

Climate and Health Vulnerability Assessment

CAMBODIA



© 2024 International Bank for Reconstruction and Development/The World Bank

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of the World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the World Bank concerning the legal status of any territory, or the endorsement or acceptance of such boundaries.

Rights and Permissions

The material in this work is subject to copyright. The World Bank encourages the dissemination of its knowledge; thus this work may be reproduced, in whole or in part, for noncommercial purposes, as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

Cover image: Djibouti, Etiopía, children at Lake Abbe. February 9 of 2024.

CAMBODIA

Climate and Health Vulnerability Assessment

June 2024



TABLE OF CONTENTS

Acknowledgments	vi
List of abbreviations.....	vii
Executive summary	1
INTRODUCTION	5
Country context	6
I. CLIMATOLOGY.....	11
Cambodia's geography.....	11
Climate Contexts: Observed and Projected Climatology	12
Climate-Related Hazards	15
Key messages	21
II. CLIMATE-RELATED HEALTH RISKS	23
III. ADAPTIVE CAPACITY OF THE HEALTH SYSTEM	33
Health system overview.....	33
Leadership and governance	34
Health service delivery	36
Health workforce.....	37
Health information systems.....	38
Essential medical products and technologies.....	39
Health financing.....	40
IV. RECOMMENDATIONS	43
Health information systems.....	44
Health financing.....	44
Health service delivery	44
Health workforce.....	44
Leadership and governance	44
ANNEX	47
REFERENCES	49

INDEX OF TABLES

Table 1. Provinces Most Impacted by Extreme Heat: Annual Number of Hot days ($T_{\max} > 35^{\circ}\text{C}$) and Tropical nights ($T_{\min} > 20^{\circ}\text{C}$ and $> 26^{\circ}\text{C}$) in the 2030s and 2050s, Under SSP3-7.0.	14
Table 2. Food Production, Per Capita Food Consumption, and Hunger Attributable to Climate Change (CC).	25
Table 3. Gaps in Adaptive Capacity.	42

INDEX OF FIGURES

Figure 1. WHO's Operational Framework for Building Climate-Resilient Health Systems	8
Figure 2. Administrative Boundaries of Cambodia's Provinces	9
Figure 3. Elevation of Cambodia and Major Cities.....	12
Figure 4. Projected Average Monthly Temperature Anomalies in Cambodia for the 2030s and 2050s, Under the SSP3-7.0 Scenario	13
Figure 5. Projected Annual Number of Hot Days ($T_{\max} > 35^{\circ}\text{C}$) in Cambodia for 2030s and 2050s, Under the SSP3-7.0 Scenario	13
Figure 6. Number of People Affected by Key Natural Hazards, 1980–2020	15
Figure 7. Types of Flood Risks in Cambodia.....	16
Figure 8. Rainfall-Triggered Landslides in Cambodia	17
Figure 9. SPEI's Projected Anomalies Under the SSP3-7.0 Scenario.....	18
Figure 10. FWI for Wildfires in Cambodia.....	19
Figure 11. Cyclone Risk in Cambodia (Source: ThinkHazard, GFDRR).....	20
Figure 12. Stunting Prevalence by Region	24
Figure 13. Summary of the Nature of Association Between Monthly Minimum Temperatures and Monthly Cases of Diarrhea	28
Figure 14. WHO's Climate-Resilient Health System Building Blocks	34
Figure 15. WHO's Operational Framework for Climate-Resilient Health Systems	43

ACKNOWLEDGMENTS

This Climate and Health Vulnerability Assessment (CHVA) for Cambodia was produced by the Health, Climate, Environment and Disasters (HCED) Program in the Health, Nutrition, and Population (HNP) Global Practice of the World Bank, led by Tamer Rabie and Stephen Dorey. The assessment was authored by Jessica Huang, Mikhael Iglesias, Kim Heang Ung, Judith Namanya, and Paul Jacob Robyn, with contributions from Ana Lucrecia Rivera-Rivera, Muloongo Simuzingili and Loreta Rufo.

This work also benefited from the administrative support of Fatima-Ezzahra Mansouri, the editorial work of Kah Ying Choo, and the production of Sarah Jene Hollis.

The authors are thankful to the Climate Investment Funds (CIF) and the Climate Support Facility (CSF) for funding this work.

The authors are also highly grateful to the HNP management for their strong support of the HCED program and this product, and would like to extend their thanks to Juan Pablo Uribe and Monique Vledder.

LIST OF ABBREVIATIONS

AAP	Ambient Air Pollution
AIDS	Acquired Immunodeficiency Syndrome
AQI	Air Quality Index
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
CCAP	Climate Change Action Plan
CCCSP	Cambodia Climate Change Strategic Plan
CCDR	Country Climate Development Report
CCFF	Climate Change Financing Framework
CCKP	Climate Change Knowledge Portal
CCRI	Child Climate Risk Index
CCSP	Climate Change Strategic Plan
CCTWG	Climate Change Technical Working Group
CEGIM	Climate Economic Growth Impact Model
CHVA	Climate and Health Vulnerability Assessment
CIF	Climate Investment Funds
CMIP6	Coupled Model Intercomparison Project Phase 6
CNM	National Center for Parasitology Entomology and Malaria Control
COPD	Chronic Obstructive Pulmonary Disease
CPA	Complementary Package of Activities
CPEIR	Climate Public Expenditure and Institutional Review
DALYs	Disability-Adjusted Life Years
DCC	Department of Climate Change
DHS	Demographic and Health Survey
ENSO	El Niño Southern Oscillation
FWI	Fire Weather Index
GCF	Green Climate Fund
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse Gases
GHSC-PSM	Global Health Supply Chain Program-Procurement and Supply Management
HAP	Household Air Pollution
HCED	Health, Climate, Environment and Disasters
HDI	Human Development Index
HEF	Health Equity Funds
HIV	Human Immunodeficiency Virus

HNP	Health, Nutrition, and Population
HSS	Health System Strengthening
HWDP	Health Workforce Development Plan
ICT	Information and Communication Technologies
INDC	National Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
JMP	Joint Monitoring Programme
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MOE	Ministry of Environment
MoH	Ministry of Health
NASA	National Aeronautics and Space Agency
NCD	Noncommunicable disease
NCDM	National Committee for Disaster Management
NCS	National Council for Sustainable Development
NDC	National Determined Contributions
NGO	Non-Governmental Organization
OOP	Out-of-Pocket Expenditure
PM_{2.5}	Particulate Matter (2.5µ)
PMD	Preventive Medicine Department
PTSD	Post-Traumatic Stress Disorder
SPEI	Standard Precipitation Evapotranspiration Index
SSCSP	Sectoral Climate Change Strategic Plan
SSP	Shared Socioeconomic Pathway
UNDP	United National Development Programme
UNFCCC	United National Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
V&A	Vulnerability and Adaptation Assessment
VBD	Vector-Borne Disease
WASH	Water, Sanitation, and Hygiene
WBD	Waterborne Disease
WHO	World Health Organization

EXECUTIVE SUMMARY

Cambodia is highly exposed and vulnerable to climate change, which has significant direct and indirect impacts on human health. Climate-related hazards — such as heavy rainfall, flooding, landslides, sea-level rises, extreme heat, droughts, wildfires, and storms — affect agricultural productivity significantly, with tremendous implications on food security and nutrition. They also lead to increased waterborne disease (WBD) outbreaks and the transmission of vector-borne diseases (VBDs) in Cambodia. Moreover, flooding, strong winds, and extreme heat cause damage to the health infrastructure, medical equipment, and supplies in the country. The increasing burden of climate-sensitive diseases, coupled with the impacts on the health infrastructure, is putting pressure on the already fragile health system in the country, thereby affecting adaptive capacity and increasing health inequalities in Cambodia.

Considering Cambodia's high vulnerability and exposure to climate change, a Climate and Health Vulnerability Assessment (CHVA) was conducted. The objective of this CHVA is to assist decision-makers with planning effective adaptation measures to deal with climate-related health risks. Where available, these measures are provided at the subnational level to assist regional health planners. The recommendations of this CHVA are primarily aimed at the health sector and related sectors that influence health risks from climate change, such as disaster risk management.

The CHVA begins with an analysis of observed climatic changes and projected trends derived from the World Bank's Climate Change Knowledge Portal (CCKP). It highlights the changes in temperature and precipitation, as well as climate-related hazards, along with the relationship to human health risks in Cambodia:

- **Mean annual temperatures have increased by approximately 0.5°C over the past half century and they are projected to increase by 1.0°–1.2°C by the 2050s.** April has had the highest mean temperature (29.4°C), while January has had the lowest mean temperature (24.3°C). Nonetheless, projections show that mean monthly temperatures will increase from 27.4°C in the historical reference period (1995–2014) to 28.6°C in the mid-term period.
- **Mean annual precipitation in Cambodia has declined by 2.46 millimeters (mm) since the 1960s (from 1961–1990 to 1990–2020).** Rainfall patterns are projected to show slight variations; however, there is likely to be greater variability during the year, with a drier dry season for the 2030s and 2050s.
- **Projected increases in the frequency and intensity of erratic rainfall events during the 2030s and 2050s are likely to exacerbate flood and landslide risks.** The average largest one-day precipitation is projected to reach nearly 100 mm during October in Kep (97.4 mm) and Kampot (95.3 mm) by 2020–2039.

- **Cambodia already has a high number of high heat index days per year (> 35°C) based on a global comparison; they are projected to increase by the 2050s.** Tropical nights (> 20°C) are also expected to be near the maximum possible from March to October, with slight increases projected for the remaining months by the 2050s.

Cambodia faces significant health challenges from communicable and non-communicable diseases, and climate change will worsen the severity of these health challenges. Moreover, climate health risks are not evenly distributed in the population, with some groups at greater risk of exposure than others. Cambodia's CHVA assesses six climate-related health risk categories:

- **Nutrition, food access, and food safety risks:** Stunting and undernutrition are major climate-sensitive concerns in Cambodia. Regional variability in nutritional deficiencies is high. In Cambodia, nutrition services for people living in poverty and other vulnerable populations are critical, especially among rural populations.
- **Vector-borne diseases (VBDs):** Malaria, dengue, Zika, chikungunya, and Japanese encephalitis are among the climate-sensitive VBDs circulating in Cambodia. While there has been significant progress in reducing malaria, with cases declining by over 90 percent from 2010 to 2020, projected changes in temperature and precipitation in the 2030s and 2050s will adversely impact this progress.
- **Waterborne diseases (WBDs):** While Cambodia has made significant progress in decreasing the under-five mortality rates from diarrheal diseases since the year 2000, preventable deaths still occur. Given the challenges of the country's water, sanitation, and hygiene (WASH) infrastructure and the projected increases in floods and landslides, the incidence of diarrheal diseases in Cambodia will likely increase.
- **Heat-related morbidity and mortality:** Increases in average seasonal temperatures, as well as the frequency and intensity of heat wave events, are projected to increase heat-related morbidity and mortality. Oddar Meanchey, Preah Vihear, and Siem Reap are anticipated to experience the largest number of very hot days (> 35°C), thereby exposing over two million people to extreme heat.
- **Air pollution risks:** Ambient air pollution (AAP) and indoor (household) air pollution pose a risk to the health of people in Cambodia, although levels of exposure are relatively mild compared with other highly urbanized countries in the region.
- **Mental health and well-being risks:** Cambodia is experiencing a rise in mental health challenges following the stressors of the COVID-19 pandemic. Climate change-related events can worsen mental health through direct and indirect impacts over the short and long terms.

The extent to which the health system in Cambodia is prepared for climate change and possesses the capacity to manage hazard exposure and susceptibility will determine its resilience in the coming decades. In this assessment, Cambodia's adaptive capacity to prevent and manage climate-related health risks is examined according to the World Health Organization's (WHO) six health system building blocks:

- **Leadership and governance:** The government of Cambodia recognizes climate change and its impacts on the country's health sector. It has made substantial efforts in furthering health into the country's policies and strategies to address climate change. However, at a subnational level, the development and implementation of policies and plans to address climate-related health risks appear mixed due to the inadequate integration of strategic plans around local-level climate and health planning.
- **Health service delivery:** There have been considerable investments in the health system to increase both access to quality health services and their utilization in order to improve the quality of care. While health facilities at the subnational level have improved and health staff deployment has increased at the health center level, efforts to assess the climate resilience and adaptive capacity of health service delivery have been limited.
- **Health workforce:** Cambodia's Health Strategic Plan 3 outlines the importance of having appropriately skilled health staff who are adequately motivated, proficiently trained, and equitably deployed. However, there has been limited coordination between healthcare professionals concerning the response to the health risks and disaster risks arising from climate change.
- **Health information systems:** Although surveillance, reporting, and early warning systems exist in Cambodia, there is limited coordination between them. Furthermore, not all sources of data are shared with the appropriate stakeholders to enable a coordinated response to climate-related health risks.
- **Essential medical products and technologies:** Laboratory capabilities in Cambodia face several challenges including testing services, the transport of specimens, quality management, and regulations. Further, limited supply chains result in a lack of basic needs, as well as contribute to stockouts of laboratory reagents, consumables, and equipment.
- **Health financing:** Several health financing policies have been implemented in the country to improve access to health services. They include community-based health insurance, the development of a donor-supported health equity fund (HEF), a voucher scheme, and government-funded HEFs. However, vulnerable populations (the elderly, poor, and children under five) are not adequately covered by risk-pooling mechanisms such as the HEF.

The extent to which the health system in Cambodia is prepared for changes in hazards, exposure, and susceptibility and has the capacity to manage them will determine its resilience in the coming decades. The recommendation options are based on an assessment of both the magnitude of the current and projected climate-related health risks, the existing gaps in the adaptive capacity to manage and / or prevent these risks, and the feasibility of developing them in the short and medium terms.

- Expand the community-level mobile application developed by the National Center for Parasitology, Entomology and Malaria Control (CNM) to include other climate-sensitive diseases.
- Incorporate a health sector climate adaptation line into the national budget. Increased financing capacity should focus on improving risk-pooling mechanisms that are targeted at climate-vulnerable populations.
- Conduct an infrastructure assessment to identify key facilities and areas that need further investments to ensure resilience in the face of climate-related hazards.
- Develop and ensure the enforcement of building codes that include adaptation and mitigation standards for the health infrastructure.
- Develop tailored capacity-building modules for healthcare workers and health center administrators, accounting for subnational differences in climate-related hazards and health risks.
- Integrate non-governmental organizations, research institutes, and private sector providers of health services into multi-stakeholder coordination mechanisms, such as the Climate Change Technical Working Group (CCTWG).

INTRODUCTION

COUNTRY CONTEXT

- 1. Cambodia has experienced significant economic and social development: its average annual growth rate was 7.7 percent between 1998 and 2019, making it one of the fastest-growing economies in the world.** Cambodia had a Gross Domestic Product (GDP) of USD26.96 million in 2021¹ and a Human Development Index (HDI) value of 0.594 in 2019.² The country achieved the lower-middle-income status in 2015, fueled largely by tourism and the garment industry.³

During this period, the poverty rate in Cambodia was declining by 1.6 percent per year, thanks to rising wages, even though rural poverty remained worse (22.8 percent) than in urban areas (12.6 percent) and the capital city of Phnom Penh (4.2 percent).⁴ The Gini coefficient measure of inequality had fallen from over 40 percent in 1997 to around 30 percent in 2012.⁵ Cambodia announced its aspirations to achieve the upper-middle-income status by 2030.

- 2. However, the COVID-19 pandemic led to an economic downturn, accompanied by increases in poverty and inequality.** In 2020, the Cambodian economy contracted by 3.1 percent, which constituted the country's worst economic performance since 1994.⁶ The poverty rate was projected in 2020 to increase by up to 2.8 percent,⁷ with the unemployment rate also rising to 0.6 percent in 2021 after staying at 0.1 percent from 2017 to 2019.⁸ The impact of the pandemic on the Gini coefficient measure of inequality in Cambodia is unknown.

- 3. The population of Cambodia, which dropped by nearly a quarter during the Khmer Rouge genocide from 1975 to 1979, has been increasing to reach 16.6 million in 2021.** While the overall population has been growing, the annual population growth rate has slowed to 1.4 percent in 2021 after hovering at nearly 3 percent or higher until the mid-1990s.^{9,10} The age dependency ratio in Cambodia has also shifted dramatically since the mid-1990s. It dropped from a high of 98 percent in 1994 to 55 percent in 2021, meaning that there are significantly fewer people younger than 15 years old or older than 64 years old vis-à-vis the working-age population of between 15 and 64 years old.¹¹

Cambodia's population remains relatively young: approximately 60 percent was under 25 in 2019.¹² The female proportion of the population, which increased to 53.1 percent in the wake of the Khmer Rouge rule, has been declining to reach 51.2 percent in 2021.¹³ The rural population, which increased dramatically from 71 percent in 1974 to 96 percent in 1975 during the Khmer Rouge rule, has also been

decreasing, though it remains significantly above the majority — at 75 percent — in 2021.¹⁴

4. Affected by floods and droughts on a seasonal basis, Cambodia is one of the more disaster-prone countries in Southeast Asia.

