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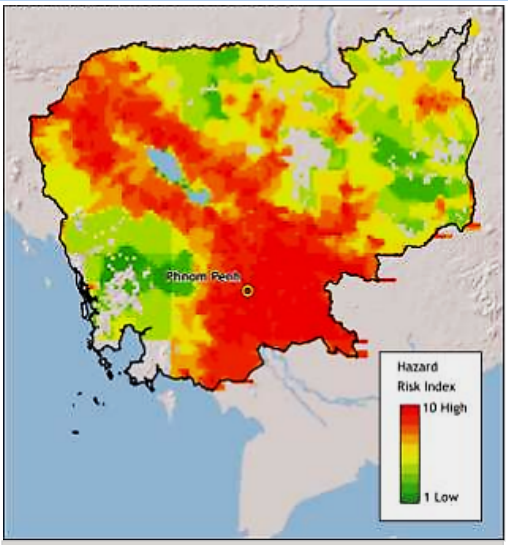
FACT SHEET

CLIMATE RISK PROFILE
CAMBODIA

COUNTRY OVERVIEW



FLOOD MORTALITY RISKS AND DISTRIBUTION: 1981-2000

Cambodia is endowed with a rich natural resource base, essential for livelihoods and food security, and threatened by changing climatic conditions. Driven by strong performance in the garment and tourism sectors, Cambodia experienced sustained high Gross Domestic Product (GDP) growth rates from 1994 to 2015 (average of 7.5 percent), which in turn saw the poverty rate decline sharply from 2007 to 2014 (from 48 percent to 14 percent). Cambodia has a robust informal economy, which provides employment for nearly 60 percent of Cambodians. Still, changing climatic conditions present an ongoing threat to achievement of the county's sustainable development goals. In 2015, adverse climate impacts resulted in losses of approximately $1.5 billion, equivalent to 10 percent of annual GDP. The country is particularly challenged given low adaptive capacity, still prevalent poverty, and its geographic location in the Mekong River and Tonle Sap Basins. These basins are characterized by a flood-pulse hydrology with significant fluctuations in water levels between wet and dry seasons. In the wet season, the Tonle Sap Lake's surface area increases from 2,500 square kilometers (km^2) to 12,500 km^2. The flood-pulse system supports flooded forests, grasslands, and wetlands as well as one of the world's most diverse and productive inland fisheries. It also largely supplies the country's freshwater resources for agriculture. Agricultural and fishery activities comprise about 27 and 12 percent of GDP respectively and are essential for food security and livelihoods. Increased temperatures, drought, and changes in seasonal rainfall patterns, in combination with extensive damming for hydropower throughout the Mekong Basin, threaten to impact food security and human health through reduced freshwater availability and, in turn, agricultural and fishery production. Cambodia further experiences extreme weather events such as flash floods following particularly heavy rainfall during monsoon season (May to October), as well as tropical storms such as 2009's Typhoon Ketsana, which impacted 180,000 households and caused 43 deaths and many injuries. (2,5,6,8,17,26,30,32,36)

CLIMATE PROJECTIONS

- 1.0– 2.6° C increase in temperatures very likely by 2050
- Longer periods of drought
- More frequent tropical storms
- Rising sea levels and saline intrusion of key freshwater resources

KEY CLIMATE IMPACTS

Agriculture and Food Security
Reduced crop yields
Reduced agricultural land
Decreased food security

Water Resources
Decreased water quality for drinking
Limited freshwater availability
Unpredictable changes in water flow

Human Health
Increased heat stress
Reduced water and food supply
Increased water- and vector-borne diseases

Fisheries and Food Security
Reduced fish production
Decreased food security
Loss of livelihoods

Ecosystems
Loss of livelihoods
Decreased food security
Habitat and biodiversity loss

