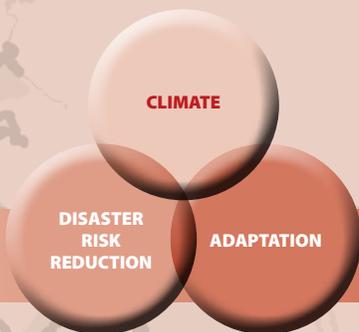




Vulnerability, Risk Reduction, and Adaptation to Climate Change

CAMBODIA



COUNTRY OVERVIEW

Cambodia is part of mainland Southeast Asia. Bordered by Laos, Thailand, and Vietnam and with a coastal region on the Gulf of Thailand, it covers an area of 181,040 square kilometers. The Mekong River is the most prominent geographical feature of the country, flowing directly from the north to the Mekong Delta of Vietnam in the south. The Tonle Sap Lake, an outlet of the Mekong River during the rainy season, is located in the country's northwest region. Cambodia's topography includes the low-lying central plains of the Mekong, which are surrounded by mountainous and highland regions. The country's coastline measures 435 km.

The population of Cambodia was 14.5 million in 2010,¹ with 80% living in rural areas. 52% of the population lives in the central plains, 30% in the surroundings of Lake Tonle Sap, 11% in the highlands and mountains, and only 7% along the coast. The national average population density is low for the region at 75 people per km².

Cambodia's Gross Domestic Product (GDP) is USD 10354 million per annum,² and the country's economy relies primarily on agriculture (33% of GDP and employing 57% of the country's labor force), industry (predominantly garments - 21% of GDP and employing 15.9% of the country's labor force), and services (42% of GDP and employing 26% of the country's labor force). Annual GDP growth rate has fluctuated widely from 5 to 13% in the 2000s.³ In 2008, GDP grew by 6.5%, with agriculture, fisheries and forestry accounting for 32.4 % of GDP, industry for 22.8 %, and services for 38.8%. The contribution of industry to GDP has doubled since 1993, but a substantial proportion of the population is still dependent on the farming and fisheries sectors. Cambodia is vulnerable to floods and droughts, mostly due to reliance on agriculture and fisheries.⁴

PRIORITY ADAPTATION MEASURES

Key Sectors

Agriculture
Forestry
Water Resources
Public Health
Coastal Zones

Source: Cambodia's National Adaptation Program of Action, 2006.

Cambodia's National Adaptation Program of Action (NAPA) was published in October 2006. It prioritizes actions in response to current and projected impacts of climate variability and change on the country's most vulnerable sectors: agriculture, forestry, water, health, and coastal zones.

¹ World Development Indicators - 2010 , the World Bank.

² Ibid.

³ From Cambodia's National Institute of Statistics, Ministry of Planning in Cambodia: Proposal for Phase 1 Funding, PPCR. June 7, 2010.

⁴ Natural Disaster Hotspots Study: A Global Risk Analysis, 2005.

