, L., Sietsma, A. J., Callaghan, M., Minx, J. C., Scheelbeek, P. F., Haddaway, N. R., ... & Dangour, A. D. (2021). Systematic mapping of global research on climate and health: a machine learning review. The Lancet Planetary Health, 5(8), e514-e525.
[23] Berry P, Enright PM, Shumake-Guillemot J, Villalobos Prats E, Campbell-Lendrum D. Assessing Health Vulnerabilities and Adaptation to Climate Change: A Review of International Progress. *Int J Environ Res Public Health*. 2018;15(12):2626. Published 2018 Nov 23. doi:10.3390/ijerph15122626
[24] David-Chavez, D. M., & Gavin, M. C. (2018). A global assessment of Indigenous community engagement in climate research. Environmental Research Letters, 13(12), 123005.
[25] Asian Development Bank. (2015). Casa Update 3: Economics of Climate Change. [online] Available at: https://www.adb.org/sites/default/files/publication/39302/casa-update-3-economics-climate-change_0.pdf
[26] Scheelbeek, P. F., Dangour, A. D., Jarmul, S., Turner, G., Sietsma, A. J., Minx, J. C., ... & Global Adaptation Mapping Initiative Team. (2021). The effects on public health of climate change adaptation responses: a systematic review of evidence from low- and middle-income countries. Environmental Research Letters, 16(7), 073001.
[27] Tiwari, I., Tilstra, M., Campbell, S. M., Nielsen, C. C., Hodgins, S., Vargas, A. R. O., ... & Yamamoto, S. S. (2022). Climate change impacts on the health of South Asian children and women subpopulations-A scoping review. Heliyon, e10811.
[28] Nations, U., 2023. Human Development Index | Human Development Reports. [online] Human Development Index | Human Development Reports. Available at: <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>.
[29] Anon n.d. Global Climate Risk Index. [online] Global Climate Risk Index | Germanwatch e.V. Available at: <https://www.germanwatch.org/en/cri>.
[30] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/official-development-assistance.htm
[31] Anon n.d. Climate Change Indicators Dashboard. [online] Climate Change Indicators Dashboard. Available at: <https://climatedata.imf.org/datasets/7cae02f84ed547fbbd6210d90da19879>.
[32] Anon n.d. The 2021 Global Health Security Index. [online] Homepage - GHS Index. Available at: <https://www.ghsindex.org/>.
[33] Anon 2023. Global temperatures set to reach new records in next five years. [online] World Meteorological Organization. Available at: <https://public.wmo.int/en/media/press-release/global-temperatures-set-reach-new-records-next-five-years>.
[34] Anon 2020. A warm pool in the Indo-Pacific Ocean has almost doubled in size, changing global rainfall patterns. [online] NOAA Climate.gov. Available at: <http://www.climate.gov/news-features/featured-images/warm-pool-indo-pacific-ocean-has-almost-doubled-size-changing-global>.
[35] Anon 2023. Goal 13 | Department of Economic and Social Affairs. [online] Goal 13 | Department of Economic and Social Affairs. Available at: <https://sdgs.un.org/goals/goal13>.
[36] Anon 2021. Climate change and health. [online] Climate change and health. Available at: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health#:~:text=Climate%20change%20affects%20the%20social,malaria%2C%20diarrhoea%20and%20heat%20stress.>.
[37] Berrang-Ford, L., Sietsma, A.J., Callaghan, M., Minx, J.C., Scheelbeek, P.F.D., Haddaway, N.R., Haines, A. and Dangour, A.D., 2021. Systematic mapping of global research on climate and health: a machine learning review. The Lancet Planetary Health, [online] 5(8), pp.e514–e525. https://doi.org/10.1016/s2542-5196(21)00179-0.
[38] Kjellstrom T, McMichael AJ. Climate change threats to population health and well-being: the imperative of protective solutions that will last. Glob Health Action. 2013 Apr 3;6:20816. doi: 10.3402/gha.v6i0.20816. Erratum in: Glob Health Action. 2014 Dec;7(1):25010. PMID: 23561024; PMCID: PMC3617647.
[39] Berrang-Ford, L., Sietsma, A.J., Callaghan, M., Minx, J.C., Scheelbeek, P.F.D., Haddaway, N.R., Haines, A. and Dangour, A.D., 2021. Systematic mapping of global research on climate and health: a machine learning review. The Lancet Planetary Health, [online] 5(8), pp.e514–e525. https://doi.org/10.1016/s2542-5196(21)00179-0.
[40] Phung et al., 2017
[41] Azhar et al., 2014
[42] Ghatak, D., Zaitchik, B., Hain, C. and Anderson, M., 2017. The role of local heating in the 2015 Indian Heat Wave. Scientific reports, 7(1), p.7707.
[43] Dimitrova et al. (2020) and Tiwari et al. (2022), https://spiral.imperial.ac.uk/bitstream/10044/1/104092/18/south%20asia%20heat%20scientific%20report.pdf
[44] Caminade, C., et al. 2014. Impact of Climate Change onGlobal Malaria Distribution. Proceedings of the National Academy of Sciences. 111(9). pp. 3286–3291.
[45] Shi Z. Impact of Climate Change on the Global Environment and Associated Human Health. OALib. 2018;5:1–6. doi: 10.4236/oalib.1104934.
[46] Mirsaeidi M., Motahari H., Taghizadeh Khamesi M., Sharifi A., Campos M., Schraufnagel D.E. Climate Change and Respiratory Infections. Ann. Am. Thorac. Soc. 2016;13:1223–1230. doi: 10.1513/AnnalsATS.201511-729PS.
[47] WHO Climate change and health: Key facts. [(accessed on 18 September 2019)]; Available online: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health [Ref list]

[48] Servadio, J.L., Rosenthal, S.R., Carlson, L. and Bauer, C., 2018. Climate patterns and mosquito-borne disease outbreaks in South and Southeast Asia. Journal of Infection and Public Health, 11(4), pp.566-571.
[49] Filho, Walter Leal, Svenja Scheday, Juliane Boenecke, Abhijit Gogoi, Anish Maharaj, and Samuela Korovou. 2019. "Climate Change, Health and Mosquito-Borne Diseases: Trends and Implications to the Pacific Region" International Journal of Environmental Research and Public Health 16, no. 24: 5114. https://doi.org/10.3390/ijerph16245114
[50] Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D.B., Huang, Y., Huang, M., Yao, Y., Bassu, S., Ciais, P. and Durand, J.L., 2017. Temperature increase reduces global yields of major crops in four independent estimates. Proceedings of the National Academy of sciences, 114(35), pp.9326-9331.
[51] Lloyd, S.J., Kovats, R.S. and Chalabi, Z., 2011. Climate Change, Crop Yields, and Undernutrition: Development of a Model to Quantify the Impact of Climate Scenarios on Child Undernutrition. Environmental Health Perspectives, [online] 119(12), pp.1817–1823. https://doi.org/10.1289/ehp.1003311.
[52] TA Carleton, Crop-damaging temperatures increase suicide rates in India. Proc Natl Acad Sci USA 114, 8746–8751 (2017)
[53] Anon n.d. Heat waves. [online] Heat waves. Available at: <https://www.who.int/india/heat-waves>.
[54] Anon n.d. India-Pakistan heat wave of 2015 | Record-Breaking Temperatures. [online] Encyclopedia Britannica. Available at: <https://www.britannica.com/event/India-Pakistan-heat-wave-of-2015>.
[55] Unusual Cold Wave Across Asia Proves Deadly [WWW Document], 2016. . Voice of America. URL https://www.voanews.com/a/unusual-cold-wave-across-asia-proves-deadly/3161248.html
[56] Cue, 2023. Asia has had a really cold month, courtesy of the polar vortex [WWW Document]. The Straits Times. URL https://www.straitstimes.com/asia/asia-has-had-a-really-cold-month-courtesy-of-the-polar-vortex
[57] Pacific, T.L.R.H.W., 2023. Water, climate change, and health in the Western Pacific Region. The Lancet Regional Health: Western Pacific, 32.
[58] Li, C., Zhao, Z., Yan, Y., Liu, Q., Zhao, Q. and Ma, W., 2022. Short-term effects of tropical cyclones on the incidence of dengue: a time-series study in Guangzhou, China - Parasites & Vectors. [online] BioMed Central. https://doi.org/10.1186/s13071-022-05486-2.
[59] Keck, M., 2020. The Pacific Is Dealing With a Dengue Fever Outbreak Amid COVID-19 and Tropical Cyclone Harold [WWW Document]. Global Citizen. URL https://www.globalcitizen.org/en/content/pacific-dengue-fever-outbreak-covid19/
[60] Sam, A.S., Abbas, A., Padmaja, S.S., Sathyan, A.R., Vijayan, D., Kächele, H., Kumar, R., Müller, K., 2021. Flood vulnerability and food security in eastern India: A threat to the achievement of the Sustainable Development Goals [WWW Document]. International Journal of Disaster Risk Reduction. https://doi.org/10.1016/j.ijdrr.2021.102589
[61] Auto, H., 2022. Worst Thai flood in years inflicts damage to crops, puts tourism revival at risk [WWW Document]. The Straits Times. URL https://www.straitstimes.com/asia/se-asia/worst-thai-flood-in-years-damage-crops-risk-tourism-revival
[62] Pickering, K., Pearce, T., Manuel, L., Doran, B., Smith, T.F., 2023. Socio-ecological challenges and food security in the 'salad bowl' of Fiji, Sigatoka Valley [WWW Document]. Regional Environmental Change. https://doi.org/10.1007/s10113-023-02059-6
[63] ShieldSquare Captcha [WWW Document], n.d. URL https://iopscience.iop.org/article/10.1088/1755-1315/886/1/012090/meta
[64] Nutrition at risk after Typhoon-hit Filipino families, WFP warns - Philippines [WWW Document], 2022. . ReliefWeb. URL https://reliefweb.int/report/philippines/nutrition-risk-after-typhoon-hit-filipino-families-wfp-warns
[65] Karmegam, D., Mappillairaju, B., 2020. Spatio-temporal distribution of negative emotions on Twitter during floods in Chennai, India, in 2015: a post hoc analysis [WWW Document]. International Journal of Health Geographics. https://doi.org/10.1186/s12942-020-00214-4
[66] Hudson, P., Pham, M. and Bubeck, P., 2019. An evaluation and monetary assessment of the impact of flooding on subjective well-being across genders in Vietnam. Climate and Development, 11(7), pp.623-637.
[67] Pollack, A., Weiss, B., Trung, L.T., 2016. Mental health, life functioning and risk factors among people exposed to frequent natural disasters and chronic poverty in Vietnam [WWW Document]. British Journal of Psychiatry Open. https://doi.org/10.1192/bjpo.bp.115.002170
[68] Rodriguez-Llanes, J.M. et al. (2011) 'Child malnutrition and recurrent flooding in rural eastern India: A community-based survey', BMJ Open, 1(2). doi:10.1136/bmjopen-2011-000109
[69] Jiang, X.Q., Mei, X.D. and Feng, D., 2016. Air pollution and chronic airway diseases: what should people know and do?. Journal of thoracic disease, 8(1), p.E31.
[70] How Extreme Weather Events Affect Mental Health [WWW Document], n.d. URL https://www.psychiatry.org/patients-families/climate-change-and-mental-health-connections/affects-on-mental-health
[71] McDuffie, E. E., Smith, S. J., O'Rourke, P., Tibrewal, K., Venkataraman, C., Marais, E. A., Zheng, B., Crippa, M., Brauer, M., and Martin, R. V.: A global anthropogenic emission inventory of atmospheric pollutants from sector- and fuel-specific sources (1970–2017): An application of the Community Emissions Data System (CEDS), Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-103, in review, 20
[72] Kurokawa, J. and Ohara, T.: Long-term historical trends in air pollutant emissions in Asia: Regional Emission inventory in ASia (REAS) version 3, Atmos. Chem. Phys., 20, 12761– 12793, https://doi.org/10.5194/acp-20-12761-2020, 2020.

[73] Sadavarte, P., Rupakheti, M., Bhave, P., Shakya, K., and Lawrence, M.: Nepal emission inventory – Part I: Technologies and combustion sources (NEEMI-Tech) for 2001–2016, Atmos. Chem. Phys., 19, 12953–12973, https://doi.org/10.5194/acp-19-12953-2019, 2019

[74] Jindal, S.K., Aggarwal, A.N., Jindal, A., 2020. Household air pollution in India and respiratory diseases: current status and future directions [WWW Document]. Current Opinion in Pulmonary Medicine. https://doi.org/10.1097/mcp.0000000000000642

[75] Upadhyay, A.K., Singh, Abhishek, Kumar, K., Singh, Ashish, 2015. Impact of indoor air pollution from the use of solid fuels on the incidence of life threatening respiratory illnesses in children in India [WWW Document]. BMC Public Health. https://doi.org/10.1186/s12889-015-1631-7

[76] Akhtar, A.S., 2016. Indoor Air Pollutants and Respiratory Problems among Dhaka City Dwellers [WWW Document]. Archives of community medicine and public health. https://doi.org/10.17352/2455-5479.000014

[77] Mulia, G.J.T., Wispriyono, B., Kusnoputranto, H., Hartono, B., Rozaliyani, A., 2020. Indoor Air Pollution and Respiratory Function on Primary School Students in West Jakarta, Indonesia [WWW Document]. The Open Public Health Journal. https://doi.org/10.2174/1874944502013010190

[78] https://www.jpmph.org/m/journal/view.php?number=2287

[79] Saksena, S., Subida, R., Büttner, L. and Ahmed, L., 2007. Indoor air pollution in coastal houses of southern Philippines. Indoor and Built Environment, 16(2), pp.159-168.