Cambodia's vulnerability to climate change is affected by its status as a post-civil war and an underdeveloped country, which is predominantly agrarian; nearly 80 percent of the population lives in rural areas. The country's weak adaptive capacity, poor infrastructure, and limited institutions further exacerbate its vulnerability to climate variability and change.

The government recognizes that floods and droughts — the main climate-related hazards affecting the country — are one of the main drivers of poverty. During the 20-year period from 1987 to 2007, a succession of droughts and floods led to significant losses of lives and considerable economic losses. Approximately 80 percent of the country's population lives along the Mekong River, which is known to fluctuate significantly. Moreover, rising sea levels pose a significant threat to marine coastal areas that already suffer from storm surges, high tides, beach erosion, and seawater intrusion.¹⁵

- 5. Cambodia is committed to tackling climate change within its own borders by putting strategies in place to mitigate net greenhouse gas (GHG) emissions and developing plans to reduce the country's vulnerability to climate change.** Cambodia signed the Paris Agreement of the United National Framework Convention on Climate Change (UNFCCC) on April 22, 2016,¹⁶ which aims to limit the global mean temperature increase to well below 2°C compared with pre-industrial levels. Cambodia submitted its intended nationally determined contributions (INDCs) on June 2, 2017,¹⁷ and submitted an update on December 31, 2020.

These INDCs outline Cambodia's commitment to addressing climate change within its own borders in addition to planned mitigation and adaptation strategies in order to reduce the country's vulnerability to the adverse impacts of climate change. Regarding climate change's impact on health, Cambodia has outlined heatwaves and higher temperatures as a main concern for human health. Adaptation and mitigation measures related to human health and healthcare system impacts focus on (a) improving surveillance and early warning systems; (b) enhancing the resilience of the health system to ensure health service delivery; (c) strengthening capacity building for the diagnosis, detection, control, prevention, and treatment of vector-borne and water-borne diseases, injuries, and food poisoning-related illnesses; (d) conducting a water, sanitation, and hygiene (WASH) vulnerability assessment and developing interventions accordingly at the community and facility levels, as well as (e) enhancing institutional capacity to better incorporate climate-related risks and adaptation measure into the health sector's strategic planning.¹⁸

AIMS OF ASSESSMENT AND CONCEPTUAL FRAMEWORK

- 6. The objective of this Climate and Health Vulnerability Assessment (CHVA) is to assist decision-makers with planning effective adaptation measures to deal with climate-related health risks.** Where available, these measures are provided at the subnational level to assist regional health planners. The recommendations of this CHVA are primarily aimed at the health sector and related sectors influencing health risks arising from climate change, such as disaster risk management.

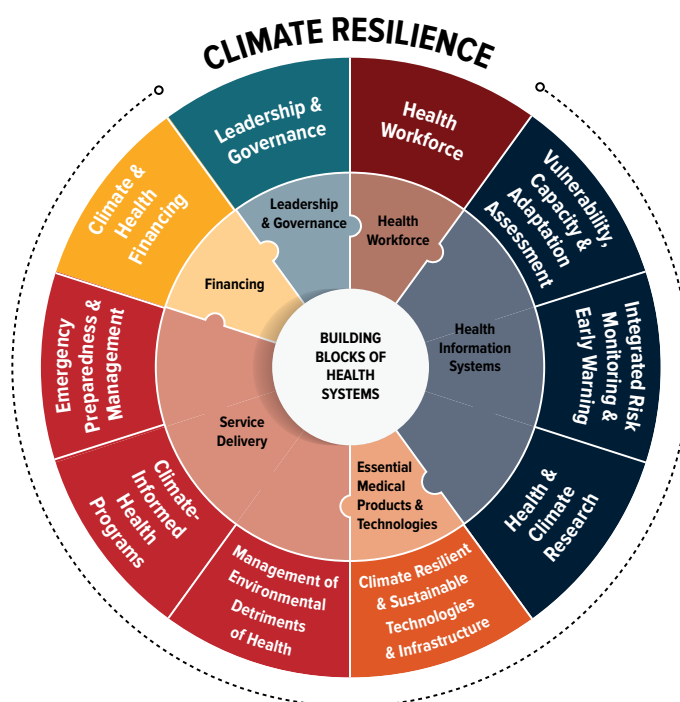
7. Adaptation priorities need to run alongside fundamental and urgent action to mitigate climate change. It is important to stress how complex the climate challenge is and how hard it is to predict exactly how severe climate exposures facing populations will become. There are many factors that could slightly slow or significantly speed up rates of change, including positive feedback effects, and, most worrying of all, cascading climatological tipping points. For this reason, mitigating existing GHG emissions, as well as developing and implementing measures to protect human development from the changing climate, is of paramount importance.

8. Investing in adaptation strategies to proactively address the effects of climate change on health outcomes is critical. This assessment is concerned with climate risks to health and health systems, the adaptive capacities that are in place to deal with these risks, and recommendations to meet identified gaps. The primary focus of this assessment is, therefore, on climate adaptation and resilience measures. However, as the Sixth Assessment Report (AR6)¹⁹ of the Intergovernmental Panel on Climate Change (IPCC) makes clear, “Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered.” Mitigation is no longer a sufficient strategy, regardless of the pace at which governments and communities around the world act. Adaptation is now as critical a part of climate action as mitigation. This report, therefore, focuses on adaptation measures, but where possible, it also includes recommendations for reducing GHGs or facilitating the decoupling of emissions from progress toward human development goals.

9. The World Health Organization’s (WHO) operational framework for building climate-resilient health systems is adopted to analyze the adaptive capacity to adequately deal with current and future identified risks. Following this framework (Figure 1), the assessment is structured around the six health system strengthening (HSS) building blocks. These six categories serve as a structure for assessing the country’s capacities and gaps — now and into the future. The framework was then used to consider the 10 components of Cambodia’s health system climate resilience for the development of the Recommendations section.

FIGURE 1.

WHO's Operational Framework for Building Climate-Resilient Health Systems.



Source: WHO, 2015

10. This assessment follows a stepwise linear approach. The first step characterizes the **climatology** in Cambodia by highlighting the observed and future climate exposures relevant to health. The second step examines the country's **climate-related health risks**, including identifying vulnerable populations most at risk. The final step assesses the **adaptive capacity of the health system** by identifying gaps in managing current and future climate-related health risks. Together, these steps inform a series of **recommendations** for reducing climate-related health vulnerability in Cambodia. The assessment was based on a review of the published literature, national statistics, and consultations with key counterparts in government — including the Ministry

of Health (MOH); the Ministry of Environment (MOE); as well as the Ministry of Agriculture, Forestry and Fisheries (MAFF).

11. -The assessment incorporates subnational considerations for health-related climate action. For the purpose of this assessment, the 25 administrative departments of Cambodia, known as provinces, were considered: Banteay Meanchey, Battambang, Kampong Cham, Kampong Chhnang, Kampong Speu, Kampong Thom, Kampot, Kandal, Koh Kong, Kratie, Mondulhiri, Phnom Penh, Preah Vihear, Prey Veng, Pursat, Ratanakiri, Siem Reap, Preah Sihanouk, Stung Treng, Svay Rieng, Takeo, Oddar Meanchey, Kep, Pailin, and Tboung Khmum.

FIGURE 2.

Administrative Boundaries of Cambodia's Provinces.



Source: World Bank Cartography Unit



CLIMATOLOGY

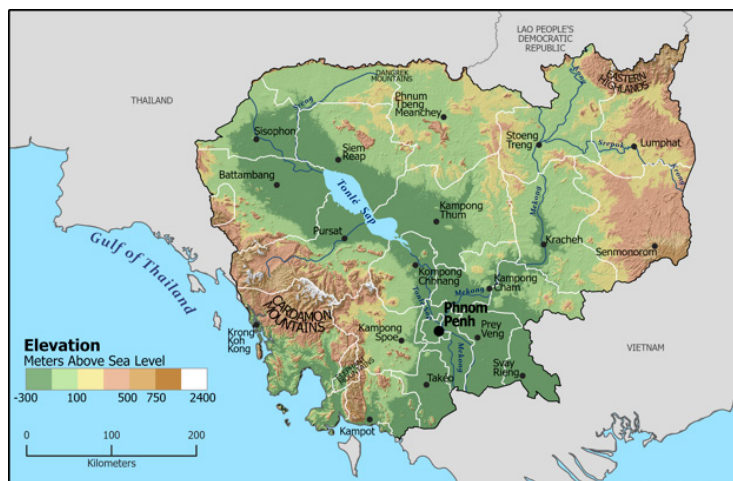
12. This section describes observed climatic changes and projected trends, highlighting the priority climate-related hazards in relation to human health risks in Cambodia. Observed changes in temperature and precipitation are taken from the World Bank Group’s Climate Change Knowledge Portal (CCKP) for the 1901–2021 period. Climate data in the CCKP is derived from the Coupled Model Intercomparison Project, Phase 6 (CMIP6); this is the foundational data used to present global climate change projections in the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC). CMIP6 uses shared socio-economic pathways (SSPs) — representations of possible societal development and policy scenarios — to determine the climate response. Essentially, the SSPs offer different plausible future societal development storylines and associated contrasting emission pathways, which outline how future emissions and land use changes would translate into responses in the climate system. This assessment explores observed climate conditions for the latest climatology (1991–2020), as well as projected climate conditions and changes under SSP3-7.0²⁰ for the near (2030s; 2020–2039) and medium terms (2050s; 2040–2059).

CAMBODIA’S GEOGRAPHY

13. A country in Southeast Asia, Cambodia is bordered by Laos, Thailand, Vietnam, and the Gulf of Thailand. The Mekong River — a prominent geographical feature of the country — flows from Laos in the north to the Mekong Delta of Vietnam in the south and feeds the Tonle Sap Lake. The Tonle Sap, covering almost 10 percent of the nation’s surface area, is a vital natural resource for the country during the peak of the southwest monsoon season. The topography of Cambodia includes the low-lying central plains of the Mekong, which are surrounded by mountainous and highland regions.²¹

FIGURE 3.

Elevation of Cambodia and Major Cities.



Source: Natural Earth, ASTER GDEM Version 3

CLIMATE CONTEXTS: OBSERVED AND PROJECTED CLIMATOLOGY

14. Cambodia has a tropical humid climate, though there are some subtropical dry regions in the southwest.²² The wet, monsoon-driven rainy season occurs from May to October, with southwesterly winds ushering in clouds and moisture that account for significant rainfall (85 percent of the country's annual rainfall) from the southwest monsoon. The dry season (November–April) is characterized by cooler temperatures, particularly between November and January. The interannual variation in climate is driven by the El Niño southern oscillation (ENSO), which influences the nature of the monsoons in the region and generally brings warmer and drier-than-average winter conditions across Southeast Asia, while the La Niña episodes bring cooler-than-average conditions.²³

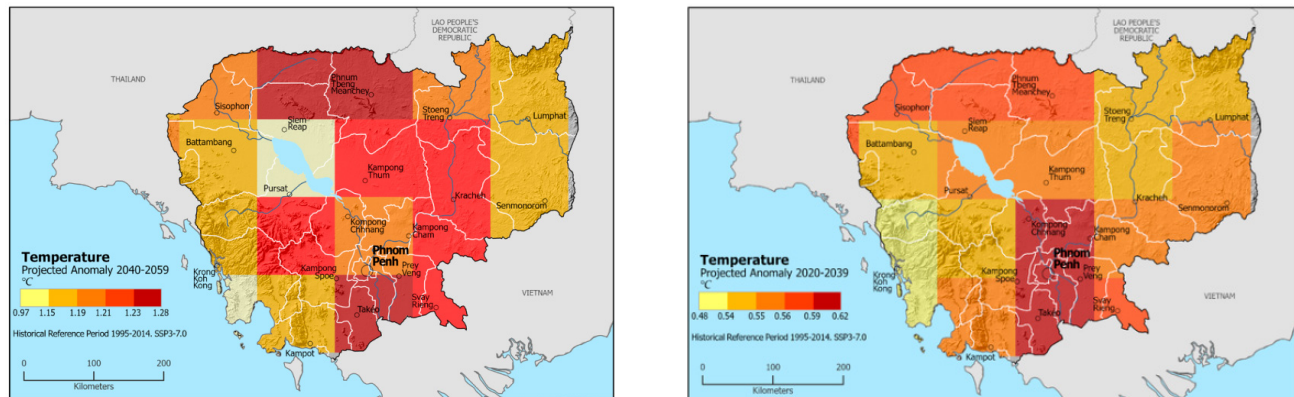
TEMPERATURE

15. Over the past half-century, across the national average, mean temperatures have increased by approximately 0.5°C. April has had the highest mean temperature (29.4°C), while January has had the lowest mean temperature (24.3°C). As the country has a homogenous topography, climate variations at the subnational level are low: temperatures range from 26.1°C in Mondul Kiri and Ratanak Kiri to 28.3°C in Banteay Meanchey.

16. Under the SSP3-7.0 scenario, temperatures are projected to increase through the mid-century throughout the country. Mean monthly temperatures will increase from 27.4°C in the historical reference period (1995–2014) to 28.6°C in the mid-term period. The level of increase in temperature will vary across the region. In the 2050s, median temperatures are projected to increase by 1.0°C in the southwest coastal region and by 1.2°C in the northern region. Median temperatures will, therefore, range from 29.7°C in Pursat to 32.6°C in Otdar Meanchey.

FIGURE 4.

Projected Average Monthly Temperature Anomalies in Cambodia for the 2030s and 2050s, Under the SSP3-7.0 Scenario.



Source: World Bank's CCKP

17. Extreme heat is projected to increase through the mid-century, with north and northwestern regions at the highest risk.

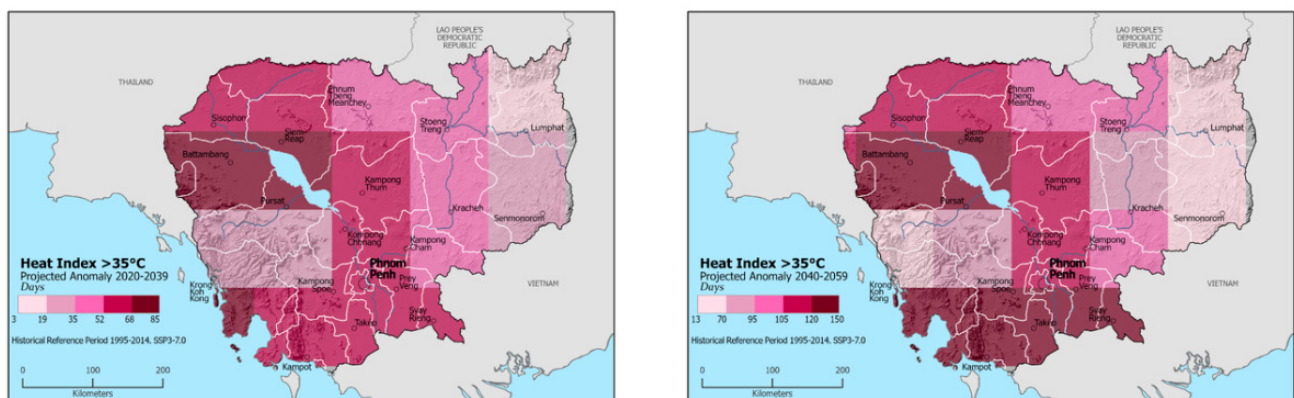
The annual number of hot days ($T_{max} > 35^{\circ}\text{C}$) will increase to 74.12 days by the 2030s and to 91.29 days by the 2050s. Departments such as Otdar Meanchey and Preah Vihear will experience the greatest number of hot days (141.2 and 122.64, respectively). In the 2030s, the greatest heat impact would occur from June through November, while the least heat impact would occur in April and May. In the 2050s, however, a large increase in the heat index is projected from March through

July. In the 2050s, the Pailin Province in the northwest is expected to experience the most severe heat exposure impact, mainly in May.

Daytime temperature increases will be coupled with high nighttime temperatures, whereby the minimum nighttime temperatures exceed 20°C (known as tropical nights). Cambodia is already prone to tropical nights. By the 2030s, most of the country will experience at least 300 tropic nights a year; by the 2050s, this figure will almost reach the whole year.

FIGURE 5.

Projected Annual Number of Hot Days ($T_{max} > 35^{\circ}\text{C}$) in Cambodia for 2030s and 2050s, Under the SSP3-7.0 Scenario.



Source: World Bank's CCKP

TABLE 1.