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CLIMATE SUMMARY

Cambodia has a humid tropical climate, heavily influenced by the annual monsoon season that typically begins in mid-May and lasts through the end of October. The dry season stretches from November to April, with less rain, little wind, and much lower humidity. The monsoons deliver approximately three-fourths of the country's annual rainfall and are the primary contributor to the flood-pulse so essential to the region, especially along the central alluvial plains of the Mekong and Tonle Sap Rivers that comprise roughly 80 percent of the country's landmass. Temperatures are generally consistent across the country, averaging 25˚ to 27˚ Celsius throughout most of the year, though with average annual maximum of 38˚ Celsius in April and average annual minimum temperature of 17˚ Celsius in January. Rainfall varies more widely, with average annual rainfall as low as 1400 millimeters (mm) in the central lowlands, and as high as 4000 mm near the Cardamom mountains and nearby coastal areas in the southwest. Cambodia's Eastern plains receive approximately 2000 to 2600 mm of rainfall annually though they may exceed those amounts in the mountainous areas in the Northeast within or around Virachey National Park. (10,11,29,34,36,43,45)

HISTORICAL CLIMATE

Climate trends since 1960 include the following:[1]

- Temperatures have increased by approximately 0.18˚C per decade.
- Temperatures increased most rapidly – 0.20 to 0.23˚C per decade – during the dry season (November-April).
- Temperatures during wet seasons (May-October) have increased between 0.13 to 0.16˚C per decade.
- Rainfall has increased in some areas of the country whereas other regions have not experienced statistically significant changes.
- The frequency of "hot days" increased by 46 days per year.[2] (11,28)

FUTURE CLIMATE

Projected changes include the following:

- Average annual temperatures are very likely to increase by 0.8 to 1.6 ˚C by 2030 and 1.0 to 2.6˚C by 2050.
- A 14 to 49 percent increase is projected in the frequency of "hot days" by 2060, while hot nights are projected to increase by 24 to 68 percent over the same period.
- Projections indicate that the frequency of "cold" days and nights will decrease and become increasingly rare.
- An increase in the intensity of heavy rainfall events of 1 to 15 percent by 2050 is very likely. However, projected changes in average annual precipitation are uncertain by 2030, though likely positive (0 to 6 percent) by 2050.
- Climate changes are projected to result in a potentially shorter, or shifted, rainy season by 2085, with drier conditions in April and May and wetter conditions in October and November. (28)

[1] Climate trends are from 1960 to 2003.

[2] A "hot day" is defined as a day when the daily maximum temperature exceeds the 90th percentile of daily maximum temperatures over the 1960-2003 period for Cambodia.

[2] A "hot day" is defined as a day when the daily maximum temperature exceeds the 90th percentile of daily maximum temperatures over the 1960-2003 period for Cambodia.

[3] Elevated arsenic concentrations have been identified in at least ten provinces, including areas South and Southeast of Phnom Penh, Kratie

SECTOR IMPACTS AND VULNERABILITIES

AGRICULTURE AND FOOD SECURITY

The agriculture sector is extremely vulnerable to increased temperatures, changes in rainfall patterns, extreme weather events such as cyclones, drought, and flooding, as well as sea-level rise in coastal areas. Climatic changes are projected to result in shorter rainy seasons and longer and drier dry seasons, with some reports that farmers are already experiencing frequent droughts and floods, reducing crop yields and decreasing food security. In rural areas, which comprise about 98 percent of the country's total land area and are home to 77 percent of the population, about 90 percent of people are engaged in agricultural activities and 80 percent rely upon subsistence crop production. Agriculture is not only a source of livelihood for many people, but it also is essential for food security. Rice is the predominant crop and a staple of rural diets, with average yields of 9.7 million metric tons between 2013 and 2017, production comprising over 80 percent of total cultivated land nationwide, and consumption representing approximately 68 percent of daily caloric intake in rural communities. At the same time cassava has increased in prominence, with production increasing by approximately 7.5 million tons from 2002 to 2012.