CLIMATE BASELINE AND CLIMATE FUTURE

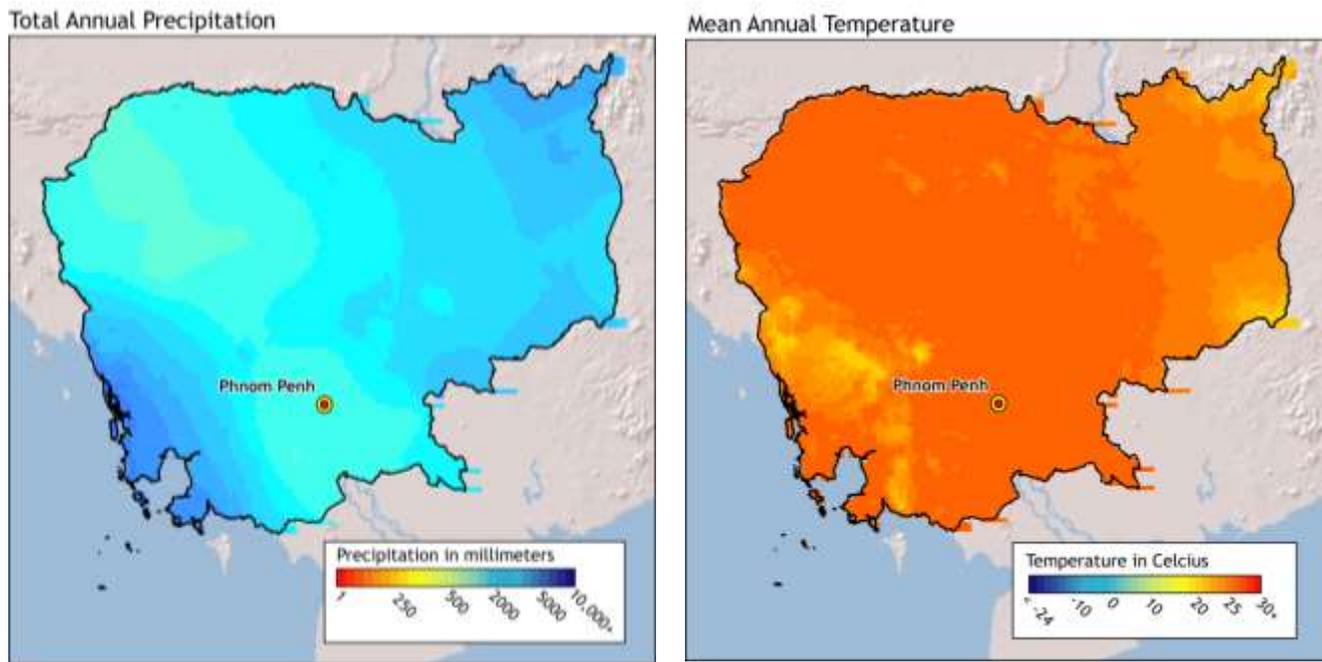


Figure 1: Annual Climate Baseline for Cambodia: Rainfall (Left) and Temperature (Right)⁵

BASELINE CLIMATE

Cambodia's climate is tropical, with characteristically high temperatures, and two seasons are recognized: a monsoon-driven rainy season (May-October) with south-westerly winds ushering in clouds and moisture that accounts for anywhere between 80-90% of the country's annual precipitation, and a dry season (November-April), with cooler temperatures, particularly between November and January. Average temperatures are relatively uniform across the country, and are highest (26- 40°C) in the early summer months before the rainy season begins. Temperatures remain at 25 to 27°C throughout the rest of the year. The wet season arrives with the summer monsoon, in May through November, bringing the heaviest rainfall to the southeast and northwest. Mean monthly rainfall at this time of year can be more than 5000 mm in some areas. Inter-annual variations in climate result from the El Niño Southern Oscillation, which influences the nature of the monsoons in the region and generally bring warmer and drier than average winter conditions across Southeast Asia, while La Niña episodes bring cooler than average conditions.⁶

⁵ Worldclim 1960-1990 Averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at The Museum Of Vertebrate Zoology, University Of California, Berkeley, in Collaboration With Peter Jones And Andrew Jarvis (Ciat), and with Karen Richardson (Rainforest Crc). www.worldclim.org/current

⁶ UNDP Climate Change Country Profile: Cambodia and Cambodia: Proposal For Phase 1 Funding, PPCR.6/3 June 7, 2010.

RECENT CLIMATE TRENDS

The following are climate trends for Cambodia observed between 1960 and 2003.⁷

- ➔ Mean annual temperatures have increased by 0.8°C since 1960, at a rate of about 0.18°C per decade. The rate of increase is most rapid in the drier seasons (December-January-February and March-April-May), increasing 0.20-0.23°C per decade, and is slower in the wet seasons (June-July-August and September-October-November), increasing 0.13-0.16°C per decade.
- ➔ Since 1960, the frequency of 'hot' days⁸ has increased significantly (+46, with strongest increases noted in September- November), as has the frequency of 'hot' nights (+63, with strongest increases noted in December-February).
- ➔ The frequency of 'cold' days⁹ has decreased significantly in September-February.
- ➔ The average number of cold days per year has decreased by 19 (5.2%). This rate of decrease is most rapid in December-January-February.
- ➔ The average number of cold nights per year has decreased, particularly during the dry season (December through February).
- ➔ Mean rainfall trends over Cambodia are unclear, with some areas experiencing increases and others decreases, but these changes are not statistically significant.