Provinces Most Impacted by Extreme Heat: Annual Number of Hot days ($T_{max} > 35^{\circ}\text{C}$) and Tropical nights ($T_{min} > 20^{\circ}\text{C}$ and $> 26^{\circ}\text{C}$) in the 2030s and 2050s, Under SSP3-7.0.

	2030s	2050s
	NO. DAYS	NO. DAYS
Hot Days ($>35^{\circ}\text{C}$)		
Oddar Meanchey	118.38 (70.49, 135.02)	141.2 (97.66, 172.13)
Preah Vihear	101.33 (56.91, 122.1)	122.64 (77.51, 158.73)
Siem Reap	93.37 (50.84, 114.38)	114.76 (69.03, 152.62)
Tropical Nights ($>20^{\circ}\text{C}$)		
Preah Sihanouk	364 (362, 362.25)	364.6 (362.3, 365.25)
Kep	362.1 (357.05, 364.9)	363.5 (359.5, 365)
Kampot	353.46 (353.46, 363.56)	362.14 (357.26, 364.2)
Tropical Nights ($>26^{\circ}\text{C}$)		
Preah Sihanouk	185.75 (134.7, 212.05)	243.2 (203.05, 289.2)
Pailin	127.25 (76.54, 174.15)	188.78 (133.92, 232.38)
Koh Kong	107.06 (67.41, 154.67)	173.1 (128.9, 230.57)

Source: World Bank's CCKP

PRECIPITATION

18. Mean annual precipitation in Cambodia has experienced a slight decline of 2.46 mm since the 1960s (from 1961–1990 to 1990–2020). Although the trend is weak, the precipitation variability is linked to the ENSO phenomenon: the years of strong El Niño are correlated with moderate and severe droughts.²⁴

In general, Cambodia experiences significant variability in its average annual rainfall at the subnational level. Precipitation levels range from 1,400 mm in the central lowlands to 4,000 mm near the Cardamom mountains in the west and nearby coastal areas in the southwest. The country's eastern plains

receive approximately 2,000–2,600 mm of rainfall annually, with even higher quantities in the mountainous areas in the Northeast.²⁵ But Koh Kong has the greatest amount of rainfall at an annual average of 3,214 mm, while Siem Reap has the lowest amount (1,413 mm). An overall precipitation decrease during May has been experienced throughout the country, with declines reaching 58 mm in Koh Kong.

Nonetheless, precipitation increases are projected for October, with average increases of 23.2 mm across the country and maximum increases (43.46 mm) in Koh Kong by the 2020–2039 period. The projected precipitation increase during October is expected

to rise to an average of 32.9 mm across the country by 2040–2059.

- 19. Rainfall patterns are projected to show slight variations under the SSP3-7.0 scenario; however, there is likely to be greater variability during the year, with a drier dry season for the 2030s and 2050s.** Increases in rainfall are projected for most of the wet season (June–October), with decreases during the dry season (March and April). The regional dynamic will provide spatial heterogeneity in future precipitation patterns. In the 2050s, increases in seasonal rainfall (June and August) are expected in the northern and northeastern regions of the country. Annual average precipitation decreases are projected for the Puset Province (to the west) and the Kampot Province (to the south coast).

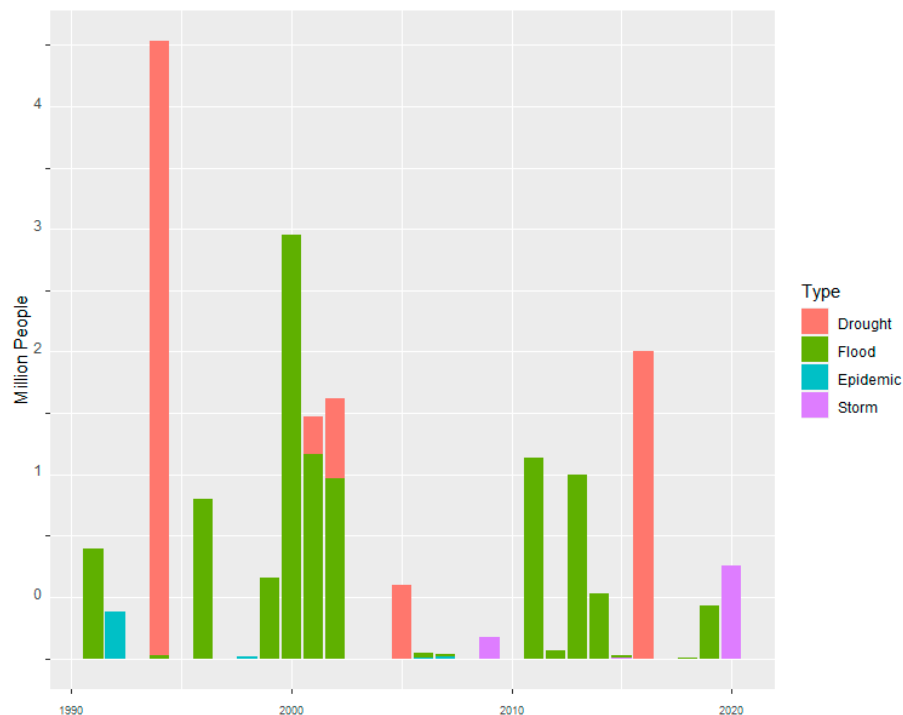
CLIMATE-RELATED HAZARDS

20. Climate-related hazards linked to changes in baseline temperatures and precipitation affect population health in Cambodia.

Cambodia was ranked 55 out of 191 countries in the 2019 Inform Risk Index.²⁶ The country faces high disaster risk levels and struggles with major climate-related hazards such as flooding, landslides, extreme heat, sea-level rises, extreme weather events, wildfires, and droughts (Figure 10). The overall impacts of such events will not merely be attributable to changing environmental conditions but also compounded by anthropogenic causes including rapid deforestation, urbanization, and inadequate housing.

FIGURE 6.

Number of People Affected by Key Natural Hazards, 1980–2020.



Source: World Bank's CCKP

FLOODS

21. Cambodia is exposed to flood-related hazards. Floods occur frequently during the monsoon seasons — the rainiest months from June to September. They are often triggered by heavy or sustained rainfall, increasing river volumes, and insufficient or blocked drainage infrastructure. Between 2000 and 2024, there were 20 major floods (as reported to the International Disaster Database Em-Dat), affecting more than 11 million people and resulting in USD1.2 billion in damages.²⁷ In August 2022 alone, 16 out of 25 provinces in Cambodia were reported to have experienced flooding for the season²⁸.

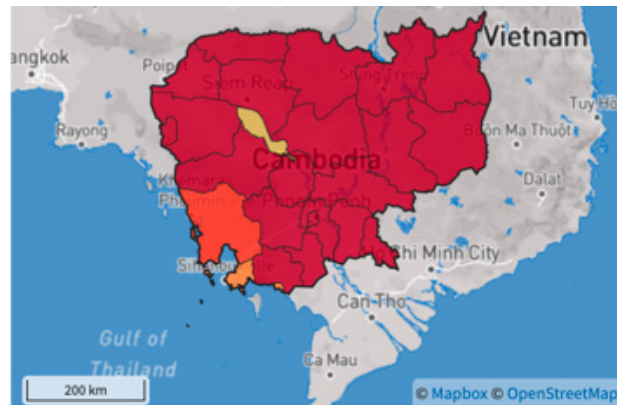
The impact of floods differs by setting. In the urban areas, Cambodia’s urban flood risk is categorized as “high” by the World Bank’s Global Facility for Disaster Reduction and Recovery (GFDRR): this means that potentially damaging and life-threatening urban floods are expected to occur at least once in the next 10 years.²⁹ Floods in densely populated urban areas (such as Phnom Penh) are of particular concern, as they lead to costly infrastructure damage, as well as the loss of life and livelihoods. In the case of the rural setting, Cambodia’s farming and fishing communities rely on the annual flooding of the Mekong River Delta from August to November.³⁰ Therefore, shifts in the flooding pattern due to climatic changes could impact livelihoods. Notably, flooding patterns increase risks for drowning and snake bite.

22. Cambodia’s precipitation may become more variable, exacerbating flood and landslide hazards. The average largest one-day precipitation is projected to reach nearly 100 mm during October in Kep (97.4 mm) and Kampot (95.3 mm) by 2020–2039 under the SSP3-7.0 scenario, which is an indicator

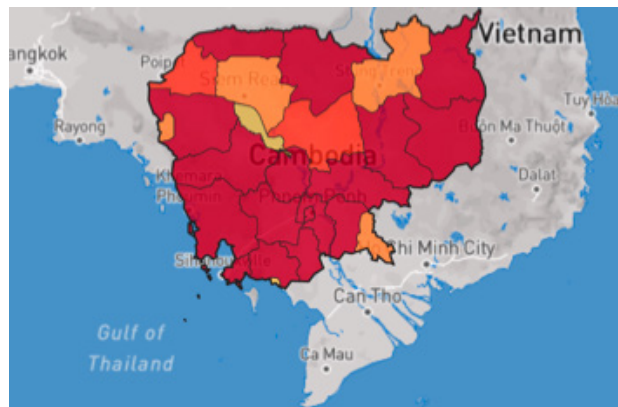
FIGURE 7.

Types of Flood Risks in Cambodia.

River Flood Risk



Urban Flood Risk



Costal Flood Risk



Source: ThinkHazard

of both a flood risk and a landslide risk. The five-day cumulative rainfall indicator is also useful for identifying water-saturated areas, thereby increasing the risks of flooding and landslides through the sustained loss of slope stability. The average largest five-day cumulative rainfall is projected to exceed 243 mm during September in Pailin by 2020–2039 and 267 mm by 2040–2059.

LANDSLIDES

23. Landslides have resulted in the loss of lives and damaged homes and other infrastructure (for example, transport, energy, and health) in Cambodia, and climate change will increase landslide risks. According to GFDRR, the highest landslide risks are in the provinces of Koh Kong and Pursat: this means those regions have “rainfall patterns, terrain slope, geology, soil, land cover, and (potentially) earthquakes that make localized landslides a frequent hazard phenomenon.”³¹

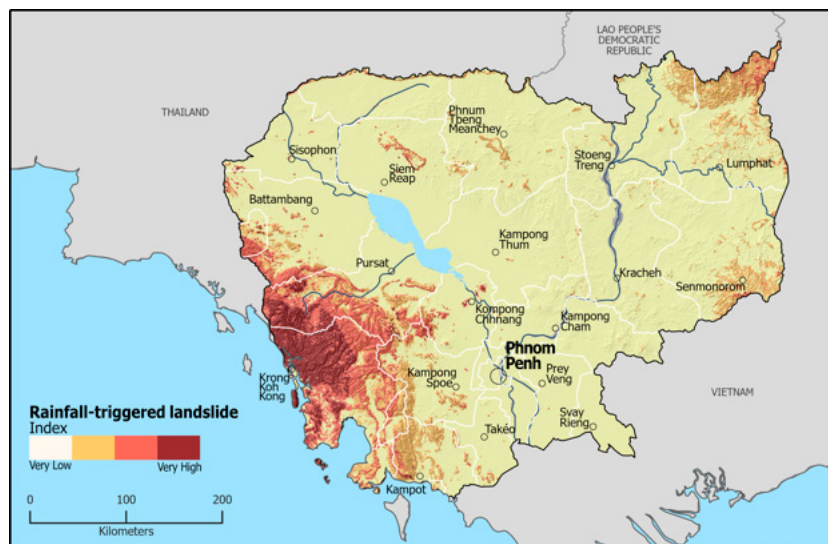
In 2023, a major flood in the Pursat region damaged 2,785 houses, eight roads, and six sewers while triggering six landslides.

SEA-LEVEL RISES

24. While Cambodia has no extensive coastline, rising sea levels pose a risk to coastal communities. CCKP data shows sea-level anomalies exceeding 200 mm between 1993 and 2015, with maximum rises of 250 mm observed near the coast of Koh Kong.³² The Cambodian government’s 2013 Climate Change Strategic Plan (CCSP)³³ anticipates projected sea-level rises exceeding half a meter by 2090, which could inundate 25,000 hectares (ha) of land and force thousands to relocate. Sea-level rises could significantly threaten marine coastal areas already experiencing storm surges, high tides, beach erosion, and seawater intrusion. This may affect low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangrove forests.

FIGURE 8.

Rainfall-Triggered Landslides in Cambodia.



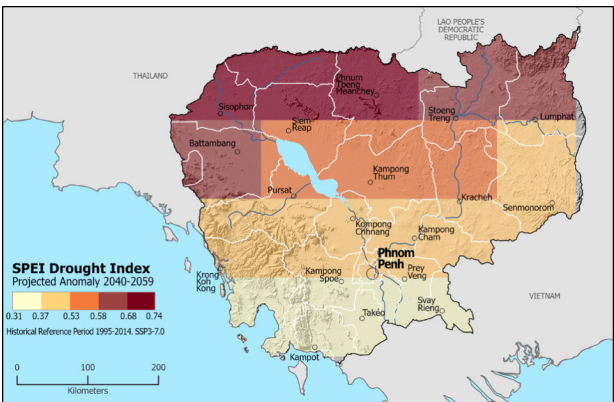
Source: Natural Earth, ASTER GDEM Version 3, and GFDRR 2020

Response	Percentage
Yes	68%
No	32%

Nonetheless, Cambodia is impacted by droughts. The Svay Rieng Province is one of the most drought-prone provinces in the country: it has experienced economic losses due to crop failure, health problems, and environmental damage. A 2019 drought in Tonle Sap Lake damaged over 70,000 ha of rice fields and impacted the food supply. Overall, between 2000 and 2024, there have been four major droughts that affected approximately 4 million Cambodians.³⁴

26. Cambodia already experiences extreme temperatures, with an estimated national average of 64 days per year when the maximum temperature exceeds 35°C. Days with a heat index exceeding 35°C are projected to increase in all future climate scenarios. Thirumalai et al. (2017) suggested that climate change contributed to extreme temperatures by 29 percent across Southeast Asia in April 2016, while ENSO contributed 49 percent.³⁵ Additionally, the increased frequency and intensity of heat waves have been observed recently. In 2015–2016, Cambodia experienced the worst drought in 50 years, amplified by an intense El Niño event in the region, during which ambient temperatures soared to an all-time high of 42.6°C.³⁶ Higher temperatures and humidity values will result in increased heat stress, which will regularly surpass safe levels for humans and biodiversity.

FIGURE 9.



Source: World Bank's CCKP

WILDFIRES

27. Many regions of Cambodia are considered at high risk for wildfires; projected decreases in rainfall levels and projected increases in rainfall variability could exacerbate them.

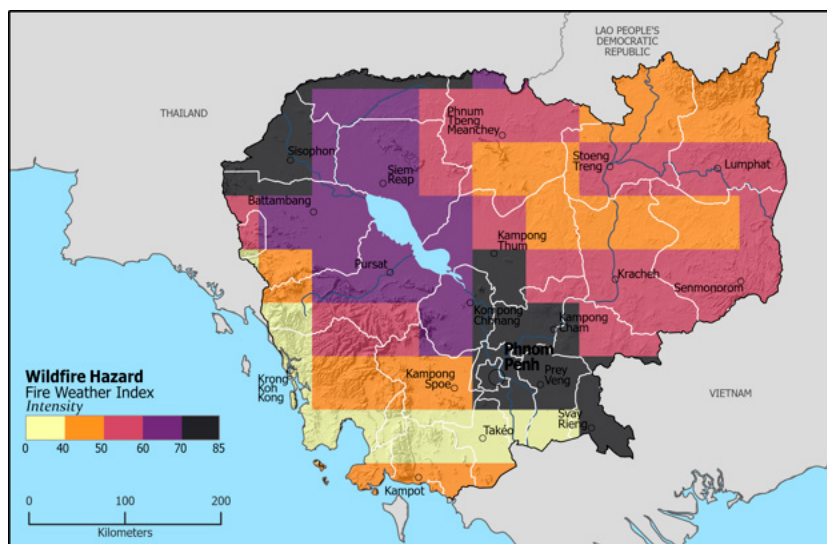
Based on the Fire Weather Index (FWI), most regions in Cambodia beyond the southwest are categorized as “in very high danger,” while others are categorized as “in extreme danger.” According to the National Aeronautics and Space Agency’s (NASA) satellite data, 45 high-confidence fire alerts were reported in the forested area around the Tonle Sap Lake between April 1 and July 1 of 2021, which experienced decreased water levels. Forests in Cambodia have declined significantly in recent decades due to the widespread practice of slash-and-burn-swidden agriculture in Southeast Asia: small-scale subsistence farmers light fires in forested areas, thus increasing the risk of wildfires. On February 18, 2020, a NASA satellite captured an image of hundreds of fires burning across large swaths of land in both Myanmar and Cambodia.