Climate Stressors and Climate Risks
AGRICULTURE AND FOOD SECURITY

Stressors	Risks
Increased temperatures	Dry conditions decreasing crop production
Changes in rainfall patterns	Damaged or degraded agricultural land, particularly rice cultivation, and infrastructure.
Increased frequency and/or duration of extreme weather events	Increases in disease and pests
Increased drought	Saline intrusion, reducing agricultural land
Increased flooding	
Sea-level rise	

Projected impacts to rice yields are uncertain, though shifts in the timing of the rainy season could have substantial adverse impact without adaptation measures. One study suggests that a failure to ensure optimal timing, cultivar, and fertilizer use in the face of shifting climatic conditions could result in as much as 9.9 percent losses in wet season yields and 7.7 percent loss in dry season yields by 2050, respectively. Because most of Cambodia's rice fields are rain-fed, with only 20 percent irrigated, the poorest farmers (typically without irrigation) are particularly vulnerable to shifts in the timing, frequency, and/or intensity of precipitation. Prolonged droughts in 2004 and 2005 affected nearly 30 percent of agricultural land in Cambodia and caused a 14 percent decrease in rice yields. Projections suggest more frequent flooding in and around the Tonle Sap as well as in the floodplain zones of the Mekong, which could increase agricultural losses already estimated at $100-170 million per year. Changing climatic conditions further expose crop production to increased outbreaks in agricultural pests and diseases. For rice crops, pest cycles may speed up and phytosanitary conditions may worsen as a result of increased periods of rain and higher temperatures. Meanwhile, drought conditions could reduce plant resistance to pests such as grasshoppers, and strong winds could accelerate the spread of those pests. These increased threats may in turn result in increased need for and cost of agricultural inputs.

Poultry and small livestock (e.g., pigs) also serve as an important source of food for many rural households, especially when rice and fish production are limited. Larger livestock are often used for ploughing and transportation. Non-climate stressors such as expansion of industrialized agriculture and mining activities are driving extensive deforestation and loss of forest cover is in turn expected to increase erosion and lead to degradation of agricultural land. Salinization further reduces the quantity and quality of available land for agriculture, with saline intrusion observed in southern provinces of Prey Veng, Takéo, and Kampot. (4,8,11,18,26,35)

WATER RESOURCES

As part of the broader flood-pulse dynamic of the Mekong River Basin system, water covers nearly 86 percent of Cambodia during the wet season. Central to Cambodia's water resources is the Tonle Sap, the largest freshwater lake in Southeast Asia and highly threatened by a combination of climatic stressors such as extended periods of droughts, changes in rainfall patterns, and storms, as well as non-climate stressors, such as overfishing, deforestation, and construction of dams throughout the Mekong Basin. Taken together, these stressors could result in alterations to the water flow. Increases in rainfall during monsoons appear likely, while rising temperatures and prolonged drought are also projected to increase evapotranspiration and decrease surface water availability. The reduced availability of surface water has increased groundwater extraction, a potential human health risk given the prevalence of elevated arsenic levels in Cambodia; more than 2 million people are potentially exposed to high levels of arsenic[3]. Water quality may also deteriorate as a function of increased sedimentation due to forest loss (from non-climate stressors and increased temperatures) and increased flooding. Such sedimentation can increase the presence of pollutants and bacteria in water and trigger algal blooms, which both pose a human health risk and adversely impact fish habitats, thus undermining food security. In coastal areas, safe drinking water is further threatened by sea-level rise, resulting in saline intrusion. Saline intrusion is also projected to increasingly impact inland waterways, which are integral for freshwater fish and rice production. In addition to drought and floods, tropical storms are expected to increase in frequency and intensity, which can cause significant damage to water infrastructure, especially in rural areas. For example, in 2011, 14 of 25 provinces reported that their water supply and sanitation systems were damaged or washed away by Typhoon Ketsana. (1,4,11,15,21,29,36)

Climate Stressors and Climate Risks
WATER RESOURCES

Stressors	Risks
Increased temperatures	Decreased food security
Prolonged drought	Alterations in flow regime and shifts in ecological functioning
Sea-level rise	Decreased availability of water for agriculture and household use (e.g., drinking water and sanitation)
More frequent and extreme tropical storms	Decrease in water quality from sedimentation
	Saline intrusion of drinking water and freshwater ecosystems
	Damage to water infrastructure

HEALTH

Higher temperatures, increased rainfall, and more extreme weather events such as tropical storms, droughts, and more frequent flooding threaten recent progress and may exacerbate ongoing health challenges in Cambodia. Health sector reforms focused on extending physical health infrastructure, expanding health financing and increasing access to services beginning in the 1990s helped strengthen the health sector and, in turn, health outcomes. Between 2000 and 2014, infant mortality in Cambodia decreased by 74 percent (from 95 deaths to 24.6 deaths per 1000 live births), while from 2005 to 2014 maternal mortality rates decreased by 64 percent, dropping from 472 deaths to 170 deaths per 100,000 live births.