[80] Blount, R.J., Phan, H., Trinh, T., Dang, H., Merrifield, C., Zavala, M., Zabner, J., Comellas, A.P., Stapleton, E.M., Segal, M.R., Balmes, J.R., Nguyen, V.N., Nahid, P., 2021. Indoor Air Pollution and Susceptibility to Tuberculosis Infection in Urban Vietnamese Children [WWW Document]. American Journal of Respiratory and Critical Care Medicine. https://doi.org/10.1164/rccm.202101-0136oc

[81] Kaur, R., Pandey, P., 2021. Air Pollution, Climate Change, and Human Health in Indian Cities: A Brief Review [WWW Document]. Frontiers in sustainable cities. https://doi.org/10.3389/frsc.2021.705131

[82] Pacific, T.L.R.H.W., 2023. Water, climate change, and health in the Western Pacific Region. The Lancet Regional Health: Western Pacific, 32.

[83] Shiiba, N., Singh, P., Charan, D., Raj, K., Stuart, J., Pratap, A., Maekawa, M., 2023. Climate change and coastal resiliency of Suva, Fiji: a holistic approach for measuring climate risk using the climate and ocean risk vulnerability index (CORVI) [WWW Document]. Mitigation and Adaptation Strategies for Global Change. https://doi.org/10.1007/s11027-022-10043-4

[84] Patz, J.; Corvalan, C.; Horwitz, P.; Campbell-Lendrum, D. Our Planet, Our Health, Our Future: Human Health and the Rio Conventions: Biological Diversity, Climate Change and Desertification; World Health Organization: Geneva, Switzerland, 2012. Available online: https://www.who.int/globalchange/publications/reports/health_rioconventions.pdf?ua=1 (accessed on 17 Octo-ber 2020).

[85] Intergovernmental Panel on Climate Change (IPCC). Climate change 2007: Impacts, adaptation and vulnerability. In *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*; Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E., Eds.; Cambridge University Press: Cambridge, UK, 2007; 976p, Available online: **https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf** (accessed on 17 October 2020).

[86] Smith, K.R.; Woodward, A.; Campbell-Lendrum, D.; Chadee, D.D.; Honda, Y.; Liu, Q.; Olwoch, J.M.; Revich, B.; Sauerborn, R. Human health: Impacts, adaptation, and co-benefits. In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Field, B.C., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., et al., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2014; pp. 709–754. Available online: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf (accessed on 17 October 2020).

[87] Haines, A.; Ebi, K. The Imperative for Climate Action to Protect Health. N. Engl. J. Med. 2019, 380, 263–273. Available online: https://www.nejm.org/doi/full/10.1056/NEJMra1807873 (accessed on 17 October 2020). [CrossRef]

[88] Sena, A. and Ebi, K., 2021. When land is under pressure health is under stress. *International Journal of Environmental Research and Public Health*, *18*(1), p.136.

[89] Prajapati, H.R. and Devi, R., 2018. Intensive farming, land degradation and food security issues in India. AKADEMOS, 313.

[90] Wairiu, M., 2017. Land degradation and sustainable land management practices in Pacific Island Countries. Regional Environmental Change, 17, pp.1053-1064.

[91] Mishra, J., Mishra, P. and Arora, N.K., 2021. Linkages between environmental issues and zoonotic diseases: with reference to COVID-19 pandemic. Environmental Sustainability, 4(3), pp.455-467.

[92] Naden, K., 2020. The prevalence of livestock diseases in the South Pacific. Tropical Animal Health and Production, 52(4), pp.2191-2192.

[93] Asian Development Bank (ADB). 2009. The Economics of Climate Change in Southeast Asia: A Regional Review. Manila.

[94] Anon 2023. *Climate change*. [online] Climate change. Available at: <https://www.who.int/health-topics/climate-change#tab=tab_1>

[95] Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.
[96] Anon 2023. IDMC. [online] IDMC - Internal Displacement Monitoring Centre. Available at: <https://www.internal-displacement.org/home>.
[97] Kabir, M.I., Rahman, M.B., Smith, W., Lusha, M.A.F. and Milton, A.H., 2016. Climate change and health in Bangladesh: a baseline cross-sectional survey. Global health action, 9(1), p.29609.
[98] Climate Change in Bangladesh: Impact on Infectious Diseases and Mental Health. (n.d.). World Bank. https://www.worldbank.org/en/news/feature/2021/10/07/climate-change-in-bangladesh-impact-on-infectious-diseases-and-mental-health
[99] ibid
[100] Letsch L. et al,. 2023: Adapting to Impacts of Extreme Heats on Bangladesh Labour Force, A Policy Brief, LSE, London
[101] Minar, M.H., Hossain, M.B. and Shamsuddin, M.D., 2013. Climate change and coastal zone of Bangladesh: vulnerability, resilience and adaptability. *Middle-East Journal of Scientific Research*, *13*(1), pp.114-120.
[102] Minar MH et al (2013): Climate Change and Coastal zones of Bangladesh- Vulnerability, Resilience and Adaptability, IDOSI Publications
[103] Kabir, R., Khan, H.T., Ball, E. and Caldwell, K., 2014. Climate change and public health situations in the coastal areas of Bangladesh. *Int'l J. Soc. Sci. Stud.*, *2*, p.109.
[104] Burkart, K., et al,. 2014. An analysis of heat effects in different subpopulations of Bangladesh. International journal of biometeorology, 58, pp.227-237.
[105] Rahman, M.S., Mushfiquee, M., Masud, M.S. and Howlader, T., 2019. Association between malnutrition and anemia in under-five children and women of reproductive age: Evidence from Bangladesh Demographic and Health Survey 2011. *PloS one*, *14*(7), p.e0219170.
[106] Alam et al (2015): Urban Climate Resilience: Water and Sanitation, A working paper of IIED and ICCCAD, Dhaka
[107] IPCC-AR-6 (2022): Climate Change, Impacts, Vulnerability and Adaptation; Vol-II, Chapter-7 on Health and Well Being
[108] Mahmud, I. (2021) *Climate Afflictions*. *openknowledge.worldbank.org*. DOI: 10.1596/978-1-4648-1764-6.
[109] Rahman, M.S., Mushfiquee, M., Masud, M.S. and Howlader, T., 2019. Association between malnutrition and anemia in under-five children and women of reproductive age: Evidence from Bangladesh Demographic and Health Survey 2011. *PloS one*, *14*(7), p.e0219170.
[110] Asadullah, M.N., Islam, K.M.M. and Wahhaj, Z., 2021. Child marriage, climate vulnerability and natural disasters in coastal Bangladesh. *Journal of biosocial science*, *53*(6), pp.948-967.
[111] ibid
[112] UNICEF, 2016. The Impact of Climate Change on Children in Bangladesh Vulnerability Profile. *UNICEF: Washington, DC, USA*. https://www.unicef.org/bangladesh/media/1946/file/UNICEF_eBook-impact_Climate_Change.pdf
[113] Tripura MB (2023): Climate Change and Water Crises in CHT: Reproductive Health and Rights, Zabarang with BNPS, Dhaka
[114] Climate Change in Bangladesh: Impact on Infectious Diseases and Mental Health. (n.d.). World Bank. https://www.worldbank.org/en/news/feature/2021/10/07/climate-change-in-bangladesh-impact-on-infectious-diseases-and-mental-health
[115] Nahar, N., Y. Blomstedt, B. Wu, I. Kandarina, L. Trisnantoro, and J. Kinsman. 2014. "Increasing the Provision of Mental Health Care for Vulnerable, Disaster-Affected People in Bangladesh." BMC Public Health 14 (708). doi:10.1186/1471-2458-14-708.
[116] Rafa N., et al: 2021: Impact of cyclone Amphan on the water, sanitation, hygiene, and health (WASH2) facilities of coastal Bangladesh, Research Article, published in February, 2021
[117] Mahmud, I., Raza, W.A. and Hossain, M.R., 2021. Climate afflictions. World Bank Publications.
[118] Ali, M., Nelson, A.R., Lopez, A.L. and Sack, D.A., 2015. Updated global burden of cholera in endemic countries. PLoS neglected tropical diseases, 9(6), p.e0003832.
[119] Nahar, N., Y. Blomstedt, B. Wu, I. Kandarina, L. Trisnantoro, and J. Kinsman. 2014. "Increasing the Provision of Mental Health Care for Vulnerable, Disaster-Affected People in Bangladesh." BMC Public Health 14 (708). doi:10.1186/1471-2458-14-708.
[120] Rahman, M.M., Ahmad, S., Mahmud, A.S., Hassan-uz-Zaman, M., Nahian, M.A., Ahmed, A., Nahar, Q. and Streatfield, P.K., 2019. Health consequences of climate change in Bangladesh: An overview of the evidence, knowledge gaps and challenges. Wiley Interdisciplinary Reviews: Climate Change, 10(5), p.e601.
[121] Mamun, M.A., Huq, N., Papia, Z.F., Tasfina, S. and Gozal, D., 2019. Prevalence of depression among Bangladeshi village women subsequent to a natural disaster: a pilot study. Psychiatry research, 276, pp.124-128.
[122] ibid
[123] CCHP (2014). Climate change and health impacts: How vulnerable is Bangladesh and what needs to be done? Ministry of Health and Family Welfare, Climate Change and Health Promotion Unit, International Centre for Diarrhoeal Disease Research, Bangladesh, World Bank.
[124] WHO and IEDCR (2018): Bangladesh Health- National Adaptation Plan (NAP), Ministry of Health and Family Welfare, GoB

[125] Haque, U. et al. Malaria burden and control in Bangladesh and prospects for elimination: An epidemiological and economic assessment. Lancet Glob. Health 2, e98-105. https://doi.org/10.1016/S2214-109X(13)70176-1 (2014).
[126] Allen, T., Murray, K. A., Zambrana-Torrelio, C., Morse, S. S., Rondinini, C., Di Marco, M., Breit, N., Olival, K. J., & Daszak, P. (2017). Global hotspots and correlates of emerging zoonotic diseases. Nature Communications, 8(1), 1– 10. https://doi.org/10.1038/s41467-017-00923-8
[127] Raza, Wameq Azfar, Iffat Mahmud, and Tamer Samah Rabie. 2022. Breathing Heavy: New Evidence on Air Pollution and Health in Bangladesh. International Development in Focus. Washington, DC: World Bank. doi:10.1596/978-1-4648-1919-3. License: Creative Commons Attribution CC BY 3.0 IGO
[128] https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2021-en.pdf
[129] ibid
[130] Khan, M.N., B Nurs, C.Z., Mofizul Islam, M., Islam, M.R. and Rahman, M.M., 2017. Household air pollution from cooking and risk of adverse health and birth outcomes in Bangladesh: a nationwide population-based study. *Environmental Health*, *16*(1), pp.1-8.
[131] Kurata, M., Takahashi, K. and Hibiki, A., 2020. Gender differences in associations of household and ambient air pollution with child health: evidence from household and satellite-based data in Bangladesh. *World Development*, *128*, p.104779.
[132] Ali, M.U., Yu, Y., Yousaf, B., Munir, M.A.M., Ullah, S., Zheng, C., Kuang, X. and Wong, M.H., 2021. Health impacts of indoor air pollution from household solid fuel on children and women. *Journal of hazardous materials*, *416*, p.126127.
[133] Osmani, S. R., Ahmed, A., Ahmed, T., Hossain, N., Huq, S., & Shahan, A. (2016). Strategic Review of Food Security and Nutrition in Bangladesh. World Food Programme. https://cdn.wfp.org/wfp.org/publications/Bangladesh_Strategic_Review_full_report.pdf?_ga=2.178300268.978432401.1644518120-196395399.1644518120
[134] World Bank. (n.d.). Water and health: The impact of climate change in 6 hotspots in Bangladesh. [Blog post]. Retrieved from https://blogs.worldbank.org/endpovertyinsouthasia/water-and-health-impact-climate-change-6-hotspots-bangladesh
[135] Bangladesh: Food Security and Vulnerability Monitoring (mVAM) July 2022 - Bangladesh. https://www.wfp.org/publications/wfp-bangladesh-mobile-vulnerability-analysis-and-mapping-mvam-reports
[136] Osmani, S. R., Ahmed, A., Ahmed, T., Hossain, N., Huq, S., & Shahan, A. (2016). Strategic Review of Food Security and Nutrition in Bangladesh. World Food Programme. https://cdn.wfp.org/wfp.org/publications/Bangladesh_Strategic_Review_full_report.pdf?_ga=2.178300268.978432401.1644518120-196395399.1644518120
[137] Arvind Kumar, D.P. Singh, Heat stroke-related deaths in India: An analysis of natural causes of deaths, associated with the regional heatwave, Journal of Thermal Biology, Volume 95, 2021, 102792, ISSN 0306-4565, https://doi.org/10.1016/j.jtherbio.2020.102792.
[138] Sidhu RK (1998) Severe heat wave over the Indian subcontinent in 1998, in perspective of global climate. Current science 75.
[139] National Oceanic and Atmospheric Administration (2013) National Weather Service Glossary. Silver Springs, Maryland.
[140] Burke J. Hundreds Die in Indian Heatwave. Guardian 30 May. 2010. [[accessed 18 November 2010]]. Available: http://www.guardian.co.uk/world/2010/may/30/india-heatwave-deaths.
[141] https://www.climate-transparency.org/wp-content/uploads/2022/10/CT2022-India-Web.pdf
[142] Nandi, J., 2021. India facing highest labour work hour loss due to heat stress: Study. [online] Hindustan Times. Available at: <https://www.hindustantimes.com/india-news/india-facing-highest-labour-work-hour-loss-due-to-heat-stress-study-101639505641905.html#:~:text=India%20already%20loses%20around%20101,in%20Nature%20on%20Tuesday%20said.>.
[143] Singh, J., et al. (2020). Malaria vulnerability in India: A systematic review of literature. Journal of Vector Borne Diseases, 57(1), 1-12.
[144] Das, A., et al. (2019). Association between malaria incidence and living conditions in households in rural and urban settings of Odisha, India. International Journal of Environmental Research and Public Health, 16(21), 4205.
[145] Adams, B., et al. (2018). Spatial and socio-economic patterns of dengue and chikungunya virus infections in an urban setting: A case study in Delhi, India. Transactions of the Royal Society of Tropical Medicine and Hygiene, 112(5), 243-252.
[146] Sorensen, C., Saunik, S., Sehgal, M., Tewary, A., Govindan, M., Lemery, J. and Balbus, J., 2018. Climate change and women's health: Impacts and opportunities in India. GeoHealth, 2(10), pp.283-297.
[147] Desai, Z. and Zhang, Y., 2021. Climate change and women's health: a scoping review. Geohealth, 5(9), p.e2021GH000386.
[148] Rajput, P., Singh, S., Singh, T.B. and Mall, R.K., 2023. The nexus between climate change and public health: a global overview with perspectives for Indian cities. Arabian Journal of Geosciences, 16(1), p.15.
[149] Roy, M. and Venema, H.D., 2002. Reducing risk and vulnerability to climate change in India: the capabilities approach. *Gender & Development*, *10*(2), pp.78-83.
[150] Li, T., Horton, R., Bader, D. et al. Aging Will Amplify the Heat-related Mortality Risk under a Changing Climate: Projection for the Elderly in Beijing, China. Sci Rep 6, 28161 (2016). https://doi.org/10.1038/srep28161
[151] Ray, K., Giri, R.K., Ray, S.S., Dimri, A.P. and Rajeevan, M., 2021. An assessment of long-term changes in mortalities due to extreme weather events in India: A study of 50 years' data, 1970–2019. *Weather and Climate Extremes*, *32*, p.100315.
[152] CLIMA, T. and TE, W., 2023. State of the Climate in Asia.