CYCLONES AND TROPICAL STORMS

28. Cyclones are an ongoing climate hazard in Cambodia; projected wind speeds and rainfall increases may exacerbate risks for the population and infrastructure. Historically, cyclones and tropical storms have caused injuries and deaths, losses to farms and livestock, and damage to homes and public infrastructure. According to the Global Facility for Disaster Reduction and Recovery (GFDRR), cyclone risk is categorized as “high” across the country, except for the provinces of Preah Sihanouk, Kampong Speu, and Kampong Chhnang which are categorized as medium risk (See Figure 11). A “high” risk indicates a 20 percent chance of potentially damaging wind speeds over the next 10 years. Between 2000 and 2023, there has been a total of eight storms reported to the International Disaster Database (Em-Dat), resulting in almost 1 million people affected and USD100 million in damages.³⁷

FIGURE 10.

FWI for Wildfires in Cambodia.



Source: NASA - Global Fire Weather Database (GFWED)

Fire Weather Index (FWI) Scale

Very low danger: <5.2

Low danger: 5.2-11.2

Moderate danger: 11.2-21.3

High danger: 21.3-38.0

Very high danger: 38.0-50

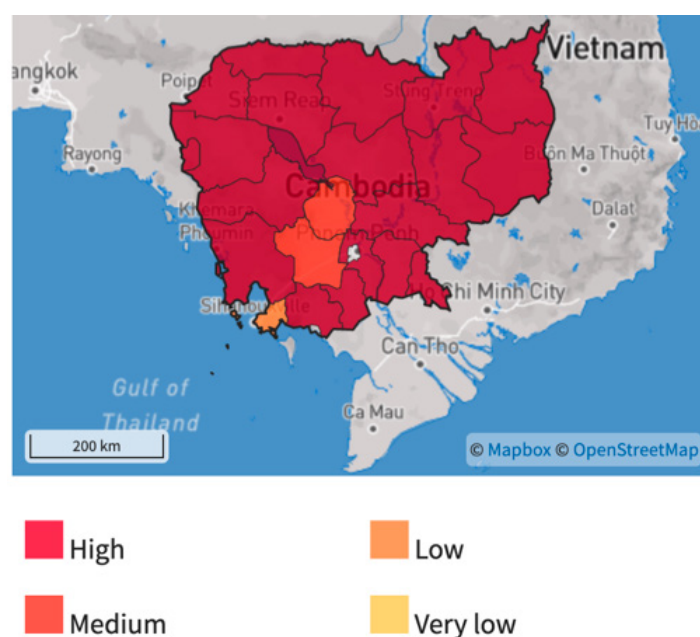
Extreme danger: >50

More specifically, Ketsana Typhoon in 2009, and Haiyan Typhoon in 2013 impacted lives and livelihoods in Cambodia. Notably, Ketsana Typhoon resulted in USD 132 million in economic damages, and around 1.4 percent of Cambodia's population being affected.³⁸ In April 2022, the National Committee for Disaster Management (NCDM) reported home losses and damage following an unprecedented rainfall event during the dry season that triggered a 0.5-meter (m) rise in the Mekong River water level. In June 2022, additional storms triggered floods, causing heavy damage to farms and homes in the Sre Russey Commune of the Thala Parivat District.

29. Storm events started to increase in magnitude and frequency during the late 2000s broadly through Southeast Asia, which has seen cyclone activity move eastward and away from the Mekong Basin. Cambodia's coastal zones are known to be exposed to cyclones and tsunami-induced storm surges, albeit at lower levels than other Southeast Asian nations. In Cambodia, rising temperatures, particularly in the case of sea surfaces with temperature thresholds of 28.2°C, are associated with the rising frequency of superstorms, increased cyclone intensity, and thus, damage.³⁹

FIGURE 11.

Cyclone Risk in Cambodia (Source: ThinkHazard, GFDRR).



Source: Think Hazard - GFDRR

KEY MESSAGES:

Projected Climate

- **Temperature:** Median temperatures may increase by 0.98–1.23°C by the 2050s (SSP3-7.0), with high daytime temperatures accompanied by tropical nights.
- **Precipitation:** Rainfall patterns are expected to increase in variability, with a projected decrease (median) of 40 mm in the 2050s (SSP3-7.0), and characterized by high levels of uncertainty.

Climate Hazards

- **Floods:** River flood risk is categorized as “high” in most of the country outside of the southwestern coastal region (with potentially damaging and life-threatening events anticipated at least once over the next 10 years). Urban flood risk — categorized as “high” in 75 percent of the provinces — is also impacted by project planning and construction methods. Both are expected to increase in the future with projections of more frequent heavy-rainfall days.
- **Landslides:** Rainfall-triggered landslide risk, which is categorized as “very high” in the southwestern coastal region, is expected to increase in the future, with projections of more variable rainfall that can impact slope and bedrock stability.
- **Droughts:** Projected Standard Precipitation Evapotranspiration Index (SPEI) anomalies for 2050s are highest in the northwest, indicating that the region may become wetter (including evapotranspiration) and be at less risk of droughts.
- **Wildfires:** Wildfire hazard — as measured by the Fire Weather Index (FWI) — is “high” across most of the country outside of the southwest coastal region. This is expected to increase in the future, with rising temperatures and more variable rainfall projected by climate models.
- **Increasing Temperatures:** Cambodia already has a high number of high heat index days (> 35°C) days per year based on a global comparison. This number is projected to increase by the 2050s, with the number of tropical nights (whereby minimum nighttime temperatures stay > 20°C) projected to be near the maximum possible from March to October, while slight increases are projected for the remaining months by the 2050s. This combination may make it more difficult for the human body to cope with increasing temperatures.
- **Extreme Weather Events:** The average cyclone wind speed and rainfall are expected to increase in the future. Cyclone risk is categorized as “high” (with the likelihood of potentially damaging wind speeds happening in the next 10 years exceeding 20 percent) across the country. Exceptions to this trend are Preah Sihanouk, Kampong Speu, and Kampong Chhnang.



CLIMATE-RELATED HEALTH RISKS

30. Cambodia has made significant advances in reducing its burden of infectious diseases since the 1990s, but it now faces an increasing burden of noncommunicable diseases (NCDs) that may be exacerbated by climate change. From 2000 to 2020, life expectancy has increased from 61 to 73 years in the female population and from 57 to 68 years in the male population.^{40,41} Nonetheless, Cambodia has been undergoing an epidemiological transition and faces the dual burdens of disease from NCDs and infectious diseases⁴² — both of which could be worsened by climate change. The four major NCDs in Cambodia — cardiovascular disease, diabetes, chronic respiratory disease, and cancer — are responsible for nearly one in four premature deaths (23 percent).⁴³

31. Risks to health outcomes from climate are not evenly distributed in the population; some groups are at greater risk of exposure to climate-related health risks than others.

The factors affecting a population's exposure to climate-related health risks are often similar to the factors affecting health disparities more broadly. Climate change may exacerbate existing health inequalities, especially among people living in poverty, rural areas, and informal urban settlements. Demographics that may be more affected include women and young children, the elderly, and those living with pre-existing conditions and disabilities. Investment in adaptation and mitigation measures must carefully consider groups who would directly benefit from, or be disadvantaged by, adopted measures.

32. This CHVA for Cambodia assesses six climate-related health risk categories. These include (a) nutrition, food access, and food safety risks; (b) vector-borne disease (VBD) risks; (c) waterborne disease (WBD) risks;

(d) heat-related morbidity and mortality (e) air quality health risks; as well as (f) mental health and well-being risks. Each category is assessed in terms of current and future risks, with considerations of both national and subnational peculiarities where possible. It is important to note that these risk categories represent only the most pressing health risks to the population in Cambodia. Other important climate-related health risks include but are not limited to direct injuries and mortality associated with natural hazard events.

NUTRITION, FOOD ACCESS, AND FOOD SAFETY RISKS

33. Weather and climate are the foundational drivers of healthy and sustainable diets. A key determinant of food availability is agricultural productivity, which is affected by weather and climate. Moreover, the mechanisms by which climate change affects nutrition via the food system are profound. They include

the acute and chronic effects on agricultural production, storage, processing, distribution, and consumption. Nutritionally secure and stable diets not only depend on agricultural production but also the complex interactions of market demand, economic situations, legislation, food waste, nutrient losses, food safety, and food access. Climate variability is already contributing to increases in global hunger and malnutrition.

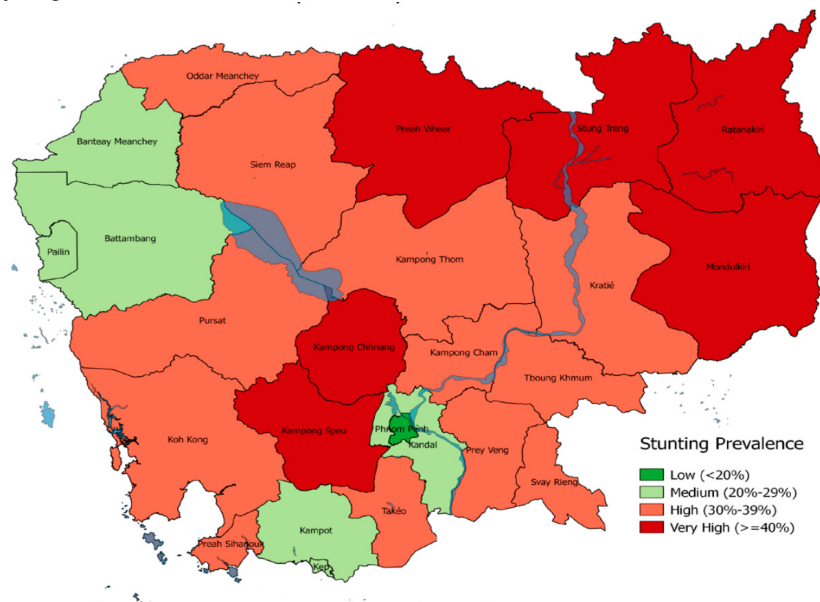
While a comprehensive analysis of climate change's impact on the food system is beyond the scope of this assessment, this CHVA examines climate and nutrition linkages through a food access lens in Cambodia, particularly in relation to the weather and climate impacts on agricultural productivity. In Cambodia, 77 percent of the population inhabits rural areas that constitute approximately 98 percent of the country; about 80 percent of the rural population depends on subsistence farming.⁴⁴

34. Stunting and undernutrition are major climate-sensitive concerns in Cambodia.

There are significant regional variabilities in levels of nutritional deficiencies, as seen in the figure below. World Vision reported significant differences in stunting rates in 2019 — 34 percent of children in rural areas (as high as 44 percent in Preah Vihear and Stung Treng) compared with 24 percent in urban areas (as low as 18 percent in Phnom Penh). At the same time, the 2021–2022 Cambodia Demographic and Health Survey (DHS) showed lower overall stunting rates at 22 percent — a 10-point drop from 2014.⁴⁵ On the other hand, wasting rates have remained relatively stagnant.⁴⁶

In Cambodia, nutrition services to people living in poverty and other vulnerable populations are a concern. Nutrition risks can be compounded by specific health conditions: for example, there is a need to provide proper nutrition for patients with NCDs (for example, diabetes) and

FIGURE 12.
Stunting Prevalence by Region.



Source: Reported by the National Institute of Statistics in 2015 and Published by the World Food Programme Summary Report in 2017

sufficient maternal and child nutrition. Recently, a 2021 World Food Programme report found that the COVID-19 pandemic negatively affected the statistics above in children under five — a population highly vulnerable to the nutrition risks of climate change.⁴⁷

35. Gaps in food access and poor nutritional outcomes in Cambodia can be exacerbated by shifting climate baselines and shocks (for example, climate-related hazards such as droughts). Projected warmer temperatures, precipitation changes and water deficits, along with the increasing frequency and intensity of climate-related hazards, are likely to interrupt food production and increase nutritional deficiencies, with important geographical variations.

Notably, with most of the population dependent on subsistence farming, especially rain-fed crops such as rice — a staple food in the country, climate shocks can exacerbate risks for food security and nutrition. For example, between 2004 and 2005, the country experienced prolonged droughts that resulted in 30 percent of the agricultural land being affected and a 14 percent decrease in rice yields. Moreover, it is expected that

more frequent flooding around the Tonle Sap area and the floodplains around the Mekong could affect crop yields. Agricultural losses are already amounting to approximately USD100–170 million annually.⁴⁸ Overall food production is expected to decrease, resulting in lower per capita food consumption (approximately 150 kilocalories [kcal] less due to climate change) and approximately 500,000 additional people at risk of hunger by the 2050s (see table below).

Besides rice, fish is also essential to the Cambodian diet, constituting around 80 percent of animal protein being consumed. Additionally, the fishing industry is critical to the country's gross domestic product (GDP) and the household's annual income.⁴⁹ The effect of climate change is likely to threaten the fisheries sector — in terms of productivity, distribution, species composition, and habitats, thereby requiring changes in how fisheries and aquaculture operations are managed. Projected increases in ocean acidification and sea temperatures are likely to negatively impact marine life migration and, consequently, marine food production off the coast of Cambodia, similar to anticipated impacts across the broader Asia-Pacific region.

TABLE 2.

Food Production, Per Capita Food Consumption, and Hunger Attributable to Climate Change (CC).

	WITHOUT CC			WITH CC	
	2010	2030	2050	2030	2050
Aggregate food production (2010 index = 1.00)	1.000	1.176	1.302	1.102	1.155
Per capita food consumption (kcal per capita per day)	2,348	2,515	2,614	2,463	2,508
Hunger (millions of people at risk)	2.4	1.9	1.5	2.2	2

Source: IFRPI, 2022.⁵⁰

36. The impacts of climate change on algal blooms and eutrophication pose ongoing health risks to the population of Cambodia by increasing the risks of food contamination.

As temperatures increase, algal blooms can flourish in coastal waters and inland freshwater sources, which in turn contaminate shellfish and fish. These algal blooms formed by dinoflagellates can result in paralytic and neurotoxic shellfish poisoning, as well as ciguatera fish poisoning due to *Gambierdiscus toxicus*. The resulting health impacts can include nausea, vomiting, and other neurologic symptoms. Additionally, eutrophication — a process whereby a body of water becomes more enriched by minerals and nutrients, including nitrogen and phosphorus — can damage fragile underwater ecosystems and negatively impact surrounding communities.

During a February 2023 World Bank mission to Cambodia, the Food and Drug Departmental representatives from the Ministry of Health (MOH) raised the concern of food safety.⁵¹ They anticipated increases in contamination associated with projected temperature increases.⁵²

VECTOR-BORNE DISEASES (VBDS)

37. Malaria, dengue, Zika, chikungunya, and Japanese encephalitis are among the climate-sensitive VBDs circulating in Cambodia. While there has been significant progress in reducing malaria, with cases declining by over 90 percent from 2010–2020, challenges remain for the “last mile” of malaria elimination.⁵³ They include artemisinin resistance and logistical difficulties in reaching remote regions.⁵⁴

The National Center for Parasitology, Entomology and Malaria Control (CNM) developed a mobile application that enables healthcare workers to report malaria cases at the grassroots level.⁵⁵ It has also been training community health center malaria workers to do diagnostic tests and provide anti-malarial medication (particularly targeting adult men, who constituted 81 percent of all malaria cases in 2020).⁵⁶ As a result, heavily affected areas have experienced progress (including the Greater Mekong subregion, which reported a 31 percent drop in annual cases in 2021).⁵⁷ Cambodia also moved forward with its pledge to eliminate the dangerous *Plasmodium falciparum* malaria parasite from 2025 to 2023.⁵⁸

38. Weather and climate patterns are critical drivers of the spatiotemporal suitability of vector distribution and transmission dynamics. On large scales, changes in precipitation and temperature can either cause the expansion or contraction of vector ranges, both in terms of geography and months of the year during which there is an optimal temperature for vector reproduction.

For example, a study shows that between 1998 and 2012, the transmission of dengue occurred between May and October — the wet season. That same study showed a significant relationship between the average temperature and dengue across Banteay Meanchey, Kampong Thom, and Siem Reap. Essentially, a 1°C increase in the average mean temperature resulted in an increase of dengue cases by 38.6 percent, 39.1 percent, and 19.9 percent, respectively. Further research is required to estimate the changes in vector suitability and reproduction at a more granular level in Cambodia.

WATERBORNE DISEASES (WBDS)

39. Climate-related hazards, such as floods and landslides, can reduce access to safe water, sanitation, and hygiene (WASH) services, which can, in turn, increase the incidences of waterborne and water-related diseases. Current drivers of WBDS (including the sources, quality, and quantity of drinking water, sanitation and waste management facilities, and hygiene practices) can be negatively affected by climate-related factors, particularly floods and landslides. Increased precipitation, floods, and landslide events can increase disease transmission in areas with limited access to safely managed drinking water and sanitation services.