CLIMATE FUTURE

The climate science community sources a suite of models to inform decision makers on future climate. GCMs (Global Climate Models), RCMs (Regional Climate Models), downscaling techniques (both empirical and statistical), and several comprehensive reviews are available on the subject. GCMs are our primary source of information about future climate. They comprise simplified but systematically rigorous interacting mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. The following insights into a changing climate are derived for the Southeast Asia region as a whole, from a suite of GCMs used by the Intergovernmental Panel on Climate Change.¹⁰

- ➔ Mean annual temperatures are projected to increase across Cambodia by 0.7-2.7°C by the 2060s, and 1.4-4.3°C by the 2090s.
- ➔ All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate, with hot days¹¹ increasing by 14-49% and hot nights¹² increasing by 24-68% by 2060.

⁷ UNDP Climate Change Country Profile: Cambodia and the World Bank's Climate Change Knowledge Portal.

⁸ Hot days or nights are defined as the temperature above which 10% of days or nights are recorded in current climate of that region and season.

⁹ Cold days or nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season.

¹⁰ UNDP Climate Change Country Profiles and the World Bank's Climate Change Knowledge Portal

¹¹ Ibid note 7.

¹² Ibid note 8.

- ➔ All projections indicate decreases in the frequency of days and nights that are considered 'cold,'¹³ with these events becoming exceedingly rare.
- ➔ As yet it is not possible to get a clear picture for precipitation change, due to large model uncertainties, however increases in rainfall appear to be likely during the monsoon season for Cambodia.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

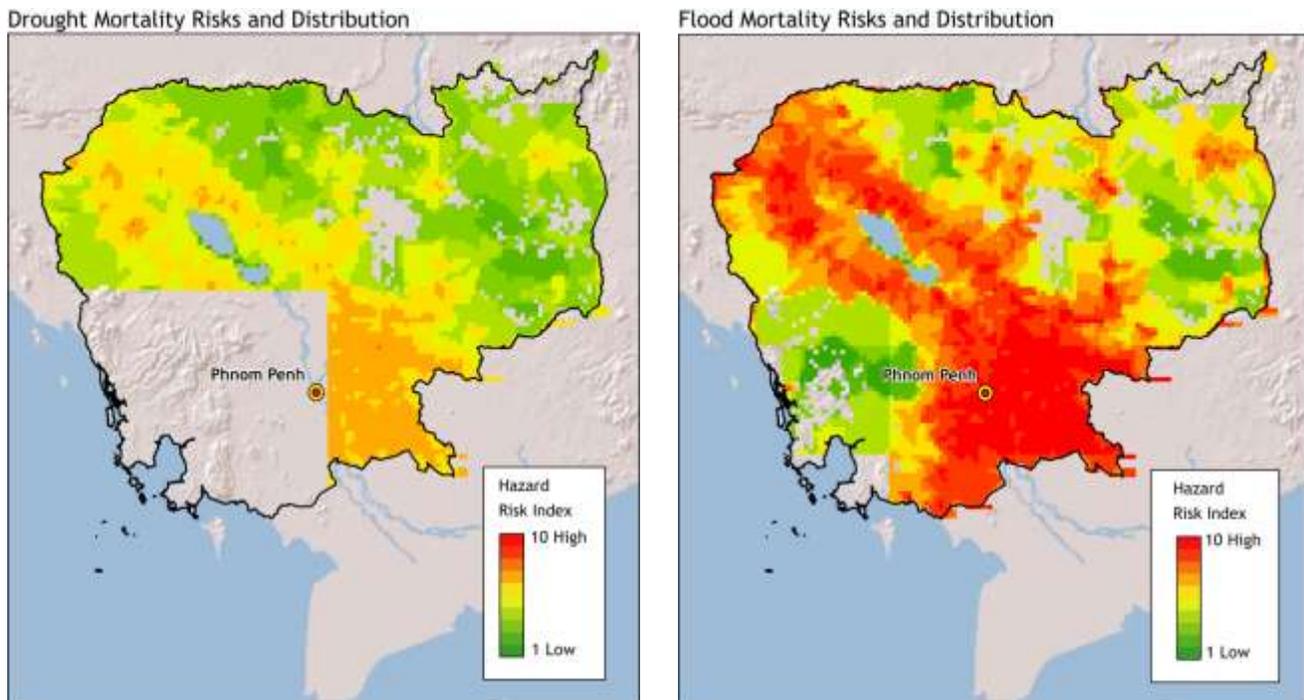


Figure 2: Mortality Risk and Distribution of Floods and Droughts across Cambodia¹⁴