[153] Ray, K., Giri, R.K., Ray, S.S., Dimri, A.P. and Rajeevan, M., 2021. An assessment of long-term changes in mortalities due to extreme weather events in India: A study of 50 years' data, 1970–2019. *Weather and Climate Extremes*, *32*, p.100315.
[154] Bahinipati, C.S., 2014. Assessment of vulnerability to cyclones and floods in Odisha, India: a district-level analysis. Current Science, pp.1997-2007.
[155] Ray, K., Giri, R.K., Ray, S.S., Dimri, A.P. and Rajeevan, M., 2021. An assessment of long-term changes in mortalities due to extreme weather events in India: A study of 50 years' data, 1970–2019. *Weather and Climate Extremes*, *32*, p.100315.
[156] Pramanik, M., Szabo, S., Pal, I., Udmale, P., Pongsiri, M. and Chilton, S., 2022. Population health risks in multi-hazard environments: action needed in the Cyclone Amphan and COVID-19–hit Sundarbans region, India. Climate and Development, 14(2), pp.99-104.
[157] Varughese, A. and Purushothaman, C., 2021. Climate change and public health in India: The 2018 Kerala floods. World Medical & Health Policy, 13(1), pp.16-35.
[158] Angeline, Nancy, Suguna Anbazhagan, A. Surekha, Sushil Joseph, and Pretesh R. Kiran. "Health impact of chennai floods 2015: Observations in a medical relief camp." *International Journal of Health System and Disaster Management* 5, no. 2 (2017): 46.
[159] Asim M, Mekkodathil A, Sathian B, Elayedath R, N RK, Simkhada P, van Teijlingen E. Post-Traumatic Stress Disorder among the Flood Affected Population in Indian Subcontinent. Nepal J Epidemiol. 2019 Mar 31;9(1):755-758. doi: 10.3126/nje.v9i1.24003. PMID: 31210997; PMCID: PMC6546152.
[160] Sarkar S, Gangare V, Singh P, Dhiman RC. Shift in Potential Malaria Transmission Areas in India, Using the Fuzzy-Based Climate Suitability Malaria Transmission (FCSMT) Model under Changing Climatic Conditions. Int J Environ Res Public Health. 2019 Sep 18;16(18):3474. doi: 10.3390/ijerph16183474. PMID: 31540493; PMCID: PMC6766004.
[161] Lingala MAL. Effect of meteorological variables on Plasmodium vivax and Plasmodium falciparum malaria in outbreak prone districts of Rajasthan, India. J Infect Public Health. 2017 Nov-Dec;10(6):875-880. doi: 10.1016/j.jiph.2017.02.007. Epub 2017 Mar 9. PMID: 28285973.
[162] Sarkar S, Gangare V, Singh P, Dhiman RC. Shift in Potential Malaria Transmission Areas in India, Using the Fuzzy-Based Climate Suitability Malaria Transmission (FCSMT) Model under Changing Climatic Conditions. Int J Environ Res Public Health. 2019 Sep 18;16(18):3474. doi: 10.3390/ijerph16183474. PMID: 31540493; PMCID: PMC6766004.
[163] Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: recent trends and importance of climatic parameters. Emerg Microbes Infect. 2017 Aug 9;6(8):e70. doi: 10.1038/emi.2017.57. PMID: 28790459; PMCID: PMC5583666.
[164] Singh, P.S., Chaturvedi, H.K. A retrospective study of environmental predictors of dengue in Delhi from 2015 to 2018 using the generalized linear model. *Sci Rep* **12**, 8109 (2022). https://doi.org/10.1038/s41598-022-12164-x
[165] Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: recent trends and importance of climatic parameters. Emerg Microbes Infect. 2017 Aug 9;6(8):e70. doi: 10.1038/emi.2017.57. PMID: 28790459; PMCID: PMC5583666.
[166] Kakarla SG, Caminade C, Mutheneni SR, Morse AP, Upadhyayula SM, Kadiri MR, Kumaraswamy S. Lag effect of climatic variables on dengue burden in India. Epidemiol Infect. 2019 Jan;147:e170. doi: 10.1017/S0950268819000608. PMID: 31063099; PMCID: PMC6518529.
[167] Singh, P.S., Chaturvedi, H.K. A retrospective study of environmental predictors of dengue in Delhi from 2015 to 2018 using the generalized linear model. *Sci Rep* **12**, 8109 (2022). https://doi.org/10.1038/s41598-022-12164-x
[168] Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: recent trends and importance of climatic parameters. Emerg Microbes Infect. 2017 Aug 9;6(8):e70. doi: 10.1038/emi.2017.57. PMID: 28790459; PMCID: PMC5583666.
[169] Shil P, Kothawale DR, Sudeep AB. Rainfall and Chikungunya incidences in India during 2010-2014. Virusdisease. 2018 Mar;29(1):46-53. doi: 10.1007/s13337-018-0428-6. Epub 2018 Feb 14. PMID: 29607358; PMCID: PMC5877844.
[170] Department of Health and Family Welfare, Government of India (2018). "Chapter 5: disease control program," in *Annual Report 2017-2018*, Department of Health and Family Welfare, Government of India. Available online at: https://main.mohfw.gov.in/sites/default/files/05Chapter.pdf
[171] Shil P, Kothawale DR, Sudeep AB. Rainfall and Chikungunya incidences in India during 2010-2014. Virusdisease. 2018 Mar;29(1):46-53. doi: 10.1007/s13337-018-0428-6. Epub 2018 Feb 14. PMID: 29607358; PMCID: PMC5877844.
[172] Climate Change and Risk of Leishmaniasis In India Naveen S. Singh* and Doris Phillips-Singh Lucknow Christian College, Golaganj, Lucknow-226018, U.P., India DOI: http://dx.doi.org/10.24327/ijrsr.2020.1101.4986
[173] UNICEF. Clean drinking water Ensuring survival and improved outcomes across all outcomes for every child. 2019.
[174] Pathak, H. (2015). Effect of water borne diseases on Indian economy: a cost-benefit analysis. *An Rom Sov Ser Med Gen*, *1*, 74-78.
[175] Morgan, O., Ahern, M., & Cairncross, S. (2005). Revisiting the tsunami: health consequences of flooding. *PLoS medicine*, *2*(6), e184.
[176] Parmar, J., Shah, S., Patel, B., Vasava, R., & Patel, K. (2015). Assessment of waterborne diseases in coastal villages of Surat, India. Journal of Environmental Health Science and Engineering, 13(1), 1-7. doi: 10.1186/s40201-015-0229-3.
[177] Dhanasekar, S., Yamasani, B., Palpandian, S., Ethirajulu, S., Bhaskaran, S., & Ramachandran, S. (2017). Prevalence of water borne diseases and wash practices in rural and urban population of Chennai. International Journal of Medical Science and Public Health, 6(12), 1718-1722.

[178] Krishnan, S., 2019. Water, sanitation and hygiene (WASH) and disaster recovery for community resilience: a mixed methods study from Odisha, India. International Journal of Disaster Risk Reduction, 35, p.101061.
[179] Singh, B. B., Sharma, R., Gill, J. P., Aulakh, R. S., & Banga, H. S. (2011). Climate change, zoonoses and India. Revue scientifique et technique (International Office of Epizootics), 30(3), 779–788. https://doi.org/10.20506/rst.30.3.2073
[180] Singh, B. B., Sharma, R., Gill, J. P., Aulakh, R. S., & Banga, H. S. (2011). Climate change, zoonoses and India. Revue scientifique et technique (International Office of Epizootics), 30(3), 779–788. https://doi.org/10.20506/rst.30.3.2073
[181] Dhiman RC, Tiwari A (2018) Emergence of Zoonotic Diseases in India: A Systematic Review. Med Rep Case Stud 3: 163. doi: 10.4172/2572-5130.1000163
[182] National Centre for Disease Control. "One Health action" plan for Climate Sensitive Zoonotic Diseases. Retrieved from https://ncdc.gov.in/WriteReadData/l892s/23469663141632475086.pdf
[183] Dhiman RC, Tiwari A (2018) Emergence of Zoonotic Diseases in India: A Systematic Review. Med Rep Case Stud 3: 163. doi: 10.4172/2572-5130.1000163
[184] Rajak, R. and Chattopadhyay, A., 2020. Short and long term exposure to ambient air pollution and impact on health in India: a systematic review. International journal of environmental health research, 30(6), pp.593-617.
[185] Epic India. (2021). India Fact Sheet Update. [online] Available at: https://aqli.epic.uchicago.edu/wp-content/uploads/2021/08/IndiaFactSheet_update-.pdf
[186] Catalyzing Clean Air in India [WWW Document], n.d. . World Bank. URL https://www.worldbank.org/en/country/india/publication/catalyzing-clean-air-in-india
[187] Ibid
[188] Chakraborty, J., & Basu, P. (2021). Air quality and environmental injustice in India: Connecting particulate pollution to social disadvantages. International Journal of Environmental Research and Public Health, 18(1), 304.
[189] Gitz, V., Meybeck, A., Lipper, L., Young, C. D., & Braatz, S. (2016). Climate change and food security: risks and responses. *Food and Agriculture Organization of the United Nations (FAO) Report*, *110*, 2-4.
[190] Rodriguez-Llanes et al., "Child malnutrition and recurrent flooding in rural eastern India: a community-based survey", BMJ Open, 1(2011), http://bmjopen.bmj.com/content/1/2/e000109.full
[191] Vedeld, T et al., "Governing extreme climate events in Maharashtra, India", Final report on WP3.2: Extreme Risks, Vulnerabilities and Community-based Adaptation in India (EVA): A Pilot Study, TERI Press, New Delhi, 2014. http://www.teriin.org/projects/eva/files/Governing_climate_extremes_in_Maharashtra.pdf
[192] Rodriguez-Llanes et al., "Child malnutrition and recurrent flooding in rural eastern India: a community-based survey", BMJ Open, 1(2011), http://bmjopen.bmj.com/content/1/2/e000109.full
[193] Chakrabarty, M., 2016. Climate change and food security in India. Observer Research Foundation (ORF): New Delhi, India, (157).
[194] World Bank. (2018). Climate Change Country Profile for Indonesia. [online] Available at: https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_IDN.pdf
[195] ibid
[196] ibid
[197] Yamanaka, M.D., Ogino, S.Y., Wu, P.M., Jun-Ichi, H., Mori, S., Matsumoto, J. and Syamsudin, F., 2018. Maritime continent coastlines controlling Earth's climate. *Progress in Earth and Planetary Science*, *5*(1), pp.1-28.
[198] Haryanto, B., Lestari, F. and Nurlambang, T., 2020. Extreme events, disasters, and health impacts in Indonesia. Extreme Weather Events and Human Health: International Case Studies, pp.227-245.
[199] Climate Risk Profile: Indonesia (2021): The World Bank Group and Asian Development Bank.
[200] Rejeki DSS, Nurhayati N, Aji B, Murhandarwati EEH, Kusnanto H. A Time Series Analysis: Weather Factors, Human Migration and Malaria Cases in Endemic Area of Purworejo, Indonesia, 2005-2014. Iran J Public Health. 2018 Apr;47(4):499-509. PMID: 29900134; PMCID: PMC5996329.
[201] Hasyim, H., Nursafingi, A., Haque, U. *et al.* Spatial modelling of malaria cases associated with environmental factors in South Sumatra, Indonesia. *Malar J* **17**, 87 (2018). https://doi.org/10.1186/s12936-018-2230-8
[202] Kesetyaningsih TW, Andarini S, Sudarto S, Pramoedyo H. The MinimumMaximum Weather Temperature Difference Effect on Dengue Incidence in Sleman Regency of Yogyakarta, Indonesia. Walailak J Sci Technol. 2018;15(5):387–96.
[203] Setiawati MDKF. The Influence of Climate Variables on Dengue in Singapore. Int J Environ Health Res [Internet]. 2011;21(6):415–26. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed10&NEWS=N&AN=2012050378
[204] Hasanah, Susanna D. Weather Implication for Dengue Fever in Jakarta, Indonesia 2008-2016. KnE Life Sci. 2019;4(10):184
[205] Alfi Syahrin A, Oktaria D, Sudarmaji, et al. Climate change impacts on waterborne disease transmission in Indonesia. Journal of Environmental Health Science and Engineering. 2020;18(1):67-78. doi: 10.1007/s40201-020-00510-0.
[206] Lestari, T. P., Soebandrio, S., & Sari, K. D. (2019). The association between climate variability and waterborne diseases in Indonesia: a systematic review. International Journal of Environmental Research and Public Health, 16(16), 2889. doi: 10.3390/ijerph16162889.