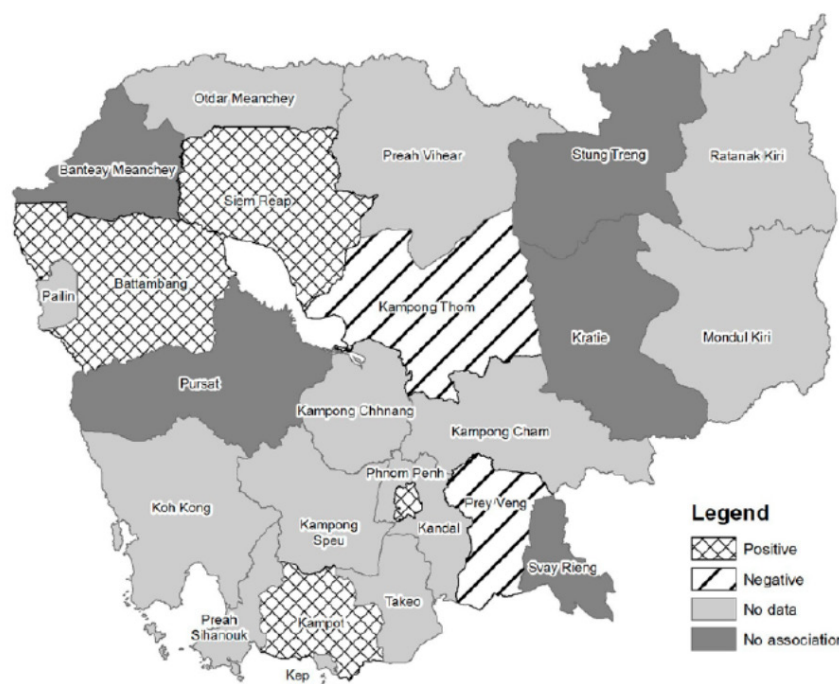
A United Nations Children’s Fund (UNICEF) report — using the 2021 Joint Monitoring Programme (JMP) data — estimates that nearly a third (31.2 percent) of the country’s population was not using at least basic sanitation services and that over a quarter (28.8 percent) of the country’s population was not using at least improved water sources in 2020.⁵⁹ While Cambodia has made significant progress in decreasing the under-five mortality rates for diarrheal disease since 2000, preventable deaths still occur. Additionally, multi-drug-resistant typhoid prevalence has increased dramatically since 1992.

Although there has been progress in improving WASH coverage over the last decade, many areas still face notable obstacles, especially those susceptible to annual floods and droughts. This includes provinces within the Tonle Sap basins and upland regions regularly impacted by climatic disasters, such as floods and droughts. They are considered areas that present complexities for ensuring WASH, particularly in a challenging context.

40. Temperature increases affect the risk of diarrheal diseases. A global study found that an additional 1°C increase in projected mean average temperatures would result in a 7 percent increase in all-cause diarrhea.⁶⁰ Another study conducted in Cambodia found that floods were significantly associated with increased diarrhea in two provinces (Kampot and Pursat).⁶¹ However, a possible protective effect from improved infrastructure, such as toilets and piped water, was found.⁶² Similarly, there have been observed increases in diarrheal diseases since 2001 in two of the worst flood-affected provinces (Prey Veang and Kampong Cham). After the 2009 typhoon, the 2011 floods, and the 2013 floods, diarrheal disease cases were recorded in affected provinces across the country. In particular, during the 2011 floods, diarrheal diseases increased to epidemic levels in three provinces (Banteay Meanchey, Oddar Meanchey, and Kampong Thom): as many as 22 percent of the children had diarrhea following exposure, with those living in poor households with untreated drinking water and unimproved sanitation facilities being at the highest risk.

FIGURE 13.

Summary of the Nature of Association Between Monthly Minimum Temperatures and Monthly Cases of Diarrhea.



Source: McIver et al. 2016

HEAT-RELATED MORBIDITY AND MORTALITY

41. The health risks of heat are wide-ranging: they include effects on mortality, heat-related injuries, mental health, and well-being.

Several factors influence mortality and morbidity in relation to extreme heat events: the magnitude of their impacts are related to their timing, duration, and intensity, an individual's level of acclimatization (or adaptive response to a hot environment), the built environment (for example, the urban heat island effect), the adaptive capacity of the affected populations, and the resilience of infrastructure and institutions, among others.⁶³

Health effects include the direct effect of heat stress, heat rash, cramps, exhaustion, and dehydration, as well as the acute exacerbation of pre-existing conditions including respiratory and cardiovascular diseases.

Longer-term mental health risks are also an important effect to consider.

In addition to the impacts on individuals, the whole-of-population exposure that occurs with an extreme heat event can lead to significant increases in hospitalizations, thus imposing a strain on health systems.⁶⁴

42. Increases in average seasonal temperatures, along with increases in the frequency and intensity of heat wave events, are projected to increase health risks. Revisiting Table 1 in the section on climatology shows Oddar Meanchey, Preah Vihear, and Siem Reap as the provinces projected to experience the highest number of very hot days (> 35°C), while Sihanouk, Pailin, and Koh Kong are expected to experience the highest number of tropical nights (> 26°C). Using provincial population projections from MOH for the latest year

available (2023), this may potentially expose over 2 million people to extreme heat, with implications for the health of those populations, particularly vulnerable groups such as children under five years old, people over 65 years old, pregnant women, and individuals living with heat-sensitive chronic health conditions.

A UNICEF report found that 2.2 million children or over a third (37.1 percent) of Cambodia's total child population are exposed to high heatwave frequency.⁶⁵ Even if the world were to keep warming at 1.7°C or lower, it would still mean that 100 percent of Cambodian children will be exposed to more than 4.5 heatwaves a year, with 55.7 percent experiencing extremely high temperatures (whereby more than 83 days a year exceed 35°C). If warming rises to 2.4°C, the proportion experiencing extreme high temperatures will exceed 87.2 percent.

While there has been limited data on the baseline level of heat-related mortality in Cambodia, a World Health Organization (WHO) report estimated four heat-related deaths per 100,000 people each year from 1961–1990. The report goes on to predict a significant increase to over 25 heat-related deaths per 100,000 people each year by the 2050s, using a high-emissions scenario, with the figure rising to 56 by the 2080s. Without adaptation, heat-related deaths in the broader Southeast Asia region are projected to increase by 295 percent and 691 percent by the 2030s and the 2050s, respectively.⁶⁶

43. Additionally, agricultural workers' exposure to heat is a growing concern because physical work capacity can decline when high temperatures and humidity exist for several months each year. Occupational heat risks are of particular concern to workers in sectors such as agriculture, which is estimated

to employ over a third (35 percent) of the Cambodian population.⁶⁷ The combination of low average income levels, high dependence on industries such as agriculture, and high burdens of NCDs (including diabetes and hypertension) contributes to elevated heat health impacts.

AIR POLLUTION RISKS

44. Ambient air pollution (AAP) and household air pollution (HAP) pose a risk to the health of people in Cambodia, although the levels of exposure are relatively mild compared with other highly urbanized countries in the region. Exposure to urban air pollution and smoke from indoor cooking, wildfires, and dust storms can affect health and contribute to the development of severe chronic health conditions. This occurs when individuals inhale fine particulate matter 2.5 micrometers or smaller (PM_{2.5}) and other toxins that can enter the deeper sections of the lungs and blood stream. People who are particularly vulnerable to particulate air pollutants include those with asthma, chronic obstructive pulmonary diseases (COPDs), children, and those with close exposure to the sources of air pollution such as women when cooking with biomass and firefighters addressing wildfires.

The age-standardized mortality rate attributed to ambient and household air pollution in Cambodia was 149.8 deaths per 100,000 in 2016.⁶⁸ As with many other countries in the region, 100 percent of the population has been exposed to PM_{2.5} air pollution levels exceeding the WHO guideline values since this indicator has been tracked (1990–2017), with the average being four times the guidance values.⁶⁹

On the whole, urban populations are often exposed to higher levels of AAP exposure

than their rural counterparts.⁷⁰ Based on its average Air Quality Index (AQI) value of 67 in 2021, urban air pollution in Phnom Penh was considered “moderate.” In contrast, rural households are exposed to higher levels of HAP due to limited access to clean fuels and technologies for cooking than their urban counterparts;⁷¹ an estimated 25 percent of the rural population has access to such technologies compared with 70 percent of the urban population.⁷²

45. Climate change exacerbates air pollution risks to human health. Studies have found that climate change is expected to increase global exposure to environmental health risk factors, including air pollution.⁷³ In urban areas, increased temperatures can result in “heat island” effects, which are characterized by an increased risk of smog formation due to the stagnation of air containing increased levels of ozone and particulate matter, thus impacting health acutely as well as chronically by damaging the cardiovascular and respiratory systems.

Ambient air quality is also impacted by smoke from wildfires, which typically occur during the drier months, and the projected increases in temperatures and the risk of wildfires could lead to a deterioration in air quality, especially when combined with high wind speeds and prolonged droughts. Droughts can also increase the frequency, intensity, geographic proximity, and duration of the wildfire season in Cambodia, thus worsening wildfire-induced air pollution.

Additionally, increasing temperatures and atmospheric carbon dioxide can extend the allergy season due to its impact on plant phenologies. While this is not well-documented in Cambodia, recent research elsewhere has

shown that poor air quality is significantly associated with the risk of autoimmune diseases, such as connective tissue disorder, inflammatory bowel disease, and rheumatoid arthritis.^{74,75}

MENTAL HEALTH AND WELL-BEING RISKS

46. Cambodia is experiencing a rise in mental health challenges following the stressors of the COVID-19 pandemic. Climate change-related events can also worsen mental health through their direct and indirect impacts over the short and long terms. Epidemiological studies show high rates of anxiety, depression, and post-traumatic stress disorder (PTSD) in Cambodia.⁷⁶ The suicide mortality rate was estimated to be 4.9 per 100,000 people in 2019.⁷⁷ More recently, the COVID-19 pandemic has worsened the mental health of Cambodians, especially among youth: UNICEF found that 16 percent of adolescents felt more anxious or depressed, while 58 percent of secondary school students reported experiencing at least one mental health issue.

Acute climate hazards (such as floods or cyclones) can precipitate a psychopathological pattern similar to experiencing traumatic stress in the short term. The National Climate Change Action Plan for Public Health 2019–2023 refers to a study in the Kampong Cham Province, which found that the most frequently experienced traumatic events — a lack of food and water, access to medical care, and access to shelter — can all be exacerbated by climate change. There is particular concern for younger generations, as exposure to extreme or prolonged weather-related impacts may result in delayed mental impacts, such as the symptoms of post-traumatic stress disorder (PTSD) and other psychological impacts in the future.

47. Community support helps protect subsistence farmers from increased anxiety and stress levels related to climate change's impact on rural communities, such as effects on water access.

In this sense, climate change impacts on mental health and well-being are mediated by social and contextual factors, including poverty conditions, water insecurity, sudden loss of property, personal or family diseases, and illness. Households that experience cumulative shocks are less able to develop coping mechanisms that are built on structural and social support, thus worsening their well-being and the possibilities of improving their livelihoods.^{78, 79}

48. It is challenging to project mental health outcomes related to climate change in Cambodia, but associations between mental health and climate change have been found in other contexts.

In Cambodia, there is a need for improved surveillance and diagnostics, as well as specialist training and services to meet the mental health and well-being needs of the population. Projections for the impact of climate change on mental health would need to consider the vulnerability of livelihoods, communities' resiliency, and individual coping mechanisms. Research in other countries⁸⁰ have projected levels of heat-related excess mortality for mental disorders (0.7 percent) and an increase in suicide rates (3.1 percent) for a 1°C increase in the monthly average temperature.⁸¹



ADAPTIVE CAPACITY OF THE HEALTH SYSTEM

HEALTH SYSTEM OVERVIEW

49. Cambodia has made significant improvements in health coverage; however, gaps between policy and implementation remain, especially at the subnational level. The public health system in Cambodia is decentralized, with commune-level health facilities being transitioned under the subnational government rather than the central Ministry of Health (MOH). Additionally, there is significant use of private services and services by non-governmental organizations (NGOs) in addition to the public system.

50. Policies and strategy planning documents highlight the pivotal role of collaboration among stakeholders and actors across sectors for increasing access to health services and the quality of delivery. Although there has been an expansion of health services around the country and the adoption of bottom-up programs, there is room for significantly improvements in the quality of health services. Efforts in building cross-sectoral partnerships have been cited as essential in the main policies and guidelines of the health sector. However, coordination gaps remain when it comes to implementation, particularly at the intersection of climate and health.

51. The emergence of the COVID-19 pandemic has brought with it a focus on health and health systems, specifically the capacity to manage emerging public health risks. Climate change, as with COVID-19, has the potential to disrupt and overwhelm health

systems, including healthcare facilities and healthcare staff. This is especially important in settings that need additional health system strengthening (HSS), where there might be limited resources and capacity.

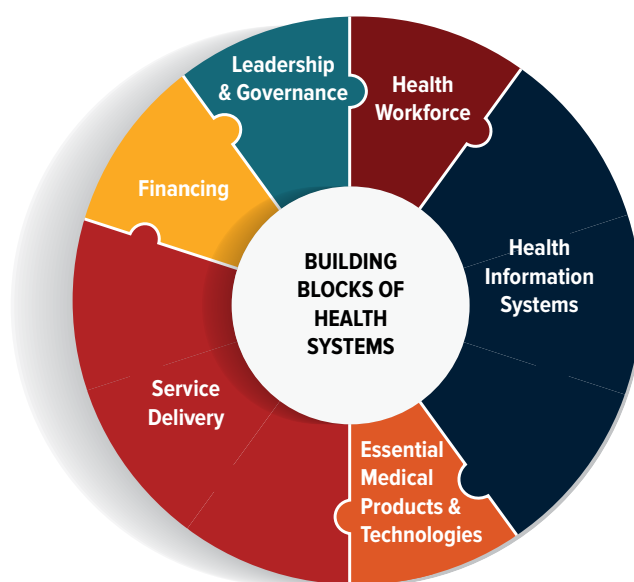
52. The extent to which the health system in Cambodia is prepared for climate change and whether it has the capacity to manage hazard exposure and susceptibility will determine its resilience in the coming decades. In this assessment, Cambodia's adaptive capacity⁸² to prevent and manage climate-related health risks is examined according to the World Health Organization's (WHO) six health system building blocks, as shown in the figure below (see also the annex for the Adaptive Capacity Rapid Assessment and a summarized Adaptive Capacity and Climate Change-Related Health Risks Gap Analysis, which inform this section).

It should be noted that several factors outside the scope of the health sector can drive reductions in adaptive capacity to manage the health risks of climate change in Cambodia's institutions and people. They include the country's economic challenges, changing demographic patterns, and slowly improving

social conditions. Promotion of equity is also important as a cross-cutting theme for enhancing adaptive capacity and resilience to the health risks of climate change. Adaptive capacity is likely to be greater when access to resources within a community, nation, or the world is equitably distributed.

FIGURE 14.

WHO's Climate-Resilient Health System Building Blocks.



Source: WHO, 2015

LEADERSHIP AND GOVERNANCE

53. The government of Cambodia's response to climate change includes a range of priorities that cover the health sector. However, the development of subnational-level policies is varied, as well as the level of implementation. Key policy frameworks that relate to climate and health include the Cambodia Climate Change Strategic Plan (CCCSP, 2014–2023), the Health Strategic Plan (2016–2020), the National Adaptation Plan (2017, update in progress), the National Climate Change Action Plan for Public Health, and

the National Strategic Plan on Disaster Risk Management for Health (2020–2024). The National Council for Sustainable Development (NCSD) ensures that the CCCSP is incorporated into the development planning of Cambodia and monitors its progress while liaising with the United Nations Framework Convention on Climate Change (UNFCCC).

Cambodia has shown leadership in climate policies through its Climate Public Expenditure and Institutional Review (CPEIR), Climate Change Financing Framework (CCFF), the

Ministry of Economy and Finance (MEF)'s Climate Economic Growth Impact Model (CEGIM), and engagement across line ministries for climate adaptation. For example, the Ministry of Health's (MOH) Department of Preventative Medicine (DPM), which is charged with leading climate change for the health sector, is given responsibility by the Ministry of Environment's (MOE) Department of Climate Change (DCC) for the Sectoral Climate Change Strategic Plan (SSCSP) and the Climate Change Action Plan (CCAP) on health. The MOH also submits budget needs for sectoral climate adaptation, while MEF requests line ministries including MOH to integrate climate change into annual budgets and investments.