While Cambodia has made significant improvement in providing comprehensive health services, many

Climate Stressors and Climate Risks
HUMAN HEALTH

Stressors	Risks
Increased temperatures	Increased heat stress resulting in illness or injury such as heat stroke, exhaustion, cramps, or rashes.
More intense and/or frequent weather events	Shifts in water- and vector-borne disease burdens
Increased and prolonged droughts	Decreased nutrition and food security
	Damage to health infrastructure
Increased rainfall and flooding	Decreased water quality impacting health, sanitation and hygiene
	Limited drinking water supply

[3] Elevated arsenic concentrations have been identified in at least ten provinces, including areas South and Southeast of Phnom Penh, Kratie Province, and Kandal Province. Kandal Province shows the highest concentrations of groundwater arsenic.

challenges still exist and may worsen due to adverse climate impacts. Maternal, child and neonatal mortality rates remain high. Increased temperatures are projected to increase heat-related conditions for at-risk groups, such as the elderly, pregnant or expecting women, young children, and infants, and deforestation is likely to lead to higher temperatures in cleared areas. Health infrastructure, such as hospitals, clinics, and cold chain storage facilities, may also be impacted by the increasing temperatures, heavy rains, and subsequent flooding, thus impacting overall patient care. Additionally, the combination of climate stressors (e.g., shift in timing of the rainy season, increased rain during the wet season, and higher temperatures) and non-climate stressors (e.g., hydropower development throughout the Mekong Basin, deforestation driven by agricultural expansion, illegal logging, and charcoal production) are anticipated to lead to impacts such as changes to the annual flooding of the Tonle Sap and degradation of agricultural land. These impacts could drive increased internal migration from rural to urban areas, which may increase stress on and constrain efficacy of urban health infrastructure, municipal waste management systems, and water supply infrastructure, all of which could adversely impact health outcomes.

These impacts could also increase the incidence of water- and vector-borne diseases, such as malaria and dengue. Longer and drier dry seasons also significantly reduce safe drinking water availability, which is already a serious issue in Cambodia. The country faces elevated arsenic levels in groundwater and high rates of diarrheal disease, the latter of which causes nearly 10,000 deaths annually and could become even more serious as a result of deforestation and degradation of watersheds[4]. At the same time, potential decreases in rice yields and fisheries production due to increasing temperatures, shifts in hydrological flow patterns, or decreases in water quality could adversely impact food security and nutrition in both the immediate and long-term, particularly for economically disenfranchised communities in both rural and urban areas. Cambodia is also experiencing more extreme weather events such as widespread flash flooding in both 2011 and 2013, and tropical storms, like Typhoon Ketsana in 2009. The 2013 flash foods affected 20 out of 24 provinces, totaling 377,354 households, and resulting in 168 deaths, while in 2011, flash flooding affected 350,000 households and destroyed 267,000 hectares (ha) of rice fields. In addition to direct injury or death, such events further damage essential health services infrastructure, as well as result in the displacement of people, increased standing water, additional strains on food and water supply, and increased risk of the spread of vector- and waterborne diseases. (3,5,10,24,37,39,40)

FISHERIES AND FOOD SECURITY

Climate change is expected to significantly impact inland fisheries in Cambodia, and thus food security throughout the country since fish consumption accounts for 80 percent of animal protein consumed by Cambodians. The sector comprises approximately 12 percent of GDP and is particularly important to rural livelihoods; fishing activities provide more than 50 percent of their annual income. The Tonle Sap's fishery, alone, accounts for 7 percent of national GDP and 98 percent of those living in the Tonle Sap floodplains are involved in some form of fishing activity. However, the combination of climate stressors, such as increased rainy season precipitation and decreased dry season precipitation, could result in hydrological changes in the Mekong and Tonle Sap River Basins leading to many impacts to fisheries, both positive and negative. For example, a projected 21% increase in runoff by 2030