[207] Lestari, T. P., Soebandrio, S., & Sari, K. D. (2019). The association between climate variability and waterborne diseases in Indonesia: a systematic review. International Journal of Environmental Research and Public Health, 16(16), 2889. doi: 10.3390/ijerph16162889.
[208] Prameswari, O. A., & Hashim, J. H. (2021). Current status, challenges and future prospects of waterborne disease control in Indonesia: A review. Journal of water and health, 19(1), 1-17. doi: 10.2166/wh.2020.256.
[209] Raksanagara, A., Kusnanto, H., & Hsu, Y.-C. (2019). Climate Change and Waterborne Diseases in Indonesia: A Systematic Review. International Journal of Environmental Research and Public Health, 16(7), 1189. doi: 10.3390/ijerph16071189
[210] Anon 2023. Indonesia Fact Sheet. [online] Air quality life index . Available at: https://aqli.epic.uchicago.edu/wp-content/uploads/2020/07/IndonesiaFactSheet2020.pdf
[211] ibid
[212] Greenstone, M. and Fan, Q., 2019. Indonesia's worsening air quality and its impact on life expectancy. Air Quality Life Index, pp.1-10.
[213] Greenstone, M. and Fan, Q., 2019. Indonesia's worsening air quality and its impact on life expectancy. Air Quality Life Index, pp.1-10.
[214] Jalaludin, B., Garden, F.L., Chrzanowska, A., Haryanto, B., Cowie, C.T., Lestari, F., Morgan, G., Mazumdar, S., Metcalf, K. and Marks, G.B., 2022. Associations between ambient particulate air pollution and cognitive function in Indonesian children living in forest fire–prone provinces. Asia Pacific Journal of Public Health, 34(1), pp.96-105.
[215] Haryanto, B. (2018). Climate Change and Urban Air Pollution Health Impacts in Indonesia. In: Akhtar, R., Palagiano, C. (eds) Climate Change and Air Pollution. Springer Climate. Springer, Cham. https://doi.org/10.1007/978-3-319-61346-8_14
[216] Escobar Carías MS, Johnston DW, Knott R, Sweeney R. Flood disasters and health among the urban poor. Health Econ. 2022 Sep;31(9):2072-2089. doi: 10.1002/hec.4566. Epub 2022 Jun 30. PMID: 35770835; PMCID: PMC9546021
[217] Estoque, R.C., Ooba, M., Seposo, X.T. *et al.* Heat health risk assessment in Philippine cities using remotely sensed data and social-ecological indicators. *Nat Commun* **11**, 1581 (2020). https://doi.org/10.1038/s41467-020-15218-8
[218] Estoque RC, Ooba M, Seposo XT, Togawa T, Hijioka Y, Takahashi K, Nakamura S. Heat health risk assessment in Philippine cities using remotely sensed data and social-ecological indicators. Nat Commun. 2020 Mar 27;11(1):1581. doi: 10.1038/s41467-020-15218-8. PMID: 32221303; PMCID: PMC7101384.
[219] World Bank, 2022. Philippines Country and Climate Development Report.
[220] Pross, C., J. Yi-Chen Han, D. Kim and S. Vigil. 2002. "Climate change, gender equality and human rights in Asia: Regional review and promising practices." New York: UN Women.
[221] Energy and Clean Air Research Institute. (2023). Philippines Health Economic Cost Report v2023. [online] Available at: https://energyandcleanair.org/wp/wp-content/uploads/2023/02/Philippines-Health-Economic-Cost-Report_v2023.pdf
[222] Chan, E.Y., Liu, S. and Hung, K.K., 2013. Typhoon Haiyan and beyond. The Lancet, 382(9908), p.1873.
[223] Dolhun, E., 2013. Aftermath of Typhoon Haiyan: the imminent epidemic of waterborne illnesses in Leyte, Philippines. Disaster medicine and public health preparedness, 7(6), pp.547-548.
[224] Ventura, R.J., Muhi, E., de Los Reyes, V.C., Sucaldito, M.N. and Tayag, E., 2015. A community-based gastroenteritis outbreak after Typhoon Haiyan, Leyte, Philippines, 2013. Western Pacific surveillance and response journal: WPSAR, 6(1), p.1.
[225] Bankoff, G., 1999. A history of poverty: The politics of natural disasters in the Philippines, 1985–95. The Pacific Review, 12(3), pp.381-420.
[226] Cinco, T.A., de Guzman, R.G., Ortiz, A.M.D., Delfino, R.J.P., Lasco, R.D., Hilario, F.D., Juanillo, E.L., Barba, R. and Ares, E.D., 2016. Observed trends and impacts of tropical cyclones in the Philippines. *International Journal of Climatology*, *36*(14), pp.4638-4650.
[227] Rocha, I.C.N., dos Santos Costa, A.C., Islam, Z., Jain, S., Goyal, S., Mohanan, P., Essar, M.Y. and Ahmad, S., 2022. Typhoons during the COVID-19 pandemic in the Philippines: impact of a double crises on mental health. Disaster Medicine and Public Health Preparedness, 16(6), pp.2275-2278.
[228] Gil Cuesta, J., Van Loenhout, J.A., de Lara-Banquesio, M.L., Isiderio, J.M., Aujoulat, I. and Guha-Sapir, D., 2018. The impact of typhoon Haiyan on health staff: a qualitative study in two hospitals in Eastern Visayas, the Philippines. Frontiers in public health, 6, p.208.
[229] Gray, J., Lloyd, S., Healey, S. and Opdyke, A., 2022. Urban and rural patterns of typhoon mortality in the Philippines. *Progress in disaster science*, *14*, p.100234.
[230] Agaton, C.B. and Cueto, L.J., 2021. Learning at Home: Parents' Lived Experiences on Distance Learning during COVID-19 Pandemic in the Philippines. International Journal of Evaluation and Research in Education, 10(3), pp.901-911.
[231] Anon n.d. Novartis supports DOH goal of malaria-free PH by 2030. [online] Novartis Philippines. Available at: <https://www.novartis.com/ph-en/news/media-releases/novartis-supports-doh-goal-malaria-free-ph-2030>.
[232] Sumi A., Telan E.F., Chagan-Yasutan H., Piolo M.B., Hattori T., Kobayashi N. Effect of temperature, relative humidity and rainfall on dengue fever and leptospirosis infections in Manila, the Philippines. Epidemiol. Infect. 2017;145:78–86.
[233] Naragdao M.A. Master's Thesis. Dalhousie University; Halifax, Nova Scotia, Canada: Dec, 2001. The Association between Local Meteorological Factors and Hospital Admissions of Dengue Hemorrhagic Fever in Iloilo Province, Philippines

[234] Arcenas A.L. Discussion Paper. School of Economics, University of the Philippines; Quezon City, Philippines: 2016. Climate Change, Dengue and the Economy Ascertaining the Link between Dengue and Climatic Conditions.
[235] Dulay A.V., Bautista J.R., Teves F.G. Climate change and incidence of dengue fever (DF) and dengue hemorrhagic fever (DHF) in Iligan City, Lanao del Norte, Philippines. Int. Res. J. Biol. Sci. 2013;2:37–41.
[236] Magtibay, B. D., Ereso, A. Q., Rillon, G. G., & Cereno, R. D. (2020). Climate change and its impact on waterborne diseases in the Philippines: A systematic review. Global Public Health, 15(11), 1656-1670. doi: 10.1080/17441692.2020.1781688
[237] Chua, P. L. C., Ng, C. F. S., Rivera, A. S., Salva, E. P., Salazar, M. A., Huber, V., & Hashizume, M. (2021). Association between Ambient Temperature and Severe Diarrhoea in the National Capital Region, Philippines. *International journal of environmental research and public health*, *18*(15), 8191. https://doi.org/10.3390/ijerph18158191
[238] Cruz, R. V. O., de los Reyes III, V. C., Sucaldito, M. N., Tayag, E. A., & Partridge, J. (2020). Water quality and health risk in informal settlements in Metro Manila, Philippines: A case study of an underserved community. Journal of Water and Health, 18(2), 217-231. doi:10.2166/wh.2020.198
[239] https://cdn.who.int/media/docs/default-source/country-profiles/environmental-health/environmental-health-phl-2022.pdf?sfvrsn=120c358f_4&download=true
[240] https://energyandcleanair.org/wp/wp-content/uploads/2023/02/Philippines-Health-Economic-Cost-Report_v2023.pdf
[241] Anon 2023. BENEFITS OF URBAN CLIMATE ACTION C40 Cities Technical Assistance Report. [online] Available at: https://www.c40.org/wp-content/uploads/2022/02/Quezon-City-%E2%80%93-Enforcement-of-Vehicle-Emissions-Regulations.pdf
[242] Rachutorn, T., Twatsupa, B. and Inmuong, U., 2019. Trends of Heat-Related Mortality and Association with Weather Variables in the Northeast, Thailand. EnvironmentAsia, 12(1).
[243] Matsee, W., Charoensakulchai, S. and Khatib, A.N., 2023. Heat-related illnesses are an increasing threat for travellers to hot climate destinations. Journal of travel medicine, 30(4), p.taad072.
[244] Tawatsupa, B., Yiengprugsawan, V., Kjellstrom, T., Berecki-Gisolf, J., Seubsman, S.A. and Sleigh, A., 2013. Association between heat stress and occupational injury among Thai workers: findings of the Thai Cohort Study. Industrial health, 51(1), pp.34-46.
[245] Kiatkitroj, K., Arphorn, S., Tangtong, C., Maruo, S.J. and Ishimaru, T., 2021. Risk factors associated with heat-related illness among sugarcane farmers in Thailand. Industrial health, 60(5), pp.447-458.
[246] ibid
[247] Sirisawasd, S., Homkham, N., Taptagaporn, S. and Kaewdok, T., 2022. Risk Factors Related to Perceived Hot Conditions on Outdoor Farms Among Thai Elderly Farmers With Chronic Diseases. Journal of UOEH, 44(3), pp.229-238.
[248] Boonruksa, P., Maturachon, T., Kongtip, P., Woskie, S., 2020. Heat Stress, Physiological Response, and Heat-Related Symptoms among Thai Sugarcane Workers [WWW Document]. International Journal of Environmental Research and Public Health. https://doi.org/10.3390/ijerph17176363
[249] Hazard Exposure with Health and Safety Outcomes Hinder the Work Ability of Salt Farm Workers in Thailand [WWW Document], 2019. . PubMed. URL https://pubmed.ncbi.nlm.nih.gov/33043321/
[250] Luangwilai, T., Robson, M.G., Siriwong, W., 2021. Effect of heat exposure on dehydration and kidney function among sea salt workers in Thailand [WWW Document]. Roczniki Państwowego Zakładu Higieny. https://doi.org/10.32394/rpzh.2021.0186
[251] Sombatsawat, E., Luangwilai, T., Kaewchandee, C., Robson, M.G. and Siriwong, W., 2023. Impact of environmental heat exposure on the health status in farmworkers, Nakhon Ratchasima, Thailand. Roczniki Panstwowego Zakladu Higieny, 74(1), pp.103-111.
[252] Factors Associated with Heat Related Illnesses among Soldiers: A Systematic Review [WWW Document], 2020. . Deepreecha | JOURNAL OF THE MEDICAL ASSOCIATION OF THAILAND. URL http://www.jmatonline.com/index.php/jmat/article/view/11065
[253] Nutong, R., Mungthin, M., Hatthachote, P., Ukritchon, S., Imjaijit, W., Tengtrakulcharoen, P., Panichkul, S., Putwatana, P., Prapaipanich, W., Rangsin, R., 2018. Personal risk factors associated with heat-related illness among new conscripts undergoing basic training in Thailand [WWW Document]. PLOS ONE. https://doi.org/10.1371/journal.pone.0203428
[254] Huang, C., Cheng, J., Phung, D., Tawatsupa, B., Hu, W., Xu, Z., 2018. Mortality burden attributable to heatwaves in Thailand: A systematic assessment incorporating evidence-based lag structure [WWW Document]. Environment International. https://doi.org/10.1016/j.envint.2018.08.058
[255] Tawatsupa, B., Yiengprugsawan, V., Kjellstrom, T., Berecki-Gisolf, J., Seubsman, S.A. and Sleigh, A., 2013. Association between heat stress and occupational injury among Thai workers: findings of the Thai Cohort Study. Industrial health, 51(1), pp.34-46.
[256] Arifwidodo, S.D., Chandrasiri, O., 2020. Urban heat stress and human health in Bangkok, Thailand [WWW Document]. Environmental Research. https://doi.org/10.1016/j.envres.2020.109398
[257] Arifwidodo, S.D., Chandrasiri, O., Abdulharis, R., Kubota, T., 2019. Exploring the effects of urban heat island: A case study of two cities in Thailand and Indonesia [WWW Document]. APN science bulletin. https://doi.org/10.30852/sb.2019.539
[258] Tawatsupa, B., Yiengprugsawan, V., Kjellstrom, T., Seubsman, S.A., Sleigh, A. and Thai Cohort Study Team, 2012. Heat stress, health and well-being: findings from a large national cohort of Thai adults. BMJ open, 2(6), p.e001396.
[259] Office of Natural Resources and Environmental Policy and Planning, 2010.Thailand's Second National Communication under the United Nations FrameworkConvention on Climate Change. Ministry of Natural Resources and Environment.Bangkok, Thailand. 102 p.