AT A GLANCE

Cambodia is one of the more disaster-prone countries in Southeast Asia, affected by floods and droughts on a seasonal basis. Cambodia's vulnerability to climate change is linked to its characteristics as a post-civil war, least developed, predominantly agrarian country, with nearly 80% of the population living

¹³ Ibid note 9.

¹⁴ Columbia University Center for Hazards and Risk Research (CHRR) and Columbia University Center for International Earth Science Information Network (CIESIN).

in rural areas. Weak adaptive capacity, poor infrastructure, and limited institutions exacerbate the country's vulnerability to climate variability and change. Indeed, floods and droughts are recognized by the government as one of the main drivers of poverty. During the 20-year period from 1987 to 2007, a succession of droughts and floods resulted in significant loss of life and considerable economic loss.¹⁵

- ➔ **Floods** - The southwest monsoons begin in mid-May and last through the end of October, bringing over three-quarters of the country's annual rainfall. As a result, floods along the Mekong River and its tributaries, as well as from the Tonle Sap Lake, are recurrent and often themselves constituting major disasters. Approximately 80% of the country's population lives along the Mekong River, which is known to have large fluctuations. Floods affect the provinces of Kandal, Kampong Cham, Kratie, Prey Veng, Stung Treng, Svay Rieng, and Takeo. Flash floods in tributaries around the Tonle Sap Lake affect others. For example, the severe floods that occurred from 2000 to 2002 resulted in 438 casualties and caused damages amounting to US \$205 million.¹⁶ Over the period 1998-2002, as much as 70% of rice production loss was attributed to floods and 20% to droughts. Estimates suggest that floods kill 100 people annually, cause agricultural losses of US \$100-170 million each year,¹⁷ and can significantly affect critical infrastructure along the floodplain. Aberrant rainfall patterns over the past few years and the destruction caused by the 2009 Typhoon Ketsana have captured the attention of key decision makers and the public.
- ➔ **Droughts** - Coupled with poor management, access, and storage of existing water resources, delays or early ending of the monsoon rains and erratic rainfall have contributed to droughts in Cambodia, especially in Svay Rieng province, which is one of the most drought-prone provinces in the country. Droughts impact every aspect of the country's economy and population, including leading to economic losses due to crop failure, health problems, and environmental damage.¹⁸ Over the period 1998-2002, a 20% loss in rice production loss was attributed to droughts.
- ➔ **Sea Level Rise** - Rising sea levels could pose a significant threat to marine coastal areas, which already suffer from storm surges, high tides, beach erosion, and seawater intrusion. Low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangrove forests could all be affected.

Implications for Disaster Risk Management (DRM)

- ➔ Increased intensity of rainfall during the monsoon seasons could significantly impact flood response management across the Mekong.
- ➔ Sea level rise threatens the country's low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangrove forests.
- ➔ Droughts are already a common occurrence in Svay Rieng province, and projected rising temperatures could exacerbate an already vulnerable situation, pushing communities in the area beyond their coping capacities.

¹⁵ GFDRR Country Disaster Risk Management Program for Cambodia at <http://gfdr.org/ctrydrmmnotes/Cambodia.pdf>.

¹⁶ Ministry of Environment, 2006. National Adaptation Program of Action to Climate Change.

¹⁷ Rinbo, 2009. The Expert Group Meeting on Innovative Strategies towards Flood Resilient Cities in Asia-Pacific—Cambodia: Mainstreaming Flood and Drought Risk Mitigation in East Mekong Delta.

¹⁸ Oxfam Cambodia and Graduate School of Global Environmental Studies of Kyoto University, Japan- Drought Management Considerations for Climate Change Adaptation: Focus on the Mekong Region CAMBODIA report.