Climate Stressors and Climate Risks
FISHERIES AND FOOD SECURITY

Stressors	Risks
Increased temperatures	Decreased production and diversity of species found in fisheries
Drought	Habitat degradation or loss for fish, other aquatic animals, and aquatic plants
Increased rainfall and flash floods	Wetland loss
Extreme weather events	Unpredictably of water levels
Sea-level rise	Loss of fishing infrastructure
	Reduced freshwater availability

[4] The condition of upstream watersheds has been shown to predict the health of children downstream. Specifically, rates of diarrheal disease in children living in rural areas are lower in areas with intact upstream watersheds.

could increase sedimentation and result in improved availability of nutrients and increasing fish productivity, while increased flooding during the wet season could extend feeding grounds likewise increasing production. On the other hand, the climate variability could amplify an emerging boom-and-bust cycle of fish catches, with years of large catch followed by shortages. Increased seasonal variability in rainfall, with wetter wet seasons that may boost inland fish production and drier dry seasons, which may threaten fish stocks, make it increasingly difficult for fishing communities to effectively adapt. This is especially problematic since those that rely upon fishing as their primary livelihood are predominantly without resources to pursue alternative income- or food-generating activities. Hydropower dam development throughout the Mekong Basin complicates the dynamics, with a good deal of uncertainty regarding how the interaction of these developments and climate change will impact hydrological flow patterns, sedimentation loading and retention, and overall year-on-year variability. Additionally, increased temperatures are projected to impact fish reproduction, growth, and migration patterns. Those temperature increases, combined with shifts in precipitation patterns and decreases in dry season precipitation, can further lead to degradation of wetland habitat and increase susceptibility of the wetland areas to spread of the fires commonly set for agriculture and hunting. For example, in 2016, the Tonle Sap region experienced a record-breaking El Niño, which led to drought, heat waves, and low water levels, and fostered unprecedented spread of wildfires in the area with an estimated 640,000 ha—approximately a third of the flooded forest area—impacted. Wetland habitats and freshwater quality are further threatened by projected rises in sea-level as increased salinity could impact the health of mangrove or freshwater ecosystems, affecting availability and/or quality of nutrients to support fisheries. Finally, extreme weather events could further threaten the fishing industry in Cambodia by destroying fishing infrastructure, specifically equipment owned and operated by rural households. (4,7,13,14,25,31,32,36,37)

ECOSYSTEMS

Much of Cambodia's wealth is present in its diverse ecosystems, which provide critical services essential to livelihoods, health, and economic development. However, these ecosystems are threatened by the adverse effects of climate change combined with numerous non-climate stressors. Cambodia has extensive forest resources, with one of the largest areas of contiguous and intact forests in Southeast Asia, and the largest percentage of primary forest remaining among Lower Mekong countries. Cambodia's forests include moist lowland evergreen, semi-evergreen, deciduous, and mangroves, and are vital for biodiversity and ecosystem services such as maintenance of freshwater supply as well as soil quality and cover. Since 2000, approximately 2 million ha (equivalent to roughly 23 percent of Cambodia's forests) have been lost due to the expansion of industrial agriculture, mining activities, and other non-climate drivers, such as illegal logging[5], firewood, and charcoal production; over 84 percent of Cambodian households meet their energy needs through firewood sourced from nearby forests. Increased temperatures and changes in precipitation patterns have the potential to influence and degrade the composition of the forest and reduce overall forest productivity. In upland forest systems, shifts in precipitation patterns and increased temperatures will accelerate degradation from agricultural expansion, illegal logging, and charcoal production. Extreme weather events, such as heavy rainfall or increased intensity of tropical storms, combined with upland deforestation could result in increases in downslope sedimentation of surface water bodies or increased risk of landslides for downslope populations.