[260] World Health Organization & United Nations Framework Convention on Climate Change. (2015). Climate and health country profile 2015: Thailand. https://iris.who.int/handle/10665/208870
[261] Pathak, S., Emah, I.E., 2017. Gendered approach towards disaster recovery: Experiences from 2011 floods in Pathumthani province, Thailand [WWW Document]. International Journal of Disaster Risk Reduction. https://doi.org/10.1016/j.ijdrr.2017.06.007
[262] Lebel, L., Lebel, P. and Lebel, B., 2014. Gender and the management of climate-related risks in Northern Thailand. International Social Science Journal, 65(217-218), pp.147-158.
[263] Lebel, L., Foran, T., Garden, P. and Manuta, J.B., 2012. Adaptation to climate change and social justice: challenges for flood and disaster management in Thailand. In Climate change adaptation in the water sector (pp. 125-141). Routledge.
[264] Sanguanklin, N., McFarlin, B.L., Park, C.G., Giurgescu, C., Finnegan, L., White-Traut, R. and Engstrom, J.L., 2014. Effects of the 2011 flood in Thailand on birth outcomes and perceived social support. Journal of Obstetric, Gynecologic & Neonatal Nursing, 43(4), pp.435-444.
[265] Europe PMC [WWW Document], n.d. URL https://europepmc.org/article/MED/22256467
[266] https://plan-international.org/uploads/2021/12/climate_change_young_women_girls_plan_and_sei_final.pdf
[267] WHO (2015). Climate Change and Health Country Profile: Thailand. file:///Users/utente/Downloads/WHO_FWC_PHE_EPE_15.16_eng%20(4).pdf
[268] ibid
[269] Stoklosa, H., Burns, C.J., Karan, A., Lyman, M., Morley, N., Tadee, R., Goodwin, E.P., 2021. Mitigating trafficking of migrants and children through disaster risk reduction: Insights from the Thailand flood [WWW Document]. International Journal of Disaster Risk Reduction. https://doi.org/10.1016/j.ijdrr.2021.102268
[270] ibid
[271] McCormick, B. J. J., Alonso, W. J., & Miller, M. A. (2012). An exploration of spatial patterns of seasonal diarrhoeal morbidity in Thailand. Epidemiology & Infection, 140(7), 1236-1243.
[272] Marks, D., 2011. Climate change and Thailand: Impact and response. Contemporary Southeast Asia, pp.229-258.
[273] Udomratn, P., 2009. Prevalence of tsunami-related PTSD and MDD in Thailand. Asian Journal of Psychiatry, 2(4), pp.124-127.
[274] Thienkrua, W., Cardozo, B.L., Chakkraband, M.L.S., Guadamuz, T.E., Pengjuntr, W., Tantipiwatanaskul, P., Sakornsatian, S., Ekassawin, S., Panyayong, B., Varangrat, A., Tappero, J.W., Schreiber, M., Van Griensven, F., 2006. Symptoms of Posttraumatic Stress Disorder and Depression Among Children in Tsunami-Affected Areas in Southern Thailand [WWW Document]. JAMA. https://doi.org/10.1001/jama.296.5.549
[275] Post traumatic stress disorder in children after tsunami disaster in Thailand: 2 years follow-up [WWW Document], 2007. . PubMed. URL https://pubmed.ncbi.nlm.nih.gov/18181322/
[276] https://pubmed.ncbi.nlm.nih.gov/19253496/
[277] Apisarnthanarak, A., Khawcharoenporn, T., Woeltje, K.F. and Warren, D.K., 2013. Hospital flood preparedness and flood-related psychological consequences in 15 provinces in central Thailand after implementation of a national guideline. Infection Control & Hospital Epidemiology, 34(6), pp.655-656.
[278] Yoda, T., Yokoyama, K., Suzuki, H., Hirao, T., 2016. Relationship Between Long-term Flooding and Serious Mental Illness After the 2011 Flood in Thailand [WWW Document]. Disaster Medicine and Public Health Preparedness. https://doi.org/10.1017/dmp.2016.148
[279] Kongsuwan, V., Eleanor, H., Sutharungsee, W. and Kristraksa, W., 2018. Thai Flood Survivors' Perceptions of Their Mental Wellbeing and Psycho-Social Support Services Received. J Nurs Health Sci| Volume, 4(1), p.53.
[280] View of Prevalence of Psychological Distress and Mental Health Problems among the Survivors in the Flash Floods and Landslide in Southern Thailand [WWW Document], n.d. URL https://wjst.wu.ac.th/index.php/wjst/article/view/4017/972
[281] Assanangkornchai, S., Tangboonngam, S.N. and Edwards, J.G., 2004. The flooding of Hat Yai: predictors of adverse emotional responses to a natural disaster. Stress and Health: Journal of the International Society for the Investigation of Stress, 20(2), pp.81-89.
[282] Public Health Ministry reveals nearly 100,000 flood victims develop mental problems - Thailand [WWW Document], 2011. . ReliefWeb. URL https://reliefweb.int/report/thailand/public-health-ministry-reveals-nearly-100000-flood-victims-develop-mental-problems
[283] The Kingdom of Thailand, 2020. Thailand's Third National Communication (TNC), s.l.: The Kingdom of Thailand.
[284] Tipayamongkholgul, M. et al., 2009. Effects of the El Niño-Southern Oscillation on dengue epidemics in Thailand, 1996-2005. *BMC Public Health,* Volume 9, p. 422.
[285] WHO, 2015. Health and Climate Change: Country Profile 2015: Thailand, Geneva: The World Health Organization.
[286] Office of Environmental Policy and Planning, 2000. Thailand's Initial National Communication under the United Nations Framework Convention on Climate Change Ministry of Science, Technology and Environment, Bangkok: s.n.
[287] Anon 2006. *An observation on correlation between rainfall and the prevalence of clinical cases of dengue in Thailand*. [online] PubMed. Available at: <https://pubmed.ncbi.nlm.nih.gov/16967819/>.
[288] Wiwanitkit, V., 2010. Emerging of dengue infection after big flood in Thailand: a concern. Asian Pac J Trop Med, 3(12), p.976.

[289] Office of Environmental Policy and Planning, 2000. Thailand's Initial National Communication under the United Nations Framework Convention on Climate Change Ministry of Science, Technology and Environment, Bangkok: s.n.
[290] WHO, 2015. Health and Climate Change: Country Profile 2015: Thailand, Geneva: The World Health Organization.
[291] The climatic factors influencing the occurrence of dengue hemorrhagic fever in Thailand [WWW Document], 2005. . PubMed. URL https://pubmed.ncbi.nlm.nih.gov/15906666/
[292] Chadsuthi, S., Modchang, C., Lenbury, Y., Iamsirithaworn, S., Triampo, W., 2012. Modeling seasonal leptospirosis transmission and its association with rainfall and temperature in Thailand using time–series and ARIMAX analyses [WWW Document]. Asian Pacific Journal of Tropical Medicine. https://doi.org/10.1016/s1995-7645(12)60095-9
[293] Polwiang, S., 2020. *The time series seasonal patterns of dengue fever and associated weather variables in Bangkok (2003-2017)*. [online] BMC Infectious Diseases. https://doi.org/10.1186/s12879-020-4902-6.
[294] Anon 2016. *Spatio-temporal climate-based model of dengue infection in Southern, Thailand*. [online] PubMed. Available at: https://pubmed.ncbi.nlm.nih.gov/33579141/
[295] Anon 2006. *An observation on correlation between rainfall and the prevalence of clinical cases of dengue in Thailand*. [online] PubMed. Available at: <https://pubmed.ncbi.nlm.nih.gov/16967819/>.
[296] https://pubmed.ncbi.nlm.nih.gov/30651742/
[297] Lee, M., 2021. Countries-Thailand. [Online] Available at: https://earth.org/country/thailand/
[298] Office of Environmental Policy and Planning, 2022. Thailand's Fourth National Communication under the United Nations Framework Convention on Climate Change, Bangkok: Ministry of Science, Technology and Environment, The Kingdom of Thailand.
[299] WHO, n.d.
Available at: https://www.who.int/thailand/news/detail/30-06-2023-combating-dengue-outbreak-and-addressing-overlapping-challenges-with-covid-19#:~:text=Alarming%20Rise%20in%20Dengue%20Cases,of%20June%2021%2C%202023).
[300] Chaturongkasumrit, Y., Techaruvichit, P., Takahashi, H., Kimura, B., Keeratipibul, S., 2013. Microbiological evaluation of water during the 2011 flood crisis in Thailand [WWW Document]. Science of The Total Environment. https://doi.org/10.1016/j.scitotenv.2013.06.071
[301] Languepin, O., 2023. Why is the air quality so bad in Thailand? - Thailand Business News [WWW Document]. Thailand Business News. URL https://www.thailand-business-news.com/environment/97653-why-is-the-air-quality-so-bad-in-thailand
[302] Brooke, E., 2023. Air Pollution in Thailand - Everything You Need to Know [WWW Document]. Breathe Safe Air. URL https://breathesafeair.com/air-pollution-in-thailand/#:~:text=The%20health%20impacts%20of%20air,expectancy%20by%20two%20full%20years.
[303] The Burden of Air Pollution in Thailand 2021Report - Greenpeace Southeast Asia [WWW Document], 2022. . Greenpeace Southeast Asia. URL https://www.greenpeace.org/southeastasia/publication/45439/the-burden-of-air-pollution-in-thailand-2021report/
[304] Final Report (Willingness to pay for air quality An analysis of multiple pollutants) revised.pdf [WWW Document], n.d. . Google Docs. URL https://drive.google.com/file/d/1kEQw_wMexUfigvlJ8T6kGNholWzcoIKn/view
[305] https://www.nature.com/articles/srep05509
[306] The pollution paralysis: Thailand's structural inability to clean up its air [WWW Document], 2019. . https://www.bangkokpost.com. URL https://www.bangkokpost.com/thailand/special-reports/1796019/the-pollution-paralysis-thailands-structural-inability-to-clean-up-its-air
[307] Vichit-Vadakan, N., Vajanapoom, N. and Ostro, B., 2008. The Public Health and Air Pollution in Asia (PAPA) Project: estimating the mortality effects of particulate matter in Bangkok, Thailand. Environmental Health Perspectives, 116(9), pp.1179-1182.
[308] https://iopscience.iop.org/article/10.1088/1748-9326/abe3ba/pdf
[309] Lee, H., Li, S., Tawatsupa, B., Punnasiri, K., Jaakkola, J.J.K., Williams, G.M., 2014. The association between air pollution and mortality in Thailand [WWW Document]. Scientific Reports. https://doi.org/10.1038/srep05509
[310] Phosri, A., Ueda, K., Phung, V.L.H., Tawatsupa, B., Honda, A., Takano, H., 2019. Effects of ambient air pollution on daily hospital admissions for respiratory and cardiovascular diseases in Bangkok, Thailand [WWW Document]. Science of The Total Environment. https://doi.org/10.1016/j.scitotenv.2018.09.183
[311] Pinichka, C., Makka, N., Sukkumnoed, D., Chariyalertsak, S., Inchai, P., Bundhamcharoen, K., 2017. Burden of disease attributed to ambient air pollution in Thailand: A GIS-based approach [WWW Document]. PLOS ONE. https://doi.org/10.1371/journal.pone.0189909
[312] Ruchiraset, A. and Tantrakarnapa, K., 2022. Association of climate factors and air pollutants with pneumonia incidence in Lampang province, Thailand: findings from a 12-year longitudinal study. International Journal of Environmental Health Research, 32(3), pp.691-700.
[313] Dang TN, Honda Y, Van Do D, Pham ALT, Chu C, Huang C, Phung D. Effects of Extreme Temperatures on Mortality and Hospitalization in Ho Chi Minh City, Vietnam. Int J Environ Res Public Health. 2019 Feb 2;16(3):432. doi: 10.3390/ijerph16030432. PMID: 30717328; PMCID: PMC6388260.
[314] Dang, T. N., Van, D. Q., Kusaka, H., Seposo, X. T., & Honda, Y. (2018). Green space and deaths attributable to the urban heat island effect in Ho Chi Minh City. American journal of public health, 108(S2), S137-S143.

[315] Nu Quy Linh Tran, Son Nghiem, Cordia Chu, Mai Anh Luong, Thi Tu Ho & Dung Phung (2022) The Prevalence of Heat-related Illnesses and Associated Factors among Rice Farmers in Vietnam, Journal of Agromedicine, DOI: 10.1080/1059924X.2022.2154086

[316] World Bank, 2022. Vietnam Country Climate and Development Report.