SECTORAL CLIMATE RISK REDUCTION RECOMMENDATIONS

AGRICULTURE

Cambodia is classified as a least developed country and a majority of the population relies on agriculture. Cambodia's agriculture is mainly based on rainfed rice and mixed crops. On average, agriculture has accounted for more than 40% of GDP in recent years.¹⁹ Agricultural production is dependent on the annual flooding and recession of the Tonle Sap Lake and the Mekong River, which bring fertile alluvium soils to the central plains. Only about 19.5 % (approximately 400,000 ha) of cultivated land in Cambodia benefits from irrigation.

There is evidence of an increase in the intensity and frequency of extreme weather events, including floods and droughts in Asia throughout the 20th century (IPCC, 2001). Cambodia has experienced increased rainfall in the wet season and prolonged drought in the dry season. The World Bank's Economics of Adaptation to Climate Change (EACC) study shows that projected changes in temperature and precipitation will negatively affect current yields, with irrigated and rainfed wheat and irrigated rice projected to be most significantly affected.

South Asia shoulders the biggest declines in agricultural productivity projected, with developing countries faring worse for almost all crops compared to developed countries. Although additional research is required to properly evaluate the impacts of a changing climate on crop yields under various management scenarios, adaptation options for Cambodia's agriculture sector include:

- ➔ Increased support for and reach of existing agricultural research and extension services;
- ➔ Implementation of improved water use (water harvesting, small-scale irrigation, etc.) in drought-prone areas to alleviate rain shortages that cause crop failure. Improving farmers' knowledge and access to weather information in carrying out agricultural activities;
- ➔ Livelihood diversification to mitigate the reliance on agriculture as the sole livelihood source;
- ➔ Restoring and rehabilitating flood protection infrastructures, such as dikes;
- ➔ Establishing grain banks to sustain communities during periods of drought.

HEALTH

Warmer temperatures and variations in rainfall patterns associated with climate variability and change are already altering the transmission mechanisms of water- and vector-borne diseases in Cambodia. The country has one of the highest rates of fatalities from malaria in Asia, and only 55% percent of the population has access to public health facilities.²⁰ NAPA surveys conducted in seven provinces show that malaria transmissions are most common in agricultural fields and forests, particularly during the wet season. Moreover, the NAPA notes a general lack of community awareness about malaria, further exacerbating the problem. Incidence of malaria, dengue fever, and water-borne diseases (i.e. cholera, dysentery) are likely to become more prevalent, while food

¹⁹ Cambodia's National Adaptation Program of Action.

²⁰ Ibid.

insecurity related to extreme events also threaten the lives and livelihoods of millions of Cambodians. Rainfall also plays a role by influencing mosquito habitats and the size of mosquito populations. While the complete eradication of malaria seems unlikely in the near term, containment of the disease may be considered as the best alternative.

To avoid future health risks associated with climate change, adaptation efforts in Cambodia's health sector should include:

- ➔ Implementation of community-based health education programs to increase awareness and improve personal hygiene and environmental health management;
- ➔ Introduction of a malaria surveillance system, coupled with improved methods for vector control for health workers and communities;
- ➔ Providing training programs to build the manpower capacity to improve the provision of health extension services at local levels;
- ➔ Supporting health research and community health services.

WATER RESOURCES

The Mekong River and its tributaries are Cambodia's most abundant source of water, while groundwater supplies serve both domestic uses and irrigation. In spite of the country's significant water resources, it is clear that groundwater amounts are not only insufficient to support large-scale irrigation, but also in some areas such as southern Cambodia, the resource is heavily laden with arsenic contamination. Water shortages (year-round) were noted by 81% of the households surveyed during the preparation of the country's NAPA. While a wide variety of coping mechanisms were noted to deal with these shortages, the NAPA also suggests that these mechanisms may be pushed beyond critical thresholds under a changing climate.