54. Cambodia has made substantial efforts to incorporate health to a greater extent into its policies and strategies to address climate change. Health has been identified in the policy landscape as a key sector for furthering adaptation to climate change. In addition to having DPM serve as the focal point for climate-related issues at MOH and MOE's DCC asking MOH to take ownership of its own sector's adaptation planning, coordination mechanisms have been put in place. They include the cross-sectoral Technical Working Group for Climate Change and a One Health initiative jointly led by three ministries: MOH, MOE, and the Ministry of Agriculture, Forestry and Fisheries (MAFF).⁸³ However, although policymakers have demonstrated an awareness of the health impacts of climate change, technical capacities among staff at the Phnom Penh headquarters, as well as among staff at subnational sites, are limited.⁸⁴

55. The National Climate Change Action Plan for Public Health provides an overarching framework for advancing adaptation measures of the health sector in the face

of climate change. This policy document focuses on three key objectives: (a) improve the health care infrastructure and the capacity of health personnel to cope with vector-borne and water-borne diseases in the context of climate change; (b) enhance emergency preparedness and response to cope with extreme weather and climate change-related disasters; and (c) improve the knowledge and research capacity on health impacts and vulnerability to climate change. Likewise, in terms of the strategic approach, three key climate-related diseases — namely, vector-borne diseases (VBDs), waterborne diseases (WBDs), and extreme weather-related impacts — are prioritized.

Nonetheless, no progress reports on the activities are outlined in the Action Plan. Information on the adoption and implementation of these activities at the subnational level is limited. Similarly, the development of policies / programs for ensuring resilience at the health system and the facility levels is also minimal.

56. At the subnational level, the development and implementation of policies and plans to address climate-related health risks appear mixed. Cambodia's Third National Communication includes a subnational-level climate vulnerability assessment. Strategic plans around climate and health could be better integrated into local-level planning initiatives. Regions that are highly vulnerable to climate-related hazards, such as the south-western coast, require tailored programs and strategic planning in order to address the compounded effect of different climate hazards and climate-related health risks (for example, floods and WBDs).

57. The World Bank's Country Climate Development Report (CCDR) for Cambodia, which has been published, provides policy guidelines for increasing efforts in mitigation and adaptation strategies, including climate change impacts on health. The CCDR for Cambodia takes an all-of-government perspective on climate change — highlighting just and green transitions as well as providing macroeconomic and selected sectoral recommendations to support the country in responding to climate change while protecting economic development. The CHVA has served as an input to the elaboration of the CCDR for Cambodia.⁸⁵

HEALTH SERVICE DELIVERY

58. There have been considerable investments in the health system with the intention of increasing both access to quality health services and their utilization in order to improve the quality of care. These investments include but are not limited to the construction, rehabilitation, renovation, and expansion of health facilities; supply of medicines and health commodities; supply of medical equipment; information and communication technologies (ICT) networks; means of transportation; production of health professionals; competency and skill development; and other essential supporting services such as medical laboratories and blood bank services. For example, from 2018 to 2022, the total number of health centers increased from 1,205 in 2018 to 1,288 in 2022, while the number of referral hospitals, including 12 national hospitals, rose from 123 to 132, during the same period. The number of occupancy beds at public hospitals and health centers also grew by 2,937 beds nationwide between 2018 and 2022.

59. In terms of access to health services, outpatient consultations (both old and new cases) totaled 64,127,629 cases between 2018 and 2022, averaging 12,825,526 cases per year. The majority of these cases (52,555,992) were new cases, averaging 10,511,198 cases per year. The ratio of new cases for outpatient consultations at public health facilities varies substantially from one province to another — ranging from 0.12 cases to 0.84 cases per person per year in 2022, while the average countrywide ratio was 0.56 cases.

60. Despite improvements in health facilities at the subnational level and increased health staff deployment at the health center level, there have only been limited efforts to assess the climate resilience and adaptive capacity of health service delivery. Mapping the vulnerability of healthcare facilities is necessary to ensure that communities and local authorities are well-informed in formulating and implementing appropriate actions. One important initiative has been the mapping of the flood risks posed to health facilities by a team at the World Bank Cambodia office. However, with limited data availability, it has not yet been possible to map flood risks for other relevant health infrastructures, such as laboratories and diagnostic facilities or supply warehouses and storage units.

Additionally, there has been limited coordination in planning by key stakeholders at subnational levels (including MOH's provincial departments of health, health facilities, and community organizations and representatives) to address climate-related health risks and disaster risks. There are gaps in implementing vulnerability reduction measures and ensuring preparedness to respond to climate-sensitive disease outbreaks and natural disasters.

HEALTH WORKFORCE

61. An increase in the size of the health workforce has been central to improvements in coverage and access to health services.

In order to prioritize the rebuilding of the health workforce, MOH invested in Health Workforce Development Plans (HWDPs). They provide guidance on staff levels and distribution, as well as pre-service and in-service training. As a result of concerted and coordinated efforts since the 1990s, the total number of public health personnel increased from 20,954 in 2015 to 32,240 in 2022, indicating an average increase of around 1,612 (6.66 percent) health personnel per year between 2015 and 2022. This has been accompanied by a rapidly growing private sector: clinics and pharmacies increased from 12,785 places and providers in 2018 to 16,181 in 2022. However, most of the increases were in Phnom Penh and the larger provinces.

62. Cambodia's Health Strategic Plan 3 from 2016–2020 outlines the importance of having appropriately skilled health staff who are adequately motivated, proficiently trained, and equitably deployed.

Building on the achievements of previous HWDPs, MOH's HWDP 4 is an ongoing development plan that is driven by the vision of building a health workforce for the future who will ensure safe and healthy lives for all Cambodians and enhance their well-being.

Strategies within the HWDP 4 involve preparing for future needs such as climate-related health risks. They include ensuring that planning aligns with health service and population needs, developing skills and competencies for the workforce to address pressing current and future needs, and building institutional capacity for projecting future needs. Additionally, HWDP 4 focuses on the importance of

recruiting, attracting, and retraining the health workforce in rural and remote health facilities, and ensuring that deployment is based on the gaps in the plans submitted at the national and subnational levels. This is crucial for ensuring that the populations likely to be disproportionately affected by climate-related health risks are able to access health services.

63. Efforts by WHO to build a strong local response to COVID-19 have proven successful in increasing capacity for managing outbreaks and emergency health responses at the local level.

This experience has also covered the development of an incident management system that supports communities in responding to climate-related hazards such as floods.⁸⁶ However, there is limited information on the scope, progress, and implementation of these efforts across the country.

64. In terms of maternal and child health, midwives have been allocated to every health center since the late 1990s, with the majority being primary midwives who have received one year of training.

As a result of the high maternal mortality ratio (470 per 100,000 live births), MOH began allocating secondary midwives with 3.5 years of training to every health center throughout the country. The allocation of secondary midwives at health centers increased from 25 percent in 2000 to over 80 percent in the last few years.

65. There are at least 19 public and private training institutions (seven public institutions and 12 private institutions) currently in Cambodia.

⁸⁷ Legislation is in progress to regulate the quality of both public and private medical education. Despite a large number of graduating health professionals, the number recruited to civil service positions is still insufficient to meet expanding needs. Furthermore,

the number of medical specialists is inadequate in meeting current needs according to the national guidelines on the complementary package of activities (CPA) for hospitals.

To improve staff performance, there have been annual salary increases from the government and initiatives such as the midwifery incentive scheme. Staff allocation has improved as a result of enhanced management tools, planning, and oversight with appropriate indicators. However, further increases in health personnel and improvements in equitable allocation will be needed to bridge current staffing gaps, especially at the district level and in remote health facilities. Lower-level health facilities are more likely to lack the appropriate mix of staff with the necessary skills to meet existing and new health demands.

The introduction of a comprehensive package of financial and non-financial incentives could help with rural deployment and retention. Between 2018 and 2022, the deployment of health personnel at referral hospitals and health centers was prioritized for the capital and the provincial level.

66. Within the public sector, nurses and midwives together comprise 70 percent of the health workforce, while general medical practitioners, specialists, dentists, and pharmacists make up 21 percent. Women represented 53 percent of the health workforce in 2022, with the majority being nurses and midwives. Females are still underrepresented in certain cadres of medical professions such as specialists, general practitioners, and dentists.

67. There has been limited coordination between healthcare professionals concerning the response to the wide range of interrelated health risks and disaster risks from climate

change. Additionally, there is a need to build the capacity of the health workforce with regard to climate and health, particularly at the subnational level where less training is offered on such topics. This is needed to improve system performance for coping with climate change and disaster risks.

HEALTH INFORMATION SYSTEMS

68. Although surveillance, reporting, and early warning systems exist in Cambodia, there is limited coordination among the platforms, and not all sources of data are shared with the appropriate stakeholders responding to climate-related health risks. For example, MOH's National Center for Parasitology, Entomology and Malaria Control (CNM) has developed a mobile application for healthcare workers to collect community-level information on malaria cases across the country. However, access to the data is highly restricted and not necessarily shared with key stakeholders to enable them to act on emerging risks. Furthermore, this mobile application platform has not yet been applied to collect data on other climate-sensitive diseases and health conditions. In the context of Cambodia, where the majority of health programs and services are delivered by non-public entities, access to information across stakeholders is critical for evidence-based decision-making.

Paying attention to climate-related variables (such as temperature or precipitation) is also critical to improving and strengthening surveillance systems by focusing on prevention and preparedness. For example, the surveillance of VBDs, such as dengue or malaria, can be improved by focusing on monitoring changes in precipitation patterns and vector control.

At the same time, as early warning systems in Cambodia are limited, communities lack the information needed to develop preparedness mechanisms that can reduce their exposure or risk in the face of climate-related hazards.

69. Although the Third National Communication led by the MOE Department of Climate Change includes a subnational Vulnerability and Adaptation (V&A) assessment, it is not yet a dynamic assessment that is frequently updated. MAFF worked with the United Nations Development Programme (UNDP) to create a text-based warning system to notify farmers of climate-related risks, such as floods and droughts. However, this platform is not yet linked with the health sector for it to be used, despite the relevance of warnings on floods, landslides, droughts, and potential food shortages to healthcare personnel for addressing corresponding health risks. Similarly, while the Ministry of Water Resources and Meteorology monitors other climate hazards such as heat, wildfires, and extreme weather events, this information is not always disseminated to affected health facilities. Moreover, not all healthcare workers are trained on how to use meteorological information.

70. Risk communication is also a key area of the National Health Centre for Health Promotion, which has been supported by the United Nations Children's Fund (UNICEF) in the country's response to COVID-19. The National Health Centre for Health Promotion also has an Environmental Health area that is furthering the climate change and health agenda. Notably, it conducted a vulnerability assessment in the Ratanakiri Province.⁸⁸ Nevertheless, there are no specific risk communication systems or channels in place that focus on climate-sensitive diseases, which are aimed

at strengthening adaptation to climate-related hazards at the community level and preparedness for them.

71. NGOs are key stakeholders in the ecosystem of health information systems. For example, UNICEF is in the process of developing a Child Climate Risk Index (CCRI). The CCRI includes two pillars: a) exposure to climate and environmental shocks (including water scarcity, floods, cyclones, heat, VBDs, air pollution, soil pollution, and water pollution); and b) child vulnerability in social sectors (including health and nutrition, poverty and social protection, as well as water, sanitation and hygiene [WASH]). The aim is to integrate CCRI with national platforms, including MOE's existing commune-level climate vulnerability index. CCRI does not currently predict future exposure and vulnerability.

ESSENTIAL MEDICAL PRODUCTS AND TECHNOLOGIES

72. There is limited monitoring and evaluation of expired and stock essential medicines. The lack of data makes it challenging to assess and plan for adequate drug stocks and allocate resources to health facilities. Nonetheless, the U.S. Agency for International Development's (USAID) Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) has documented the availability of high-quality health commodities for the prevention and treatment of human immunodeficiency virus (HIV) / acquired immunodeficiency syndrome (AIDS) and malaria to help ensure uninterrupted availability.⁸⁹

At the same time, there are still under-resourced hospitals and healthcare facilities (including preventive, dispensaries, and critical care entities) that tend to be more ill-equipped.

They are characterized by limited health technologies, stockouts of medicines and supplies, and a lack of management of health system needs. Gaps in equipment and supplies at healthcare facilities (ranging from preventive and critical care providers to dispensaries) can exacerbate the impact of climate-related health risks. Reliable stockpiles of essential medicines and emergency supplies are needed to adequately prepare for extreme weather events, particularly in more remote rural health centers and peripheral health units.

73. Laboratory capabilities in Cambodia face several challenges including testing services, the transport of specimens, quality management, and regulations. Further, poor supply chains result in the lack of basic needs (for example, water and electricity), as well as contribute to stock-outs of laboratory reagents, consumables, and equipment. Laboratory capacities and other health technologies in Cambodia need further assessments to better determine their ability to manage current and projected climate-sensitive diseases. This includes the extent to which the laboratory capabilities require fundamental strengthening to ensure access to essential medicines, testing, and equipment. Additionally, while flood risk mapping is in progress for health centers, it has not yet been extended to include diagnostic laboratories, storage facilities, and other supply chain infrastructure.⁹⁰

HEALTH FINANCING

REVENUE GENERATION

74. Cambodia has three main sources of health financing: the government's general revenue (taxes), donor assistance, and out-of-pocket (OOP) payments;⁹¹ there are no taxes earmarked for health.⁹² Payments to

healthcare financing also includes voluntary health insurance. Although the country's total health expenditure as a percentage of gross domestic product (GDP) is among the highest for low- and middle-income countries in the region, public health expenditure as a percentage of GDP is among the lowest.⁹³

75. The government finances approximately 20 percent of the health sector. Per capita government expenditure has been increasing over the past two decades from USD3.90 in 2000 to USD27.54 in 2019.⁹⁴ Yet, government expenditure (as a percentage of current health expenditure) was low at approximately 24 percent in 2019. External / donor health expenditure (as a percentage of current health expenditure) also declined from approximately 22 percent in 2014 to 6.5 percent in 2019.⁹⁵ By comparison, OOP expenditure was extremely high in 2019, representing approximately 64 percent of the current health expenditure⁹⁶ — higher than the WHO's recommended threshold of 20 percent. OOP health expenditure by households as a proportion of household budget was approximately 5 percent — one of the highest in Asia in 2017.⁹⁷

POOLING

76. Several health financing policies have been implemented in the country to improve access to health services. They include community-based health insurance (1998); the development of a health equity fund (HEF) (donor-funded, 2000); and HEFs (government-funded, 2008) where public facilities provide free services using transfers from the national budget.⁹⁸

77. Risk pooling in Cambodia is insufficient. Only 17 percent of the population is covered by social / voluntary health insurance or

government subsidies. Although Cambodia has seven community-based insurance schemes, they only cover 1 percent of the population.⁹⁹ As of 2017, there were plans to expand the coverage of the HEFs to include additional vulnerable groups. Although these populations are more vulnerable to the negative impacts of climate change, there is limited evidence to suggest that populations in climate-vulnerable areas are targeted by these programs.

STRATEGIC PURCHASING

78. The financing of healthcare provision in the public sector comes from different sources — both government transfers and payments from consumers. These include user fees, fee-for-service payments from small community-based health insurance, performance-based payments, and payments from the HEFs.¹⁰⁰ HEF is a third-party payer mechanism that reimburses public facilities for health services rendered to the poor.¹⁰¹

79. National budget lines pay for the infrastructure and the in-kind distribution of pharmaceuticals and commodities, while the benefits package from the HEF includes the reimbursement for medical services, transportation, food, and funeral costs. Currently, there appear to be limited considerations of climate-sensitive diseases and other climate-related health risks.

FINANCING FOR CLIMATE

80. Cambodia has a Climate Change Financing Framework¹⁰² passed in 2015 to assist with the mobilization and management of climate finance.¹⁰³ It identifies sources of climate finance and proposes the costing of a climate change national response. Cambodia's Climate Change Financing Framework has

health considerations. It includes a benefit-cost analysis showing that investing in climate will have benefits that outweigh the costs when it comes to new malaria cases.¹⁰⁴ There is evidence that the health sector has contributed to climate finance, including KHR53.3 billion on general health and KHR38 billion on climate-sensitive diseases between 2009 and 2012.¹⁰⁵

81. To address climate change risks, Cambodia requires climate adaptation spending of 3.3 percent of the GDP until 2050;¹⁰⁶ this will involve dedicated domestic sources. However, given that Cambodia mainly depends on external funds (86 percent of climate expenditure is from external sources),¹⁰⁷ identifying alternative sources of revenue will be critical to furthering climate adaptation and mitigation activities in the health sector. Such sources include the private sector, non-governmental organizations (NGOs) and development partners, as well as global climate funds (that is, the Green Climate Fund [GCF] and the Climate Investment Funds [CIF]). In 2022, the World Bank approved a USD113 million project to improve access to health care for the most vulnerable, which supported the second phase of the Health Equity and Quality Improvement Project that ran from 2016 to 2022.

While the capacity to align climate finance with national budgets has been limited,¹⁰⁸ there is evidence that the Climate Change Alliance supported a pilot to integrate climate finance in subnational plans in three districts between 2011 and 2013.¹⁰⁹ Furthermore, during a World Bank mission to Cambodia on February 2023, DCC from MOE shared that MEF is currently reviewing a proposal to incorporate climate change into the national budget.¹¹⁰

TABLE 3:

Gaps in Adaptive Capacity.