[317] Tuyet Hanh, T.T., Huong, L.T.T., Huong, N.T.L., Linh, T.N.Q., Quyen, N.H., Nhung, N.T.T., Ebi, K., Cuong, N.D., Van Nhu, H., Kien, T.M. and Hales, S., 2020. Vietnam climate change and health vulnerability and adaptation assessment, 2018. Environmental Health Insights, 14, p.1178630220924658.

[318] Tuyet Hanh, T.T., Huong, L.T.T., Huong, N.T.L., Linh, T.N.Q., Quyen, N.H., Nhung, N.T.T., Ebi, K., Cuong, N.D., Van Nhu, H., Kien, T.M. and Hales, S., 2020. Vietnam climate change and health vulnerability and adaptation assessment, 2018. Environmental Health Insights, 14, p.1178630220924658.

[319] World Bank, 2022. Vietnam Country Climate and Development Report.

[320] ibid

[321] ibid

[322] Wang, K., et al., 2021a: Understanding the impacts of climate change and socioeconomic development through food-energy-water nexus: A case study of mekong river delta. Resour. Conserv. Recycl., 167, 105390, doi:10.1016/j.resconrec.2020.105390.

[323] Thuc, T., Van Thang, N., Huong, H.T.L., Van Khiem, M., Hien, N.X. and Phong, D.H., 2016. Climate change and sea level rise scenarios for Vietnam. Ministry of Natural resources and Environment. Hanoi, Vietnam.

[324] World Bank, 2022. Vietnam Country Climate and Development Report.

[325] Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., Nguyen, M., Nguyen, N. H., Manh, C. D., & Nguyen, T. H. (2015). Association between climate factors and diarrhoea in a Mekong Delta area. International journal of biometeorology, 59(9), 1321–1331. https://doi.org/10.1007/s00484-014-0942-1

[326] Razafindrabe, B.H., Kada, R., Arima, M. and Inoue, S., 2014. Analyzing flood risk and related impacts to urban communities in central Vietnam. Mitigation and adaptation strategies for global change, 19, pp.177-198.

[327] Pollack, A.A., Weiss, B. and Trung, L.T., 2016. Mental health, life functioning and risk factors among people exposed to frequent natural disasters and chronic poverty in Vietnam. BJPsych open, 2(3), pp.221-232.

[328] World Bank, 2022. Vietnam Country Climate and Development Report.

[329] Caminade, C., Kovats, S., Rocklov, J., Tompkins, A. M., Morse, A. P., Colón-González, F. J., ... & Lloyd, S. J. (2014). Impact of climate change on global malaria distribution. *Proceedings of the National Academy of Sciences*, *111*(9), 3286-3291.

[330] Lee H.S., Nguyen-Viet H., Nam V.S., Lee M., Won S., Duc P.P., Grace D. Seasonal patterns of dengue fever and associated climate factors in 4 provinces in Vietnam from 1994 to 2013. *BMC Infect. Dis.* 2017;**17**:218. doi: 10.1186/s12879-017-2326-8.

[331] Huy B.V., Hoa L.N.M., Thuy D.T., Van Kinh N., Ngan T.T.D., Duyet L.V., Hung N.T., Minh N.N.Q., Truong N.T., Chau N.V.V. Epidemiological and clinical features of dengue infection in adults in the 2017 outbreak in Vietnam. *Biomed. Res. Int.* 2019;**2019**:3085827. doi: 10.1155/2019/3085827.

[332] Cheng J, Bambrick H, Yakob L, Devine G, Frentiu FD, Toan DTT, Thai PQ, Xu Z, Hu W. Heatwaves and dengue outbreaks in Hanoi, Vietnam: New evidence on early warning. PLoS Negl Trop Dis. 2020 Jan 21;14(1):e0007997. doi: 10.1371/journal.pntd.0007997. PMID: 31961869; PMCID: PMC6994101.

[333] Huy B.V., Hoa L.N.M., Thuy D.T., Van Kinh N., Ngan T.T.D., Duyet L.V., Hung N.T., Minh N.N.Q., Truong N.T., Chau N.V.V. Epidemiological and clinical features of dengue infection in adults in the 2017 outbreak in Vietnam. *Biomed. Res. Int.* 2019;**2019**:3085827. doi: 10.1155/2019/3085827.

[334] Thompson, C. N., Zelner, J. L., Nhu, T. D. H., Phan, M. V., Le, P. H., Thanh, H. N., ... & Baker, S. (2015). The impact of environmental and climatic variation on the spatiotemporal trends of hospitalized pediatric diarrhea in Ho Chi Minh City, Vietnam. *Health & place*, *35*, 147-154.

[335] Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., Nguyen, M., Nguyen, N. H., Manh, C. D., & Nguyen, T. H. (2015). Association between climate factors and diarrhoea in a Mekong Delta area. *International journal of biometeorology*, *59*(9), 1321–1331. https://doi.org/10.1007/s00484-014-0942-1

[336] Tran, T. T. H., Pham, Q. T., Nguyen, T. T. H., & Tran, T. H. (2019). Climate change and waterborne diseases in Vietnam: A review. Environmental Health Insights, 13, 1178630219829571. doi:10.1177/1178630219829571

[337] https://www.trade.gov/country-commercial-guides/vietnam-environmental-technology

[338] Brauer, M., Freedman, G., Frostad, J., van Donkelaar, A., Martin, R. V., Dentener, F., ... Cohen, A. (2015). Ambient air pollution exposure estimation for the Global Burden of Disease 2013. Environmental Science & Technology, 50(1), 79–88

[339] Koplitz, S.N., Jacob, D.J., Sulprizio, M.P., Myllyvirta, L. and Reid, C., 2017. Burden of disease from rising coal-fired power plant emissions in Southeast Asia. *Environmental science & technology*, *51*(3), pp.1467-1476.

[340] World Bank, 2021 (unpublished). "Accelerating Clean, Green, and Climate-Resilient Growth." Vietnam Country Environmental Analysis. Washington, DC: World Bank. These costs are based on the loss of output and constitute a market cost-based estimate. Two alternative approaches are to use the value of a statistical life (VSL) or the willingness to pay (WTP) to reduce the risk of death, which is a measure of the welfare loss associated with mortality. Using the latter, the economic cost would amount to around 3.9 percent of GDP.

[341] Phung, D., Hien, T.T., Linh, H.N., Luong, L.M., Morawska, L., Chu, C., Binh, N.D. and Thai, P.K., 2016. Air pollution and risk of respiratory and cardiovascular hospitalizations in the most populous city in Vietnam. Science of the total environment, 557, pp.322-330.
[342] Kim, S.E., Harish, S.P., Kennedy, R., Jin, X. and Urpelainen, J., 2020. Environmental degradation and public opinion: The case of air pollution in Vietnam. The Journal of Environment & Development, 29(2), pp.196-222.
[343] Wertheim-Heck, S., Raneri, J. E., & Oosterveer, P. (2019). Food safety and nutrition for low-income urbanites: exploring a social justice dilemma in consumption policy. *Regional environmental change*, *31*(2), 397–420. https://doi.org/10.1177/0956247819858019
[344] Carrique-Mas, J. J., & Bryant, J. E. (2013). A review of foodborne bacterial and parasitic zoonoses in Vietnam. Ecohealth, 10(4), 465-489.
[345] Huong, N. Q., Nga, N. T. T., Long, N. V., Luu, B. D., Latinne, A., Pruvot, M., ... & Olson, S. H. (2020). Coronavirus testing indicates transmission risk increases along wildlife supply chains for human consumption in Viet Nam, 2013-2014. PLoS One, 15(8), e0237129.
[346] Trang do T., Siembieda J., Huong N.T., Hung P., Ky V.D., Bandyopahyay S., et al. Prioritization of zoonotic diseases of public health significance in Vietnam. J. Infect. Dev. Ctries. 2015;9(12):1315–1322. doi: 10.3855/jidc.6582.
[347] Ministry of Health–Ministry of Agriculture and Rural Development . Joint Circular: Guidelines for coordinated prevention and control of zoonotic diseases. 2013. Ref. No. 16/2013/TTLT-BYT-BNN&PTNT. Hanoi, Vietnam, May 27.
[348] Ministry of Health . *Guidance on reporting and declaration of infectious diseases and epidemics.* 2015. Ref. No. 54/2015/TT-BYT. Hanoi, Vietnam, December 28.http://vbpl.yte.gov.vn/van-ban-phap-luat/thong-tu-542015tt-byt.6.1508.html
[349] Ministry of Agriculture & Rural Development Ref. No. 07/2016/TT-BNNPTNT. Regulations on prevention, control of epidemics on terrestrial animals. http://www.cucthuy.gov.vn/vanban/Pages/thong-tu-07-2016-tt-bnnptnt.aspx

[350] WHO Climate and Health Country Profile Fiji-2015

[351] Honda, Y., Kondo, M., McGregor, G., Kim, H., Guo, Y-L, Hijioka, Y., Yoshikawa, M., Oka, K., Takano, S., Hales, S., Sari Kovats, R. (2014). Heat-related mortality risk model for climate change impact projection. Environmental Health and Preventive Medicine 19: 56–63. URL: https://www.ncbi.nlm.nih.gov/pubmed/23928946

[352] Human health and climate change in Pacific Island countries

https://www.who.int/publications/i/item/9789290617303

[353] Moceituba, A. and Tsang, M., 2015. Averting climate change's health effects in Fiji. *World Health Organization. Bulletin of the World Health Organization*, *93*(11), p.746.

[354] WHO. Protecting health of the Pacific people from climate change and environmental hazards. https://www.who.int/westernpacific/activities/protecting-the-islanders-from-climate-change-and-environmental-hazards

[355] IFRC, 2015, Climate Change Impacts on Health and Livelihoods: Fiji Assessment
[356] ibid

[357] https://www.traveldoctor.network/country/fiji/risk/air-pollution/

[358] Ibid
[359] Climate Risk Country Profile: Fiji (2021): The World Bank Group.

[360] Human health and climate change in Pacific Island countries

https://www.who.int/publications/i/item/9789290617303

[361] Moceituba, A. and Tsang, M., 2015. Averting climate change's health effects in Fiji. *World Health Organization. Bulletin of the World Health Organization*, *93*(11), p.746.

[362] WHO. Protecting health of the Pacific people from climate change and environmental hazards. https://www.who.int/westernpacific/activities/protecting-the-islanders-from-climate-change-and-environmental-hazards

[363] Tiatia-Seath, J., Tupou, T. and Fookes, I., 2020. Climate change, mental health, and well-being for Pacific peoples: a literature review. *The Contemporary Pacific*, *32*(2), pp.399-430.

[364] Tiatia, J., Langridge, F., Newport, C., Underhill-Sem, Y. and Woodward, A., 2023. Climate change, mental health and wellbeing: privileging Pacific peoples 'perspectives–phase one. *Climate and Development*, *15*(8), pp.655-666.

[365] Gibson, K.E., Barnett, J., Haslam, N. and Kaplan, I., 2020. The mental health impacts of climate change: Findings from a Pacific Island atoll nation. *Journal of anxiety disorders*, *73*, p.102237.

[366] Kelman, I., Ayeb-Karlsson, S., Rose-Clarke, K., Prost, A., Ronneberg, E., Wheeler, N. and Watts, N., 2021. A review of mental health and wellbeing under climate change in small island developing states (SIDS). *Environmental Research Letters*, *16*(3), p.033007.

[367] WHO Climate change adaptation to protect human health https://www.who.int/docs/default-source/climate-change/adaptation-report-fiji-2010.pdf?sfvrsn=80d3b127_2

[368] World Food Project 2015 https://www.wfp.org/content/two-minutes-climate-change-and-hunger

[369] Barnet, J., 2007. Food security and climate change in the South Pacific. Pacific Ecologist, Winter.

[370] McIver, L., Kim, R., Woodward, A., Hales, S., Spickett, J., Katscherian, D., Hashizume, M., Honda, Y., Kim, H., Iddings, S. and Naicker, J., 2016. Health impacts of climate change in Pacific Island countries: a regional assessment of vulnerabilities and adaptation priorities. *Environmental health perspectives*, *124*(11), pp.1707-1714.

[371] https://journals.plos.org/climate/article?id=10.1371%2Fjournal.pclm.0000296

[372] https://www.sciencedirect.com/science/article/pii/S2667278222000013

[373] WHO Climate change adaptation to protect human health https://www.who.int/docs/default-source/climate-change/adaptation-report-fiji-2010.pdf?sfvrsn=80d3b127_2

[374] Air Pollution in Fiji | Travel Doctor Network [WWW Document], n.d. URL https://www.traveldoctor.network/country/fiji/risk/air-pollution/

[375] MoHP (2022). Vulnerability and Adaptation Assessment of Climate Sensitive Diseases and Health Risks in Nepal. Ministry of Health and Population, Government of Nepal, Kathmandu, Nepal.

[376] Kathmandu, N., 2018. Assessing Trends of Heat Waves and Perception of People about Health Risks of Heat Wave in Nepal. Available at: https://nhrc.gov.np/wp-content/uploads/2019/04/Assessing-Trends-of-Heat-Waves-CTP.pdf

[377] Food poisoning, water- and vector-borne diseases on the rise. 2023. Available at: https://kathmandupost.com/health/2023/07/26/food-poisoning-water-and-vector-borne-diseases-on-the-rise.

[378] Bhandari, D., Bi, P., Sherchand, J.B., Dhimal, M. and Hanson-Easey, S., 2020. Assessing the effect of climate factors on childhood diarrhoea burden in Kathmandu, Nepal. *International Journal of Hygiene and Environmental Health*, *223*(1), pp.199-206. Available at: https://www.sciencedirect.com/science/article/pii/S1438463919305498.