While much remains unknown regarding water resources across Cambodia, the NAPA has identified several key activities and research streams to make the water sector more resilient to a changing and more variable climate. These include:

- ➔ Conducting water resources assessment studies, including an inventory of water quality and quantity of both surface and underground water in time and space, to develop proper use of available water resources;
- ➔ Introducing improved methods of water conservation, storage and use, including the construction of small check dams and rainwater harvesting schemes to supplement domestic and irrigation supplies;
- ➔ Establishing community-based, participatory watershed management and conservation programs aimed at restoring degraded watersheds;
- ➔ Introducing methods for flood protection, disaster prevention, and maintenance of flood control structures;
- ➔ Improving provincial water transportation arteries (reducing silt, dredging), particularly along upper Mekong waterways in the provinces of Svay Rieng, Prey Veng, Pursat, and Koh Kong.

EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SET UP

The Kingdom of Cambodia ratified the UNFCCC on 18 November 1995 and it entered into force on 17 March 1999. Also in 1999, Cambodia implemented Phase I of its Climate Change Enabling Project (CCEP), followed by CCEPII in 2002. Both projects had the goal of raising the technical and institutional capacity of government staff, as well as raising public awareness of climate change issues, all leading to the country's preparation of its Initial National Communication (INC) to the UNFCCC. In 2002, Cambodia ratified the Kyoto Protocol. The country's National Adaptation Program of Action (NAPA), completed in 2006, identified 20 high priority adaptation projects, with a combined budget of USD 130 million. The Second National Communication (SNC) Team's revised vulnerability analysis and adaptation plan are being used to update the NAPA. The government of Cambodia has made notable progress toward establishing institutional arrangements focused on managing climate change and adaptation interventions. Among the most important efforts are:

- ➔ **The Climate Change Strategy and Action Plan (CCSAP)** was implemented by The Royal Government of Cambodia (RGC) in order to provide a strategic framework for climate change adaptation and mitigation in Cambodia.
- ➔ **The Strategic National Action Plan for Disaster Risk Reduction (2008-2015)** sets out clear priorities for disaster risk management in Cambodia.
- ➔ **The National Climate Change Committee (NCCC)**, a national institutional body formed in April 2006, has the role of preparing, coordinating and monitoring the implementation of policies, strategies, legal instruments, plans, and programs of the Royal Government to address climate change issues within the country.²¹ The Committee is inter-ministerial, cross-sectoral, and multidisciplinary.
- ➔ A climate baseline survey on **Knowledge, Attitudes, and Practices (KAP)** was conducted with the support of UNDP and Oxfam America, to identify what different groups of society know, understand, and already do to address climate variability and change.
- ➔ The **Rectangular Strategy for Growth, Employment, Equity and Efficiency in Cambodia** provides a broad overarching policy framework, outlining the RGC's long-term vision for growth, employment, equity, and efficiency. The Phase II Rectangular Strategy, announced in September 2008, does not address climate change directly, but provides for flood and sea protection levies and other measures to boost agricultural production, while reporting on past success in rescuing and providing post-disaster support to 'victims of natural disasters'.
- ➔ In March 2009 the RGC launched a new **Strategic National Action Plan for Disaster Risk Reduction (SNAP)**, which firmly embraces the principles of risk reduction. The SNAP covers a number of themes relevant to climate change adaptation, including mainstreaming disaster risk reduction into national, sector, and local development policies and plans, national and local risk assessments, improved flood forecasting and early warning capabilities, education and awareness raising, and the promotion of structural and non-structural measures to enhance resilience.

²¹ CCCO, 2008.

Several development partners are actively engaged in addressing climate risks in Cambodia. Key donors include the Governments of Australia, Denmark, the European Community, France, and Japan. Multilateral institutions such as the World Bank Group, the Asian Development Bank (ADB), the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP) and others are involved in several projects with implications for climate change adaptation and disaster risk reduction. The Cambodia Climate Change Alliance (CCCA), funded by EU, UNDP, SIDA, and Danida, is a major new initiative addressing climate resilience in Cambodia using a program-based approach. Yet much more needs to be done to improve Cambodia's resilience to climate variability and change.