GAPS IN ADAPTIVE CAPACITY	
LEADERSHIP AND GOVERNANCE	• Limited integration of climate vulnerability assessments and tailored interventions into subnational- and local-level planning initiatives • Technical capacities among Ministry of Health (MOH) staff at national and subnational levels are lacking • Lack of policies focusing on furthering resilience at the health system and health facility levels
HEALTH SERVICE DELIVERY	• Limited information on health infrastructure and health system capacity • Limited coordination mechanisms for different key stakeholders in health service provision at the subnational level, thus constraining the implementation of risk reduction measures and preparedness strategies
HEALTH WORKFORCE	• Lack of specialized health workforce to meet current needs as per national guidelines, as well as imbalance in distribution • Health workforce distribution does not account for climate-related health risks • Limited training opportunities at the subnational level to improve system performance in the face of climate change and disaster risks
HEALTH INFORMATION SYSTEMS	• Fragmentation of surveillance, reporting, and early warning systems limiting coordination between platforms and curtailing data-sharing among key stakeholders • Community-level mobile application for monitoring malaria cases across the country (developed by the National Center for Parasitology, Entomology and Malaria Control [CNM]) highly restricted and not shared with key stakeholders
ESSENTIAL MEDICAL PRODUCTS AND TECHNOLOGIES	• Lack of data on essential medicines limiting the monitoring of facilities to ensure the procurement and allocation of resources • Testing services, transport of specimens, and quality management and regulations limited in Cambodia, mainly due to poor supply chains, thus undermining the proper procurement of laboratory reagents, consumables, and equipment
HEALTH FINANCING	• Vulnerable populations — including the elderly, the poor, and children under five — not properly covered by risk-pooling mechanisms such as the health equity funds (HEFs); these mechanisms not targeting climate-vulnerable areas • Cambodia heavily reliant on external funds for climate financing, with 86 percent of climate expenditure coming from external sources • No budget line in the national budget for climate-related strategies and interventions

RECOMMENDATIONS

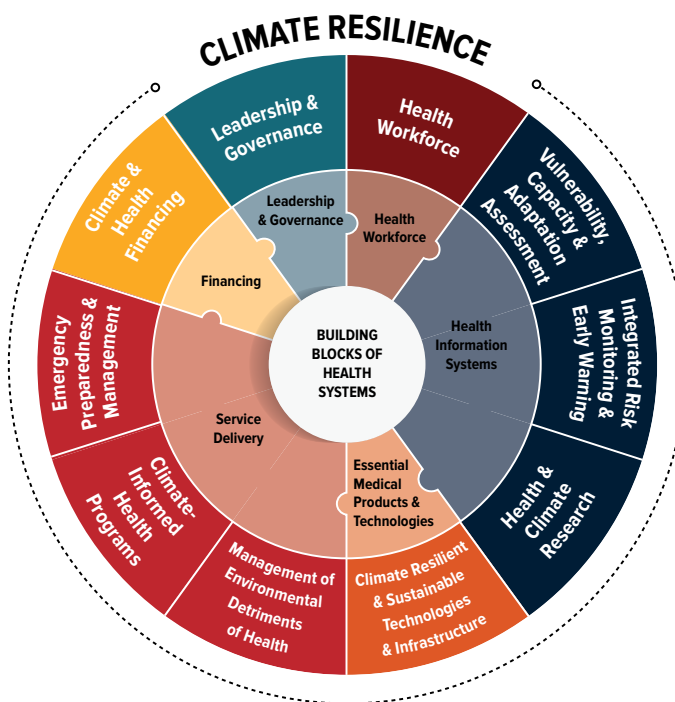
82. This section outlines a set of recommendations to enhance health system resilience and adaptation to climate change, including potential health interventions and strategies, which can be put in place. The recommended options are based on an assessment of both the magnitude of the current and projected climate-related health risks, the existing gaps in the country's adaptive capacity to manage and / or prevent these risks, and the feasibility to develop them in the short and medium terms.

The discussion is organized using the World Health Organization's (WHO) climate-resilient health systems, as shown in the figure below. It draws from the consultations and reviews of

all relevant governmental policies as well as the Climate and Health Guidance Note of the World Bank's Health, Nutrition, and Population (HNP).

FIGURE 15.

WHO's Operational Framework for Climate-Resilient Health Systems.



Source: WHO, 2015

HEALTH INFORMATION SYSTEMS

83. Expand the community-level mobile application developed by the National Center for Parasitology, Entomology and Malaria Control (CNM) to include other climate-sensitive diseases, such as dengue and diarrhea.

In order to better prevent outbreaks and improve responses to them, data access on case numbers and potential outbreaks should be extended to key stakeholders. They should include community-based organizations, development partners, and other actors within the Ministry of Health (MOH) dealing with health information systems, early warning systems, and communicable diseases (CDs).

HEALTH FINANCING

84. Incorporate a health sector climate adaptation line into the national budget.

Increased financing capacity should focus on improving risk-pooling mechanisms targeting climate-vulnerable populations.

85. Develop an investment roadmap outlining key priorities at the national and subnational levels in terms of health infrastructure and service delivery programs, notably for vector-borne diseases (VBDs), waterborne diseases (WBDs), and extreme weather events.

The investment roadmap should outline the roles of public, private, and development sectors.

HEALTH SERVICE DELIVERY

86. Conduct an infrastructure assessment to identify key facilities and areas that need further investments to ensure resilience in the face of climate-related hazards.

There should be a nationwide system for assessing the resilience of the health infrastructure, including laboratories and supply-chain

facilities, and strengthening them against climate hazards. Such efforts can build on current projects, such as the World Bank's mapping of flood risks for health facilities.

87. Develop building codes that include adaptation and mitigation standards for health infrastructure and ensure their enforcement.

These building codes can mobilize existing efforts by the Cambodia Green Building Council, the Ministry of Environment (MOE), and the Ministry of Land Management, Urban Planning and Construction.

HEALTH WORKFORCE

88. Develop tailored capacity-building modules for healthcare workers and health center administrators, which account for subnational differences in climate-related hazards and health risks.

A formal system of regular training is needed to ensure that human resources are adequately prepared for projected climate-related health risks in the future.

LEADERSHIP AND GOVERNANCE

89. Integrate non-governmental organizations (NGOs), research institutes, and private sector providers of health services into multi-stakeholder coordination mechanisms, such as the Climate Change Technical Working Group (CCTWG).

The structure could also provide members of the technical working group with more time to dedicate to the working group and serve as focal points between line ministries, as the participation of the Chair and other core members is in addition to their full-time job responsibilities.

90. Strengthen coordination across the international, national, and subnational levels to improve the management of flood risks, drought risks, and fisheries across the Mekong's subbasins.

Sea-level rises pose risks not only to Cambodia's coastline but also to the southeastern provinces through Vietnam's coastal inundation, as cyclones and tropical storm risks extend beyond national borders. It is important for countries to establish effective mechanisms to exchange and share information on coastal and river flood situations, as well as extreme weather events, in order to reduce morbidity, mortality, and infrastructure damage.



ANNEX A.- ASSUMPTIONS OF FUTURE GLOBAL CLIMATE CHANGE

Predicting the future climate of any country requires several assumptions to be made about the direction of the future global climate. Climate information was acquired from the World Bank Group's Climate Change Knowledge Portal (CCKP). Observed climate data for 1901–2020 was presented at a spatial resolution of 50 km x 50 km. The model-based climate projection data was derived from the Coupled Model Intercomparison Project Phase 6 (CMIP6), with projections shown through five shared socio-economic pathways (SSPs). This assessment explores projected climate change under SSP3-7.0 for the short (2030s; 2020–2039) and medium (2050s; 2040–2059) terms. The SSP3-7.0 is a high-greenhouse gas (GHG) emissions scenario in which countries are increasingly competitive and emissions continue to climb, doubling from the current levels by 2100.

This assessment uses future time periods that can be compared with the baseline and for which assumptions or models can be used to predict changes in future climate-related disease burdens. The World Bank's Climate and Health Vulnerability Assessments (CHVAs) use two 20-year time periods: together, they cover the next four decades to show imminent climatic changes and medium-term climatic changes in a given country.

The baseline period covers 30 years (1990–2020): this has conventionally been the length of time over which climatic conditions are measured to reduce noise from annual or other cyclical variations.

Looking to the future, 20-year time periods are used as a consequence of the accelerating pace of global climate change so as to be able to analyze climate-related threats over a sufficiently proximate timescale.

2030s: This is the 20-year period from 2020 to 2039, with 2030 as the chronological mid-point. It represents the immediate coming years requiring countries and their governments to respond with the utmost urgency.

2050s: This is a 20-year period from 2040 to 2059, with 2050 as the chronological mid-point. It represents a medium-term period, still well within the lifetime of current populations whose countries and governments still have sufficient time to make profound changes in preparation for expected threats.



REFERENCES

- 1 World Bank, n.d. "GDP (current US \$) – Cambodia," <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=KH>.
- 2 UNDP (United Nations Development Programme), 2024, "Human Development Insights: Access and Explore Human Development Data for 191 Countries and Territories Worldwide," <https://hdr.undp.org/sites/default/files/Country-Profiles/KHM.pdf>.
- 3 World Bank, 2024, "The World Bank in Cambodia," <https://www.worldbank.org/en/country/cambodia/overview>.
- 4 World Bank, 2024, "The World Bank in Cambodia," <https://www.worldbank.org/en/country/cambodia/overview>.
- 5 Niels-Jakob Harbo Hansen and Albe Gjonbalaj, 2019, "Advancing Inclusive Growth in Cambodia," International Monetary Fund (IMF) Working Paper 19/187, <https://www.imf.org/en/Publications/WP/Issues/2019/09/06/Advancing-Inclusive-Growth-in-Cambodia-48563>.
- 6 World Bank, 2024, "The World Bank in Cambodia," <https://www.worldbank.org/en/country/cambodia/overview>.
- 7 World Bank, 2024, "The World Bank in Cambodia," <https://www.worldbank.org/en/country/cambodia/overview>.
- 8 World Bank, n.d., "Unemployment, Total (% of Total Labor Force) Modeled ILO Estimate — Cambodia," <https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?locations=KH>.
- 9 World Bank, n.d., "Population, Total — Cambodia," <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=KH>.
- 10 World Bank, n.d., "Population Growth (Annual %) — Cambodia," <https://data.worldbank.org/indicator/SP.POP.GROW?locations=KH>.
- 11 World Bank, n.d., "Age Dependency Ratio (% of Working-Age Population) — Cambodia," <https://data.worldbank.org/indicator/SP.POP.DPND?locations=KH>.
- 12 UNICEF (United Nations' Children's Fund), 2019, "Voices of Youth," August 14, 2019, <https://www.unicef.org/cambodia/stories/voices-youth-applications-open>.
- 13 World Bank, n.d., "Population, Female (% of Total Population) — Cambodia," <https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=KH>.
- 14 World Bank, n.d., "Rural Population (% of Total Population) — Cambodia," <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=KH>.
- 15 CCKP (Climate Change Knowledge Portal), 2021, "Cambodia," <https://climateknowledgeportal.worldbank.org/country/cambodia/vulnerability>.
- 16 UNCC (United Nations Climate Change), n.d. "Cambodia," UNFCCC, <https://unfccc.int/node/180416>.
- 17 Climate Resource, 2023, "NDCs > Countries > Cambodia," <https://www.climate-resource.com/tools/ndcs/countries/khm?version=>.
- 18 The General Secretariat of the National Council for Sustainable Development / Ministry of Environment, the Kingdom of Cambodia, 2020, Cambodia's Updated National Determined Contribution, Phnom Penh, Cambodia: The General Secretariat of the National Council for Sustainable Development / Ministry of Environment, https://unfccc.int/sites/default/files/NDC/2022-06/20201231_NDC_Update_Cambodia.pdf.
- 19 Hoesung Lee, Katherine Calvin, Dipak Dasgupta, Gerhard Krinner, Aditi Mukherji, Peter Thorne, Christopher Trisos, et al., 2023, 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, 1–34, Geneva, Switzerland: IPCC, <https://www.ipcc.ch/assessment-report/ar6/>.
- 20 Note: SSP3-7.0 represents a higher emissions scenario. It is considered a more realistic worst-case scenario in which warming reaches approximately 3.5°–4°C by 2100. When considering "risk," it is most prudent to use higher-emissions scenarios in order to not dangerously underestimate potential changes and risk conditions.
- 21 Alex Chapman, William Davies, and Ciaran Downey, 2021, Climate Risk Country Profile: Cambodia, Washington, DC and Manila, Philippines: World Bank Group and Asian Development Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/36380/Cambodia-Climate-Risk-Country-Profile.pdf?sequence=1&isAllowed=y>.
- 22 Roger Sayre, Deniz Karagulle, Charlie Frye, Timothy Boucher, Nicholas H. Wolff, Sean Breyer, Dawn Wright, et al., 2020, "An Assessment of the Representation of Ecosystems in Global Protected Areas Using New Maps of World Climate Regions and World Ecosystems," *Global Ecology and Conservation* 21: e00860, doi: 10.1016/j.gecco.2019.e00860.
- 23 C. McSweeney, M. New, and G. Lizcano, 2008, Climate Change Country Profile: Cambodia, 1–27, New York City, NY: United Nations Development Programme (UNDP); CIF (Climate Investment Funds), 2010, Cambodia: Proposal for Phase 1 Funding, PPCR.6/3, Meeting of the PPCR Sub-Committee, Washington, DC, June 7, 2010, https://d2qx68gt0006nn.cloudfront.net/sites/cif_enc/files/meeting-documents/cambodia_phase_1_proposal_jdk_0.pdf.
- 24 Bradfield Lyon, 2004, "The Strength of El Niño and the Spatial Extent of Tropical Drought," *Advances in Geosciences* 31, doi: 10.1029/2004GL020901.
- 25 USAID (United States Agency for International Development), 2019, "Cambodia — Climate Risk Profile. Fact Sheet," https://www.climateintelinks.org/sites/default/files/asset/document/2019_USAID_Cambodia%20CRP.pdf.
- 26 European Commission DRM KC (Disaster Risk Management Knowledge Centre), n.d., "INFORM Risk," <https://drmkc.jrc.ec.europa.eu/inform-index>.
- 27 International Disaster Database, 2024, "Cambodia," <https://www.emdat.be/>.
- 28 Reliefweb, "Cambodia, Flooding in 16 Provinces (8 Aug 2022)," August 15, 2022, <https://reliefweb.int/report/cambodia/cambodia-flooding-16-provinces-8-aug-2022>.
- 29 GFDRR, n.d., "Cambodia: Urban Flood," <https://thinkhazard.org/en/report/44-cambodia/UF>.
- 30 Earth Observatory, n.d., "Flooding on the Mekong River," <https://earthobservatory.nasa.gov/images/13982/flooding-on-the-mekong-river>.
- 31 GFDRR, n.d., "Cambodia: Landslide," <https://thinkhazard.org/en/report/44-cambodia/LS>.
- 32 Note: Sea levels are impacted by tides and changing ocean currents throughout the year. The highest anomalies identified are not meant to be interpreted as a "constant"; instead, they reflect the highest anomaly recorded at a given time. This is useful when calculating for the highest possible risk.
- 33 National Climate Change Committee, Royal Government of Cambodia, 2013, *Cambodia Climate Change Strategic Plan, 2014–2023*, https://www.unfccc.int/sites/NAPC/Documents/Parties/Cambodia_CCCSP.pdf.
- 34 International Disaster Database, 2024, "Cambodia," <https://www.emdat.be/>.
- 35 Kaustubh Thirumalai, Pedro N DiNezio, Yuko Okumura, and Clara Deser, 2017, "Extreme Temperatures in Southeast Asia Caused by El Niño and Worsened by Global Warming," *Nature Communications* 8: 15531, doi: 10.1038/ncomms15531.
- 36 UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific), 2015, *El Niño 2015/2016: Impact Outlook and Policy Implications*, Science Policy Knowledge Series: Integration of Disaster Risk Reduction and Climate Change Adaptation into Sustainable Development, Advisory Note, December 2015, <https://www.unescap.org/sites/default/files/El%20Nino%20Advisory%20Note%20Dec%202015%20Final.pdf>.
- 37 International Disaster Database, 2024, "Cambodia," <https://www.emdat.be/>.