[379] Aryal, P., 2015. Climate change and food security: Nepal perspective. *Climate Change*, *1*(2), pp.105-109. Available at: https://discoveryjournals.org/climate_change/current_issue/v1/n2/A7.pdf

[380] Randell, H., Jiang, C., Liang, X.Z., Murtugudde, R. and Sapkota, A., 2021. Food insecurity and compound environmental shocks in Nepal: Implications for a changing climate. *World development*, *145*, p.105511. Available at: https://pubmed.ncbi.nlm.nih.gov/34012190/

[381] Sapkota, R. and Rijal, K., 2016. Climate change and its impact in Nepal. *Tribhuva n University*. Available at: http://dpnet.org.np/public/uploads/files/ClimatechangeandNepal_ReganSapkota%202020-02-04%2006-16-55.pdf

[382] Chuk, L. (2020, November 8). Disasters | Open Development Cambodia (ODC). Open Development Cambodia (ODC). https://opendevelopmentcambodia.net/topics/disasters/?queried_post_type=topic

[383] Cambodia 2013 Post-flood early recovery need assessment report, Royal Government of Cambodia. http://www.kh.undp.org/content/dam/cambodia/docs/PovRed/Cambodia%20post-flood%20recovery%20need%20assessment%20report.pdf accessed on 27 June 2016.

[384] https://www.tuvaluclimatechange.gov.tv/sites/default/files/documents/Climate%20Change%20Policy_FINAl_0.pdf

[385] World Bank (2016) *Pacific Possible: Climate*. Available at: https://thedocs.worldbank.org/en/doc/720371469614841726-0070022016/original/PACIFICPOSSIBLEClimate.pdf
[386] IPCC-AR-6 (2022): Climate Change, Impacts, Vulnerability and Adaptation; Vol-II, Chapter-7 on Health and Well Being
[387] Taylor S. (2020). Anxiety disorders, climate change, and the challenges ahead: Introduction to the special issue. *Journal of anxiety disorders*, *76*, 102313. https://doi.org/10.1016/j.janxdis.2020.102313
[388] Tuvalu Four Year Plan. Four Year Plans for Pacific Island countries published by the New Zealand Ministry of Foreign Affairs and Trade. https://www.mfat.govt.nz/assets/Aid/4YPs-2021-24/Tuvalu-4YP.pdf; 2021
[389] file:///D:/OneDrive%20-%20The%20Energy%20and%20Resources%20Institute/Desktop/9789290229049-eng.pdf
[390] Lugten, E. and Hariharan, N., 2022. Strengthening Health Systems for Climate Adaptation and Health Security: Key Considerations for Policy and Programming. Health security, 20(5), pp.435-439.
[391] Committee for the Study of the Future of Public Health IoM (1988) The future of public health. Washington (D.C.): National Academy Press.
[392] Committee for the Study of the Future of Public Health IoM (1988) The future of public health. Washington (D.C.): National Academy Press.
[393] US Department of Health and Human Services (1994) Public health in America. Washington (D.C.): US Department of Health and Human Services.
[394] World Health Organization (2007) Everybody's business: strengthening health systems to improve health outcomes. WHO's framework for action. Geneva: World Health Organization.
[395] Framework for action in building health systems resilience to climate change in South-East Asia Region, 2017–2022. New Delhi: World Health Organization, Regional Office for South-East Asia; 2017. Licence: CC BY-NC-SA 3.0 IGO
[396] https://www.orfonline.org/expert-speak/building-climate-resilient-health-systems-in-india/#:~:text=Ultimately%2C%20three%20key%20structural%20changes,%2C%20services%2C%20and%20capacities%20accordingly.
[397] 3 Singh N, Singh S, Mall RK. Urban ecology and human health: implications of urban heat island, air pollution and climate change nexus. In: Verma P, Singh P, Singh R, Raghubanshi AS, eds. Urban Ecology: Emerging Patterns and Social-Ecological Systems. Amsterdam: Elsevier; 2020:317-334
[398] Watts N, Amann M, Arnell N, et al.. The 2020 report of the *Lancet* Countdown on health and climate change: responding to converging crises. *Lancet*. 2021;397(10269):129-170.
[399] United Nations Department of Economic and Social Affairs. Do you know all 17 SDGs? Accessed July 15, 2022.
[400] file:///C:/Users/p.sisira/Downloads/World%20Health%20Organization%20Strategy%20(2022%E2%80%932026)%20for%20the%20National%20Action%20Plan%20for%20Health%20Security.pdf
[401] World Bank Open Data [WWW Document], n.d. . World Bank Open Data. URL https://data.worldbank.org/indicator/SH.MED.PHYS.ZS
[402] World Bank Open Data [WWW Document], n.d. . World Bank Open Data. URL https://data.worldbank.org/indicator/SH.MED.NUMW.P3
[403] World Bank Open Data [WWW Document], n.d. . World Bank Open Data. URL https://data.worldbank.org/indicator/SH.MED.BEDS.ZS
[404] https://main.mohfw.gov.in/sites/default/files/5NHA_19-20_dt%2019%20April%202023_web_version_1.pdf
[405] World Bank Open Data [WWW Document], n.d. . World Bank Open Data. URL https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS
[406] Contact us [WWW Document], n.d. URL https://apps.who.int/gho/data/view.main.GHEDOOPSCHESHA2011v?lang=en
[407]Sarwal R; Prasad U; Madangopal K; Kalal S; Kaur D; Kumar A; Regy P; Sharma J. Investment Opportunities in India's Healthcare Sector. NITI Aayog. March 2021.
[408] Selvaraj S, Karan K A, Srivastava S, Bhan N, & Mukhopadhyay I. India health system review. New Delhi: World Health Organization, Regional Office for South-East Asia; 2022.
[409] Anon n.d. About NHA - National Health Authority | GOI. [online] Available at: <https://nha.gov.in/NHA>.
[410] https://dghs.portal.gov.bd/sites/default/files/files/dghs.portal.gov.bd/page/8983ee81_3668_4bc3_887e_c99645bbfce4/2022-09-20-12-31-58c5a0b12e3aad087eaa26c3ce0f1a7b.pdf
[411] Ahmed, S. M., Hossain, M. A., & Chowdhury, M. R. (2011). Informal sector providers in Bangladesh: how equipped are they to provide rational health care?. Journal of Health, Population, and Nutrition, 29(6), 570–581.
[412] Source: James P. Grant School of Public Health. (2018). National Health Workforce Strategy of Bangladesh: Mapping Future Health Workforce Needs.
[413] World Health Organization (WHO). (2019). Bangladesh Health Workforce Strategy.
[414] Bangladesh health system review(Health Systems in Transition, Vol. 5 No. 3 2015)

ISBN 978 92 9061 705 1 (NLM Classification: WA 540 JB2)

[415] *Understanding Indonesia's Healthcare System*. (n.d.). International Citizens Insurance. https://www.internationalinsurance.com/health/systems/indonesia.php

[416] Joint Committee on Reducing Maternal and Neonatal Mortality in Indonesia; Development, Security, and Cooperation; Policy and Global Affairs; National Research Council; Indonesian Academy of Sciences. Reducing Maternal and Neonatal Mortality in Indonesia: Saving Lives, Saving the Future. Washington (DC): National Academies Press (US); 2013 Dec 26. 4, The Indonesian Health Care System. Available from: https://www.ncbi.nlm.nih.gov/books/NBK201708/

[417] Joint Committee on Reducing Maternal and Neonatal Mortality in Indonesia; Development, Security, and Cooperation; Policy and Global Affairs; National Research Council; Indonesian Academy of Sciences. Reducing Maternal and Neonatal Mortality in Indonesia: Saving Lives, Saving the Future. Washington (DC): National Academies Press (US); 2013 Dec 26. 4, The Indonesian Health Care System. Available from: https://www.ncbi.nlm.nih.gov/books/NBK201708/

[418] Vietnam's Healthcare System Decentralization: how well does it respond to global health crises such as covid-19 pandemic? 1 Asia Pacific Journal of Health Management 2021; 16(1):i619. doi: 10.24083/apjhm.v16i1.619

[419] https://www.rvo.nl/sites/default/files/2021/06/Healthcare-in-The-Philippines.pdf

[420] ibid

[421] Dayrit, M.M., Lagrada, L.P., Picazo, O.F., Pons, M.C. and Villaverde, M.C., 2018. The Philippines health system review. Health systems in transition, 8(2).

[422] WHO | Primary health care: Fiji's broken dream [WWW Document], 2011. URL https://web.archive.org/web/20140619005026/http://www.who.int/bulletin/volumes/86/3/08-020308/en/

[423] WHO The Fiji islands health system review. (Health Systems in Transition, Vol. 1 No. 1 2011)

[424] Fiji - GHS Index [WWW Document], 2021. . GHS Index. URL https://www.ghsindex.org/country/fiji/

[425] D. Quek, "The Malaysian healthcare system: a review," presented at the Intensive workshop on health systems in transition, 2009, pp. 29–30. [Online]. Available: https://www.researchgate.net/profile/David-Quek/publication/237409933_The_Malaysian_Health_Care_System_A_Review/links/0c96053b844e2563b9000000/The-Malaysian-Health-Care-System-A-Review.pdf

[426] M. Yorulmaz and N. N. Mohamed, "Malaysia health system review: Overviews and opinions," presented at the International Journal of Health Administration and Education Congress (Sanitas Magisterium), Ayşegül KAPTANOĞLU, 2019, pp. 45–57.

[427] WHO, "Malaysia health system review," 2012.

[428] GIZ (2021). SECTOR BRIEF CAMBODIA: Health Care. [online] Available at: https://www.giz.de/en/downloads/SectorBrief_Cambodia_HealthCareSector.pdf

[429] Manuella, S., Ministry of Health, Permanent Secretary of Health, Director of Health, & Ta'ape, I. (n.d.). Health Reform Strategy 2016-2019. In *Tuvalu Health Reform Strategy 2016-2019*. https://faolex.fao.org/docs/pdf/tuv192703.pdf

[430] Pacific Prime. (n.d.). *Tuvalu health insurance*. Retrieved from https://www.pacificprime.com/country/australasia/tuvalu-health-insurance-pacific-prime/

[431] Anon 2021. National Action Plan on Climate Change (NAPCC). [online] Ministry of Environment, Forest and Climate Change. Available at: <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2021/dec/doc202112101.pdf> [Accessed 9 Oct. 2023].

[432] https://www.adaptationcommunity.net/wp-content/uploads/2019/04/giz2019-en-factsheet-nap-india-low-res.pdf

[433] NDMA, "National Disaster Management Guidelines - Hospital Safety," National Disaster Management Authority of India, Ministry of Home Affairs, Government of India, New Delhi, 2016

[434] Mint, "Amrita Hospital, Faridabad, takes responsibility for its environmental impact," 09 August 2022. [Online]. Available: https://www.livemint.com/brand-stories/amrita-hospital-faridabad-takes-responsibility-for-itsenvironmental-impact-11660031297957.htm

[435] R. Venkatesh and A. G. Shukla, "Sustainability in eye care: Aravind Eye Hospital's low carbon eyecare system," 4 August 2021. [Online]. Available: https://www.eyenews.uk.com/features/ophthalmology/post/sustainability-ineyecare-aravind-eye-hospital-s-low-carbon-eyecare-system

[436]] P. CEH, "A Solar Energy Initiative to Reduce Cost and Carbon Emission by Bhagat Chandra Hospital," February 2018. [Online]. Available: https://050740.p3cdn1.secureserver.net/wp-content/uploads/2018/03/Energy_BhagatChandra.pdf?time=1690088305.

[437] IANS, "Kerala's health department among UN-backed Race to Zero campaign," 26 October 2021. [Online]. Available: https://health.economictimes.indiatimes.com/news/industry/keralas-health-department-among-unbacked-race-to-zero-campaign/87269107.