INSTITUTIONAL AND POLICY GAPS

- ➔ Disaster risk management in Cambodia is the purview of a wide variety of actors and institutions, which lack coordination, suffer from fragmented external support, and are unable to keep up with Cambodia's disaster response. Promoting coordination and partnerships between these organizations is central to reducing Cambodia's present vulnerability.
- ➔ Most of the current national strategies, policies, planning, and budgetary processes do not yet adequately reflect climate change considerations either in principle or in budgetary terms.
- ➔ Most financial and institutional support to date has been on an ad hoc basis and relates to project-specific interventions though there is now a trend toward more programmatic approaches that include disaster risk prevention instead of focusing solely on response.

RESEARCH, DATA, AND INFORMATION GAPS

Cambodia's history of political instability, geographical location, and status as a least developing country dependent on agriculture make it particularly vulnerable to the effects of climate change. Cambodia's NAPA has identified several barriers to the implementation of adaptation measures. These include:

- ➔ Inadequate technical, financial, and institutional capacity of government agencies and of local communities for dealing with climate hazards, as well as limited coordination among the agencies and communities;
- ➔ Limited integration of climate change issues into national policies and programs; and
- ➔ Limited awareness of climate change issues.

Climate change may bring not only negative impacts but also new economic opportunities, but the lack of available information and measures to identify these opportunities hampers the country's ability to respond to a changing climate environment. Addressing the gaps identified below is central to placing Cambodia on the course of successful adaptation to climate change.

RESEARCH GAPS

- ➔ A better understanding of the local dimensions of vulnerability is essential for developing appropriate adaptation measures that will mitigate any adverse consequences. This requires detailed vulnerability assessments to be conducted in the most vulnerable communities.

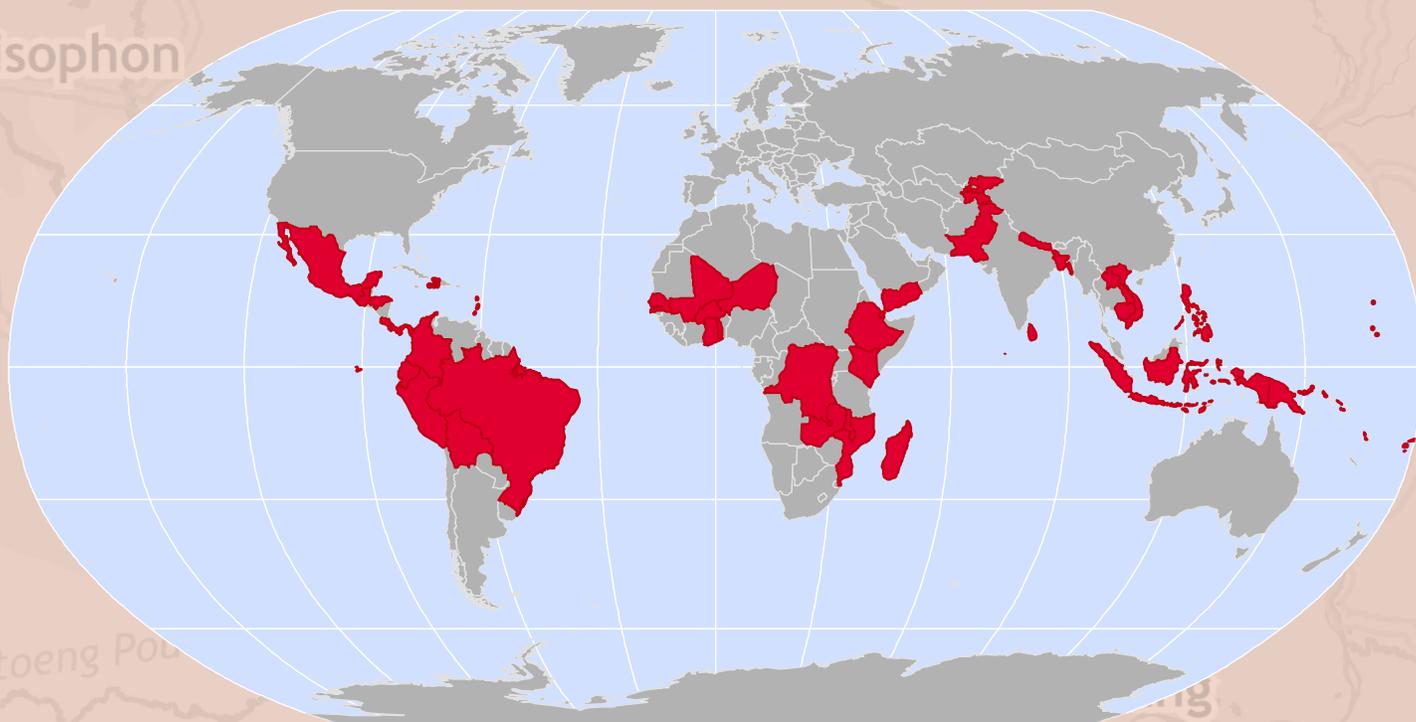
- ➔ Flood forecasting and communication systems are weak and should be improved in those areas that are heavily affected by floods. Feasibility studies for early warning systems are central to this goal, particularly at the province and community level.
- ➔ There is a growing demand for detailed accounts of local adaptation to climate change to serve as a starting point for knowledge exchange on successful practices among vulnerable populations and to support rational policymaking in vulnerable areas.
- ➔ Mainstreaming disaster risk management into planning and administration requires further research on appropriate mechanisms for mainstreaming at the administrative level, including studies on the differential effects of climate variability and change on disaster vulnerability, including shifting rainfall patterns.
- ➔ Additional research is required to properly evaluate the impacts of a changing climate on crop yields under various management scenarios.