- 38 GFDRR (2010). Cambodia: Post-Ketsana Disaster Needs Assessment. https://www.gfdr.org/sites/default/files/GFDRR_Cambodia_PDNA_2010_EN.pdf
- 39 Chew-Hung Chang, 2010, "The Impact of Global Warming on Storms and Storm Preparedness in Southeast Asia," *Kajian Malaysia* 28 (1): 53–76, [http://web.usm.my/km/28\(1\)2010/KM%20ART%203%20\(53-82\).pdf](http://web.usm.my/km/28(1)2010/KM%20ART%203%20(53-82).pdf).
- 40 World Bank, n.d., "Life Expectancy at Birth, Male (Years) — Cambodia," <https://data.worldbank.org/indicator/SP.DYN.LE00.MA.IN?locations=KH>.
- 41 World Bank, n.d., "Life Expectancy at Birth, Female (Years) — Cambodia," <https://data.worldbank.org/indicator/SP.DYN.LE00.FE.IN?locations=KH>.
- 42 WHO Regional Office for the Western Pacific, Cambodia—WHO Country Cooperation Strategy 2016–2020, https://iris.who.int/bitstream/handle/10665/246102/WPRO_2016_DPM_004_eng.pdf?sequence=1.
- 43 Alexey Kulikov, Aashna Mehta, Dudley Tarlton, Daniel Grafton, and Rebekka Aarsand, 2019, Prevention and Control of Noncommunicable Diseases in Cambodia: The Case for Investment, Manila, Philippines: WHO Regional Office for the Western Pacific, <https://cdn.who.int/media/docs/default-source/unitaf/cambodia-ic-report-final.pdf>.
- 44 USAID, n.d., "Climate Risk Profile: Cambodia. Fact Sheet," https://www.climate-links.org/sites/default/files/asset/document/2019_USAID_Cambodia%20CRP.pdf.
- 45 NIS (National Institute of Statistics), MoH (Ministry of Health), and ICF, 2023, Cambodia Demographic and Health Survey 2021–22 Final Report, Phnom Penh, Cambodia, and Rockville, Maryland, USA: NIS, MoH, and ICF, <https://dhsprogram.com/publications/publication-FR377-DHS-Final-Reports.cfm>.
- 46 NIS, MoH, and ICF, 2023, Cambodia Demographic and Health Survey 2021–22 Final Report, Phnom Penh, Cambodia, and Rockville, Maryland, USA: NIS, MoH, and ICF, <https://dhsprogram.com/publications/publication-FR377-DHS-Final-Reports.cfm>.
- 47 WFP, n.d., "WFP Cambodia: 2021 Annual Country Report Summary," <https://www.wfp.org/publications/wfp-cambodia-2021-annual-country-report-overview>.
- 48 USAID, n.d., "Climate Risk Profile: Cambodia. Fact Sheet," https://www.climate-links.org/sites/default/files/asset/document/2019_USAID_Cambodia%20CRP.pdf.
- 49 USAID, n.d., "Climate Risk Profile: Cambodia. Fact Sheet," https://www.climate-links.org/sites/default/files/asset/document/2019_USAID_Cambodia%20CRP.pdf.
- 50 IFPRI (International Food Policy Research Institute), 2022, Global Food Policy Report 2022: Climate Change and Food Systems, Washington, DC: IFPRI, doi: 10.2499/9780896294257.
- 51 Cambodia MOH Food and Drug Representatives, World Bank Mission Meeting on January 31, 2023 in Phnom Penh.
- 52 Cambodia MOH Food and Drug Representatives, World Bank Mission Meeting on January 31, 2023 in Phnom Penh.
- 53 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 54 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 55 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 56 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 57 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 58 WHO, 2021, "The 'Last Mile' of Malaria Elimination in Cambodia," April 1, 2021, <https://www.who.int/news-room/feature-stories/detail/the-last-mile-of-malaria-elimination-in-cambodia>.
- 59 WHO/UNICEF. 2020. Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP): Annual Report 2020. <https://washdata.org/search?keywords=2020+annual+report>
- 60 Elizabeth J. Carlton, Andrew P. Woster, Peter DeWitt, Rebecca S. Goldstein, and Karen Levy, 2015, "A Systematic Review and Meta-Analysis of Ambient Temperature and Diarrhoeal Diseases," *International Journal of Epidemiology* 45 (1): doi: 10.1093/ije/dyv296.
- 61 Grace Davies, Lachlan McIver, Yoonhee Kim, Masahiro Hashizume, Steven Iddings, and Vibol Chan, 2014, "Water-Borne Diseases and Extreme Weather Events in Cambodia: Review of Impacts and Implications of Climate Change," *International Journal Environmental Research and Public Health*, 12 (1): 191–213, doi: 10.3390/ijerph120100191.
- 62 Grace Davies, Lachlan McIver, Yoonhee Kim, Masahiro Hashizume, Steven Iddings, and Vibol Chan, 2014, "Water-Borne Diseases and Extreme Weather Events in Cambodia: Review of Impacts and Implications of Climate Change," *International Journal Environmental Research and Public Health*, 12 (1): 191–213, doi: 10.3390/ijerph120100191.
- 63 G.R. McGregor, P. Bessmoulin, K. Ebi, and B. Menne, eds., 2015, Heatwaves and Health: Guidance on Warning-System Development, Geneva, Switzerland: World Meteorological Organization and World Health Organization, <https://dro.dur.ac.uk/28811/1/28811.pdf>.
- 64 R. Sari Kovats and Shakoor Hajat, 2008, "Heat Stress and Public Health: A Critical Review," *Annual Review of Public Health* 29: 41–55, doi: 10.1146/annurev.publhealth.29.020907.090843.
- 65 UNICEF and DCC (Data for Children's Collaborative), 2022, The Coldest Year of the Rest of Their Lives: Protecting Children from the Escalating Impacts of Heatwaves, New York, NY: UNICEF.
- 66 USAID, n.d., "Climate Risk Profile: Cambodia. Fact Sheet," https://www.climate-links.org/sites/default/files/asset/document/2019_USAID_Cambodia%20CRP.pdf.
- 67 World Bank, n.d., "Employment in Agriculture (% of Total Employment) (Modeled ILO Estimate) — Cambodia," <https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=KH>.
- 68 World Bank, n.d., "Mortality Rate Attributed to Household and Ambient Air Pollution, Age-Standardized (Per 100,000 Population) — Cambodia," <https://data.worldbank.org/indicator/SH.STA.AIRPP5?locations=KH>.
- 69 M. Brauer, et al., 2017, for the Global Burden of Disease Study 2017, "PM2.5 Pollution, Population Exposed to Levels Exceeding WHO Interim Target-1 Value (% of Total)," *World Bank*, <https://data.worldbank.org/indicator/EN.ATM.PM25.MC.T1.ZS>.
- 70 WHO, 2024, "Environment and Health: Air Pollution," who.int/data/gho/data/themes/air-pollution/household-air-pollution.
- 71 WHO, 2024, "Environment and Health: Air Pollution," who.int/data/gho/data/themes/air-pollution/household-air-pollution.
- 72 WHO, 2024, "Environment and Health: Air Pollution," who.int/data/gho/data/themes/air-pollution/household-air-pollution.
- 73 Susan C. Anenberg, Shannon Haines, Elizabeth Wang, Nicholas Nassikas, and Patrick L. Kinney, 2020, "Synergistic Health Effects of Air Pollution, Temperature, and Pollen Exposure: A Systematic Review of Epidemiological Evidence," *Environmental Health* 19 (1): 130, doi: 10.1186/s12940-020-00681-z.
- 74 Chan-Na Zhao, Zhiwei Xu, Guo-Cui Wu, Yan-Mei Mao, Li-Na Liu, Qian-Wu, Yi-Lin Dan, et al., 2019, "Emerging Role of Air Pollution in Autoimmune Diseases," *Autoimmunity Reviews* 18 (6): 607–14, doi: 10.1016/j.autrev.2018.12.010.
- 75 Giovanni Adami, Marco Pontalti, Giorgio Cattani, Maurizio Rossini, Ombretta Viapiana, Giovanni Orsolini, Camilla Benini, et al., 2022, "Association Between Long-Term Exposure to Air Pollution and Immune-Mediated Diseases: A Population-Based Cohort Study," *Rheumatic & Musculoskeletal Diseases Open* 8: e002055, doi: 10.1136/rmdopen-2021-002055.
- 76 Sarah J. Parry, Nil Ean, Shirley P. Sinclair, and Ewan Wilkinson, 2020, "Development of Mental Healthcare in Cambodia: Barriers and Opportunities," *International Journal of Mental Health Systems* 14: 53, doi: 10.1186%2Fs13033-020-00385-4; Desiree M Seponski, Cindy J Lahar, Sareth Khann, Sovandara Kao, and Tanja Schunert, "Four

- Decades Following the Khmer Rouge: Sociodemographic Factors Impacting Depression, Anxiety and PTSD in Cambodia," *Journal of Mental Health* 28 (2): 175–80, doi: [10.1080/09638237.2018.1466039](https://doi.org/10.1080/09638237.2018.1466039).
- 77 World Bank, "Suicide Mortality Rate, Male (Per 100,000 Male Population) — Cambodia," <https://data.worldbank.org/indicator/SH.STA.SUIC.MA.P5?locations=KH>.
 - 78 Elizabeth King MacFarlane, 2016, "Participatory Methods for Climate Change and Mental Health Research: Photovoice in Nepal," Master's thesis, Duke University, <https://dukespace.lib.duke.edu/dspace/handle/10161/12298>.
 - 79 Susan Clayton, Christie Manning, Meighen Speiser, and Alison Nicole Hill, 2021, *Mental Health and Our Changing Climate: Impacts, Inequities, Responses*, Washington, DC: American Psychological Association and ecoAmerica, <https://www.apa.org/news/press/releases/mental-health-climate-change.pdf>.
 - 80 Shaohua Gu, Liang Zhang, Shiqiang Sun, Xiaofeng Wang, Beibei Lu, Hangtao Han, Jun Yang, and Aihong Wang, 2020, "Projections of Temperature-Related Cause-Specific Mortality Under Climate Change Scenarios in a Coastal City of China," *Environment International* 143: 105889, doi: [10.1016/j.envint.2020.105889](https://doi.org/10.1016/j.envint.2020.105889).
 - 81 Marshall Burke, Felipe González, Patrick Baylis, Sam Heft-Neal, Ceren Baysan, Sanjay Basu, and Solomon Hsiang, 2018, "Higher Temperatures Increase Suicide Rates in the United States and Mexico," *Nature Climate Change* 8: 723–9, doi: [10.1038/s41558-018-0222-x](https://doi.org/10.1038/s41558-018-0222-x).
 - 82 Adaptive capacity is defined by the Intergovernmental Panel on Climate Change (IPCC) in the Fifth Assessment Report (AR5) as "the ability of a system to adjust to climate change, moderate potential damages, take advantage of opportunities, and cope with the consequences." The related term, "resilience," is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. People and communities with strong adaptive capacity have greater resilience. This assessment makes use of the terms — "adaptation" and "adaptive capacity" — to encompass both "adaptive capacity" and "resilience."
 - 83 Cambodia MOE DCC Representatives, World Bank Mission Meeting on February 1, 2023 in Phnom Penh.
 - 84 Cambodia MOE DCC Representatives, World Bank Mission Meeting on February 1, 2023 in Phnom Penh.
 - 85 Muthukumara Mani, Katherine Stapleton, Tao Wang, Sandra Baquie, Erica Honeck, Hector Pollitt, Phearanich Hing, Shawn W. Tan, Ha Thu Nguyen, and S. Vaideeswaran, 2023, *Country Climate Development Report: Cambodia*, Washington, DC: World Bank Group, <https://openknowledge.worldbank.org/entities/publication/83b19e-fc-96d1-4be4-8240-28e0e7f13c9b>.
 - 86 WHO, 2022, "In Cambodia, WHO's Preparedness Team Recognised for Helping Build a Stronger Local Response," October 7, 2022, <https://www.who.int/westernpacific/news-room/feature-stories/item/in-cambodia-who-s-preparedness-team-recognised-for-helping-build-a-stronger-local-response>.
 - 87 Cambodia National Health Congress, March 2023.
 - 88 The National Centre for Health Promotion, n.d., "Environment Health and Hygiene," <https://nchp.gov.kh/environmental-health>.
 - 89 USAID, n.d., "Cambodia," <https://www.ghsupplychain.org/country-profile/cambodia>.
 - 90 World Bank Environment Team in Cambodia, World Bank Mission Meeting on February 2, 2023 in Phnom Penh.
 - 91 Health Policy Project, 2016, "Health Financial Profile: Cambodia," May 2016, https://www.healthpolicyproject.com/pubs/7887/Cambodia_HFP.pdf.
 - 92 Health Policy Project, 2016, "Health Financial Profile: Cambodia," May 2016, https://www.healthpolicyproject.com/pubs/7887/Cambodia_HFP.pdf.
 - 93 Health Policy Project, 2016, "Health Financial Profile: Cambodia," May 2016, https://www.healthpolicyproject.com/pubs/7887/Cambodia_HFP.pdf.
 - 94 World Bank, 2023, "Domestic General Government Health Expenditure Per Capita (Current US\$) — Cambodia," <https://data.worldbank.org/indicator/SH.XPD.GHED.PC.CD?locations=KH>.
 - 95 World Bank, 2023, "External Health Expenditure Per Capita, PPP (Current International \$) — Cambodia," <https://data.worldbank.org/indicator/SH.XPD.EHEX.PP.CD?locations=KH>.
 - 96 World Bank, 2023, "Out-of-Pocket Expenditure Per Capita (% of Current Health Expenditure) — Cambodia," <https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?locations=KH>.
 - 97 Virginia Wiseman, Augustine Asante, Por Ir, Supon Limwattananon, Bart Jacobs, Marco Liverani, Andrew Hayen, and Stephen Jan, 2017, "System-Wide Analysis of Health Financing Policies in Cambodia: A Study Protocol," *British Medical Journal (BMJ) Global Health* 2 (1): e000153, <https://gh.bmj.com/content/2/1/e000153>.
 - 98 Tim Ensor, Chhim Chhun, Ton Kimsun, Barbara McPake, and Ijeoma Edoaka, 2017, "Impact of Health Financing Policies in Cambodia: A 20-Year Experience," *Social Science & Medicine* 177, doi: [10.1016/j.socscimed.2017.01.034](https://doi.org/10.1016/j.socscimed.2017.01.034).
 - 99 Health Policy Project, 2016, "Health Financial Profile: Cambodia," May 2016, https://www.healthpolicyproject.com/pubs/7887/Cambodia_HFP.pdf.
 - 100 Virginia Wiseman, Augustine Asante, Por Ir, Supon Limwattananon, Bart Jacobs, Marco Liverani, Andrew Hayen, and Stephen Jan, 2017, "System-Wide Analysis of Health Financing Equity in Cambodia: A Study Protocol," *BMJ Global Health* 2 (1), <https://gh.bmj.com/content/2/1/e000153>.
 - 101 Virginia Wiseman, Augustine Asante, Por Ir, Supon Limwattananon, Bart Jacobs, Marco Liverani, Andrew Hayen, and Stephen Jan, 2017, "System-Wide Analysis of Health Financing Equity in Cambodia: A Study Protocol," *BMJ Global Health* 2 (1), <https://gh.bmj.com/content/2/1/e000153>.
 - 102 Royal Government of Cambodia. 2015. *Climate Change Financing Framework*. <https://pr.adb.org/sites/default/files/resource/921/cambodia-climate-change-financing-framework.pdf>
 - 103 Sara Tchapanian, 2016, "Closing the Climate Finance Gap in Cambodia: Could Training be the Simple Answer," United Nations Institute for Training and Research (UNITAR), <https://www.unitar.org/about/news-stories/stories/closing-climate-finance-gap-cambodia-could-training-be-simple-answer>.
 - 104 Royal Government of Cambodia. 2015. *Climate Change Financing Framework*. <https://pr.adb.org/sites/default/files/resource/921/cambodia-climate-change-financing-framework.pdf>
 - 105 Sara Tchapanian, 2016, "Closing the Climate Finance Gap in Cambodia: Could Training be the Simple Answer," UNITAR, <https://www.unitar.org/about/news-stories/stories/closing-climate-finance-gap-cambodia-could-training-be-simple-answer>
 - 106 Royal Government of Cambodia. 2015. *Climate Change Financing Framework*. <https://pr.adb.org/sites/default/files/resource/921/cambodia-climate-change-financing-framework.pdf>
 - 107 Ibid.
 - 108 Sara Tchapanian, 2016, "Closing the Climate Finance Gap in Cambodia: Could Training be the Simple Answer," United Nations Institute for Training and Research (UNITAR), <https://www.unitar.org/about/news-stories/stories/closing-climate-finance-gap-cambodia-could-training-be-simple-answer>
 - 109 Ma Chan Sethea, n.d. "Climate Finance: The Cambodia Experience," Presentation, https://unfccc.int/files/cooperation_support/financial_mechanism/long-term_finance/application/pdf/climate_finance_-_the_cambodian_experience.pdf.
 - 110 Cambodia MOE DCC Representatives, World Bank Mission Meeting on February 1, 2023 in Phnom Penh.

JUNE 2024



THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