[438] Ayers, J. M., Huq, S., Faisal, A. M., & Hussain, S. T. (2014). Mainstreaming climate change adaptation into development: A case study of Bangladesh. WIREs Climate Change, 5, 37– 51.
[439] Rahman, M. M., Ahmad, S., Mahmud, A. S., Hassan-uz-Zaman, M., Nahian, M. A., Ahmed, A., ... & Streatfield, P. K. (2019). Health consequences of climate change in Bangladesh: An overview of the evidence, knowledge gaps and challenges. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(5), e601.
[440] Shaw, J. (2015, March 2). Vulnerability to climate change adaptation in rural Bangladesh. Climate Policy, 15(3), 410–412. https://doi.org/10.1080/14693062.2015.1007837
[441] Khan, A. E., Ireson, A., Kovats, S., Mojumder, S. K., Khusru, A., Rahman, A., & Vineis, P. (2011). Drinking water salinity and maternal health in coastal Bangladesh: Implications of climate change. Environmental Health Perspectives, 119, 1328– 1332.
[442] M.A. Chowdhury and M.A. Hossen, "Challenges of governance for addressing climatic concerns in Bangladesh,"2017, [Online]. Available: https://www.researchgate.net/publication/325285575_Challenges_of_Governance_for_Addressing_Climatic_Concerns_in_Bangladesh.
[443] Berkhout F. Adaptation to climate change by organizations. Wiley InterdiscipRev Clim Change 2012;3(1):91–106 Jan. doi: 10.1002/wcc.154.
[444] Bangladesh [WWW Document], n.d. . Climate & Clean Air Coalition. URL https://www.ccacoalition.org/partners/bangladesh
[445] Graham-Harrison, E., Doshi, V., 2020. Rajshahi: the city that took on air pollution – and won [WWW Document]. the Guardian. URL https://www.theguardian.com/world/2016/jun/17/rajshahi-bangladesh-city-air-pollution-won
[446] https://www.adb.org/sites/default/files/publication/780921/air-quality-asia.pdf
[447] Maintains programme: Research supporting social services' adaptation to external shocks [WWW Document], 2021. . Oxford Policy Management. URL https://www.opml.co.uk/projects/researching-how-social-services-can-better-adapt-to-external-shocks#bangladesh
[448] Vietnam - Environmental Technology. (2022, December 15). International Trade Administration | Trade.gov. https://www.trade.gov/country-commercial-guides/vietnam-environmental-technology
[449] Key Highlights: Country Climate and Development Report for Vietnam. (n.d.). World Bank. https://www.worldbank.org/en/country/vietnam/brief/key-highlights-country-climate-and-development-report-for-vietnam
[450] World Health Organization (WHO). (2020). Health and Climate Change: Country Profile 2020 - Vietnam.
[451] Center of Excellence in Disaster Management and Humanitarian Assistance, 2021. Philippines: Disaster Management Reference Handbook. Center for Excellence in Disaster Management and Humanitarian Assistance.
[452] Anon 2023. BENEFITS OF URBAN CLIMATE ACTION C40 Cities Technical Assistance Report. [online] Available at: https://www.c40.org/wp-content/uploads/2022/02/Quezon-City-%E2%80%93-Enforcement-of-Vehicle-Emissions-Regulations.pdf
[453] Dayrit MM, Lagrada LP, Picazo OF, Pons MC, Villaverde MC. The Philippines Health System Review. Vol. 8 No. 2. New Delhi: World Health Organization, Regional Office for SouthEast Asia; 2018
[454] https://www.adb.org/sites/default/files/linked-documents/54022-001-cca.pdf
[455] https://info.undp.org/docs/pdc/Documents/PHL/NSPP%202020%20APR.pdf
[456] UNDRR (2020). Disaster Risk Reduction in The Republic of Indonesia: Status Report 2020. Bangkok, Thailand, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific
[457] National Adaptation Plan Executive Summary 2019 Ministry of National Development Planning/ National Development Planning Agency (Bappenas)
[458] https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf
[459] UNDRR (2020). Disaster Risk Reduction in The Republic of Indonesia: Status Report 2020. Bangkok, Thailand, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific
[460] World Bank (2020). https://projects.worldbank.org/en/projects-operations/project-detail/P170874
[461] https://www.ccacoalition.org/sites/default/files/resources//2019_air-pollution-asia-pacific_summary%20report%28v0225%29.pdf
[462] https://www.adb.org/sites/default/files/publication/780921/air-quality-asia.pdf
[463] Anon n.d. *Policies & action*. [online] Available at: <https://climateactiontracker.org/countries/thailand/policies-action/>.
[464] Anon n.d. Thailand. [online] SCALA. Available at: <https://www.fao.org/in-action/scala/countries/thailand/en>.
[465] Anon 2022. Bangkok Action Plan on Global Warming Mitigation - C40 Cities. [online] C40 Cities. Available at: <https://www.c40.org/case-studies/bangkok-action-plan-on-global-warming-mitigation/>.
[466] Sanooj, B., Chamsilpa, M., Lekfuangfu, N.-A. and Kittichungchit, V., 2023. Spotlight: climate change law, regulation and policy in Thailand. [online] Lexology. Available at: <https://www.lexology.com/library/detail.aspx?g=adc8fe60-c506-4e80-823a-01deeda16838>.
[467] Anon n.d. Thailand and the Climate and Clean Air Coalition begin a major new initiative to reduce air pollution, improve human health and mitigate climate change. [online] Climate & Clean Air Coalition. Available at:

<https://www.ccacoalition.org/news/thailand-and-climate-and-clean-air-coalition-begin-major-new-initiative-reduce-air-pollution-improve-human-health-and-mitigate-climate-change>.
[468] WHO. 2017. Pacific Island Countries and Areas—WHO Cooperation Strategy 2018–2022. https://www.who.int/westernpacific/about/how-we-work/pacific-support/pacific-health-ministers-meetings
[469] Tye, S. and Waslander, J., 2021. Mainstreaming Climate Adaptation Planning and Action into Health Systems in Fiji, Ghana, and Benin.
[470] Tye, S. and Waslander, J., 2021. Mainstreaming Climate Adaptation Planning and Action into Health Systems in Fiji, Ghana, and Benin.
[471] World Bank Boosts Support for Fiji’s Sustainable Recovery [WWW Document], 2021. . World Bank. URL https://www.worldbank.org/en/news/press-release/2021/03/26/-world-bank-boosts-support-for-fiji-s-sustainable-recovery
[472] World Bank Group’s new Country Partnership Framework for Fiji (2021 – 2024) [WWW Document], 2021. . World Bank. URL https://www.worldbank.org/en/country/pacificislands/brief/world-bank-groups-new-country-partnership-framework-for-fiji-2021-2024
[473] Bank, A.D., 2022. ADB Approves $150 Million to Support COVID-19 Recovery and Climate Resilience in Fiji [WWW Document]. Asian Development Bank. URL https://www.adb.org/news/adb-approves-150-million-support-covid-19-recovery-and-climate-resilience-fiji
[474] Breezy, 2023. ADB's Work in the Pacific [WWW Document]. Asian Development Bank. URL https://www.adb.org/where-we-work/pacific/overview
[475] Dhimal, M., Dhimal, M.L., Pote-Shrestha, R.R., Groneberg, D.A. and Kuch, U., 2017. Health-sector responses to address the impacts of climate change in Nepal. *WHO South-East Asia journal of public health*, *6*(2), pp.9-14. Available at: https://d-nb.info/1160308667/34

[476] NHSSP, 2017. Climate Change and Health Infrastructure Framework. [online] NHSSP.org.np. Available at: https://www.nhssp.org.np/Resources/HI/Climate_Change_HI_Framework_Nov2017.pdf.
[477] Government of Nepal and World Bank Launch $103.84 Million Nepal Quality Health Systems Program to Strengthen Nepal’ s Health System. 2023. Available at: https://www.worldbank.org/en/news/press-release/2023/12/01/government-of-nepal-and-world-bank-launch-103-84-million-nepal-quality-health-systems-program-to-strengthen-nepal-s-heal.

[478] Nepal, 2020–2024 —Promoting Connectivity, Devolved Services, and Resilience. 2019. Available at: https://www.adb.org/sites/default/files/institutional-document/531716/cps-nep-2020-2024.pdf
[479] Bernama, "Climate change: Govt to form national adaptation plan," Malaysiakini. Accessed: Mar. 27, 2024. [Online]. Available: https://www.malaysiakini.com/news/625587
[480] B. Tan, "Putrajaya activates measures from National Haze Action Plan as air quality worsens | Malay Mail," MalayMail, Kuala Lumpur, 2023. Accessed: Mar. 27, 2024. [Online]. Available: https://www.malaymail.com/news/malaysia/2023/10/02/putrajaya-activates-measures-from-national-haze-action-plan-as-air-quality-worsens/94049
[481] World Health Organization (WHO). Third Round of the Global Pulse Survey on Continuity of Essential Health Services During the COVID-19 Pandemic: November–December 2021. Interim Report. Geneva: WHO; 2022. Accessed July 11, 2022. https://www.who.int/publications/i/item/WHO-2019-nCoV-EHS_continuity-survey-2022.1
[482] Lugten, E. and Hariharan, N., 2022. Strengthening Health Systems for Climate Adaptation and Health Security: Key Considerations for Policy and Programming. *Health security*, *20*(5), pp.435-439.
[483] Mosadeghrad, A.M., Isfahani, P., Eslambolchi, L., Zahmatkesh, M. and Afshari, M., 2023. Strategies to strengthen a climate-resilient health system: a scoping review. *Globalization and Health*, *19*(1), p.62.
[484] Source: World Health Organization (WHO). (2019). Bangladesh Health Workforce Strategy.
[485] Rfe/rl, 2022. Pakistan Floods Damage Nearly 900 Health Facilities, Hampering Response To Health Crises, WHO Says [WWW Document]. RadioFreeEurope/RadioLiberty. URL https://www.rferl.org/a/pakistan-floods-health-facilities-crisis-response-who/32013978.html
[486] Healthcare. Invest India. https://www.investindia.gov.in/sector/healthcare.
[487] Expenditure on healthcare in Indonesia 2013-2028 [WWW Document], 2023. . Statista. URL https://www.statista.com/forecasts/1149023/healthcare-spending-forecast-in-indonesia
[488] Maheshwari, R., 2023. Top Health Insurance Statistics Of 2023 [WWW Document]. Forbes Advisor INDIA. URL https://www.forbes.com/advisor/in/health-insurance/health-insurance-statistics/#sources_section
[489] https://www.pwc.com/bd/en/assets/pdfs/research-insights/2019/potential-for-growth.pdf
[490] Sakshi Bajpai et al., "Strengthening Health System Responses to Climate Risks in Multilateral Processes," T20 Policy Brief, June 2023.

[491] Ibid
[492] Leiserowitz, A., Thaker, J., Carman, J., Neyens, L., Rosenthal, S., Deshmukh, Y., Shukla, G., Marlon, J., Sircar, A. and Sekoff, S., 2012. Climate change in the indian mind. 2012.
[493] Mahendradhata, Y., Andayani, N. L. P. E., Hasri, E. T., Arifi, M. D., Siahaan, R. G. M., Solikha, D. A., & Ali, P. B. (2021). The Capacity of the Indonesian Healthcare System to Respond to COVID-19. *Frontiers in public health*, *9*, 649819. https://doi.org/10.3389/fpubh.2021.649819
[494] Mahendradhata Yodi, A. N. L. P. E. H. E. T. A. M. D. S. R. G. M. S. D. A. A. P. B., 2021. *The capacity of the Indonesian health care system to respond to covid 19,* Indonesia: Frontier in Public health . https://www.frontiersin.org/articles/10.3389/fpubh.2021.649819; DOI=10.3389/fpubh.2021.649819 ISSN=2296-2565
[495] World Health Organization (WHO). (2021). Global Health Workforce Statistics.
[496] https://www.trade.gov/country-commercial-guides/vietnam-healthcare
[497] Agustina, R., Dartanto, T., Sitompul, R., Susiloretni, K. A., Suparmi, Achadi, E. L., . . . Thabrany, H. (2019). Universal health coverage in Indonesia: Concept, progress, and challenges. Lancet, 393(10166), 75–102.
[498] Somanathan, A., Tandon, A., Dao, H. L., Hurt, K. L., & Fuenzalida-Puelma, H. L. (2014). Moving toward universal coverage of social health insurance in Vietnam: Assessment and options. Directions in Development No. 89066. Washington, DC: World Bank.
[499] Takashima, K., Wada, K., Tra, T. T., & Smith, D. R. (2017). A review of Vietnam's healthcare reform through the Direction of Healthcare Activities (DOHA). Environmental Health and Preventive Medicine, 22, 74.
[500] Bui, L., Ha, T.S., Nguyen, N.H., Sukhbaatar, K. and Bui, M.H., 2021. Big Data for Public Health Surveillance in Vietnam: Challenges and Opportunities. Soft Computing for Biomedical Applications and Related Topics, pp.197-204.
[501] Enhancing health data quality: strengthening Indonesia's data quality assurance [WWW Document], 2023. URL https://www.who.int/indonesia/news/detail/02-11-2023-enhancing-health-data-quality--strengthening-indonesia-s-data-quality-assurance
[502] World Bank (2017) Climate vulnerability assessment: making Fiji climate resilient. Washington, D.C. Available at: http://documents1.worldbank.org/curated/ en/163081509454340771/pdf/Climate-vulnerability-assessment-making-Fiji-climateresilient.pdf
[503] IFRC, 2015, Climate Change Impacts on Health and Livelihoods: Fiji Assessment
[504] ibid
[505] Training health workers about climate change and health linkages in the Philippines – Healthy DEvelopments [WWW Document], 2021. . Healthy DEvelopments. URL https://health.bmz.de/toolkits/climate-health/adaptation-measures/training-health-workers-about-climate-change-and-health-linkages-in-the-philippines/

[506] https://public.wmo.int/en/media/press-release/climate-change-bad-health-climate-services-save-lives

[507] Climate change: Viet Nam secures hospital water supplies for resilient future [WWW Document], 2023. URL https://www.who.int/vietnam/news/detail/12-07-2023-climate-change--viet-nam-secures-hospital-water-supplies-for-resilient-future

[508] https://www.oas.org/dsd/publications/unit/oea66e/ch07.htm

[509] Mint, "Amrita Hospital, Faridabad, takes responsibility for its environmental impact," 09 August 2022. [Online]. Available: https://www.livemint.com/brand-stories/amrita-hospital-faridabad-takes-responsibility-for-itsenvironmental-impact-11660031297957.htm
[510] R. Venkatesh and A. G. Shukla, "Sustainability in eye care: Aravind Eye Hospital's low carbon eyecare system," 4 August 2021. [Online]. Available: https://www.eyenews.uk.com/features/ophthalmology/post/sustainability-ineyecare-aravind-eye-hospital-s-low-carbon-eyecare-system
[511] P. CEH, "A Solar Energy Initiative to Reduce Cost and Carbon Emission by Bhagat Chandra Hospital," February 2018. [Online]. Available: https://050740.p3cdn1.secureserver.net/wp-content/uploads/2018/03/Energy_BhagatChandra.pdf?time=1690088305.
[512] IANS, "Kerala's health department among UN-backed Race to Zero campaign," 26 October 2021. [Online]. Available: https://health.economictimes.indiatimes.com/news/industry/keralas-health-department-among-unbacked-race-to-zero-campaign/87269107.