DATA AND INFORMATION GAPS

- ➔ Accurate and reliable local forecasts of extreme climate events are non-existent. Villagers in downstream areas essentially rely on word of mouth from upstream areas to ready themselves for floods. Observation and forecasting systems need to be installed where appropriate.
- ➔ Meteorological information for Cambodia is sparse, and a country-wide network of hydrometeorological stations needs to be established in order to quantify long-term changes in climate, including benchmarking future climate variability and change.
- ➔ Comprehensive vulnerability maps identifying the locations of high vulnerability could support disaster planners in preparing communities for worse-case impacts as well as help local communities take an active role in identifying appropriate response mechanisms.
- ➔ The use of existing meteorological information is limited to specific agencies, and this information needs to be tailored to decision makers across a wider range of sectors, including water resources management.

Climate Risk and Adaptation Country Profile

This Country Profile (<http://countryadaptationprofiles.gfdr.org>) is part of a series of 49 priority country briefs developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and the Global Support Program of the Climate Investment Funds (CIF). The profile synthesizes most relevant data and information for Disaster Risk Reduction and Adaptation to Climate Change and is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and operations. Sources on climate and climate-related information are linked through the country profile's online dashboard, which is periodically updated to reflect the most recent publicly available climate analysis.



Acknowledgments: The *Country Profiles* were produced through a partnership between the Global Facility for Disaster Reduction and Recovery, the Global Support Program of the Climate Investment Funds, and the Climate Change Team of the Environment Department of the World Bank, by a joint task team led by Milen Dyoulgerov (TTL), Ana Bucher (co-TTL), Fernanda Zermoglio, and Claudio Forner. Additional support was provided by Sarah Antos, Michael Swain, Carina Bachofen, Fareeha Iqbal, Iretomiwa Olatunji, Francesca Fusaro, Marilia Magalhaes, Habiba Gitay, Laura-Susan Shuford, Catherine Nakalembe, Manisha Ganeshan, Roshani Dangi, Anupam Anand and Li Xu. IT, GIS, and map production support was provided by Varuna Somaweera, Katie McWilliams, and Alex Stoicof from the Sustainable Development Network Information Systems Unit (SDNIS). Jim Cantrell provided design. The team is grateful for all comments and suggestions received from the regional and country specialists on disaster risk management and climate change.

© 2011 THE WORLD BANK GROUP
1818 H Street, NW
Washington, DC 20433
Internet: www.worldbank.org
Contact: Milen Dyoulgerov,
mdyoulgerov@worldbank.org

This volume is a product of the World Bank Group. The World Bank Group 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 judgement on the part of the World Bank Group concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

All rights reserved.



GFDRR
Global Facility for Disaster Reduction and Recovery

CLIMATE
INVESTMENT FUNDS



CAMBODIA