Climate Stressors and Climate Risks ECOSYSTEMS

Stressors	Risks
Increased temperatures	Loss of key ecosystem services
Prolonged drought	Decreased biodiversity and decreased tourism potential
Increased rainfall	Deforestation, including increased risk of forest fires
Extreme weather events	Reduced water quality from soil erosion and sedimentation
	Saltwater intrusion of freshwater ecosystems

[5] Illegal logging activities are exacerbated by corruption, among other causes, supporting the black market for timber and illegal timber export. In 2018, the murder of three environmental activists was linked to the national army, which has also been implicated in illegal logging activities. In the past, the deaths of environmental actors or forest rangers would often not be investigated.

In the Tonle Sap, climate stressors -- especially prolonged drought -- combined with illegal fishing and upstream hydropower development are damaging this vital freshwater ecosystem, with fish stocks substantially decreased in drought years and nutrient loads threatened by development. In Cambodia's Eastern Plains, as well as parts of the Prey Lang landscape, increased temperatures present significant risk, with projected increases as great as 4 to 6˚C by 2050. Such dramatic increases in temperature would have substantial impact on non-timber forest products, could result in tropical forest dieback or changes in rainforest or monsoon forest health, and may lead to changes in the frequency or intensity of wildfires and pest outbreaks. Elsewhere, Cambodia's southern mangroves, which host and protect marine and coastal ecosystems through coastline stabilization and protection for reefs and sea grass meadows, are heavily threatened by sea-level rise, industrial dredging, and flooding. These climate and non-climate stressors impact the amount of sediment reaching the mangrove systems while inundating them with sand, ultimately killing mangroves. These impacts may also lead to beach recession, which could in turn result in further vulnerability of mangrove and coastal ecosystems to inundation of sand and greater exposure to increasing wave energy. (9,11,12,21,23,36,41,44)

POLICY CONTEXT

Since ratifying the United Nations Framework Convention on Climate Change (UNFCCC) in 1995, the Royal Government of Cambodia approved of the Kyoto Protocol in 2002 and has submitted two national communications to the UNFCCC, most recently in 2015. Additionally, the Cambodia Climate Change Strategic Plan 2013-2023 (CCCSP) provides an overall framework for climate change response and integration of climate change issues into development planning at national and sectoral levels. As a result, the Strategic National Development Plan 2014-2018 (NSDP) has made climate change a cross-cutting issue, with the goal of mainstreaming climate change as an essential part of development efforts in Cambodia. Sectoral Climate Change Action Plans were also developed to support goals outlined in the CCCSP. Furthermore, the National Climate Change Action Plan 2014-2018 defines the concrete actions and resources needed for the operationalization of the Ministry of Environment's response to climate change. While many strong policies are now in place, effective implementation has been problematic. (11,16,18,20,24)

INSTITUTIONAL FRAMEWORK

The Royal Government of Cambodia instituted the National Council for Sustainable Development (NCSD) in 2015 to oversee and manage the preparation, coordination and monitoring of the implementation of policies, strategies, plans and programs related to climate change. The NCSD, chaired by the Minister of Environment, developed the Climate Change Action Plan 2014-2018 andcreated the Climate Change Financing Framework to portion funds specifically for addressing issues related to climate change. (11,18,20,22)

NATIONAL STRATEGIES AND PLANS

- Second National Communication to the UNFCCC (2015)
- National Adaptation Programme of Action (2006)
- Royal Government of Cambodia Climate Change Strategic Plan (2013)
- Royal Government of Cambodia Climate Change Action Plan (2016)
- Climate Change Financing Framework (2015)

KEY RESOURCES

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SELECTED ONGOING EXPERIENCES

Selected Program	Amount	Donor	Year	Implementer
Supporting Forests and Biodiversity	$24,807,151	USAID	2012-2018	Winrock International
Feed the Future-Rice Field Fisheries Phase II	$7,000,741	USAID	2016-2021	WorldFish
Water, Sanitation and Health Finance (WASH-FIN) Cambodia	$40 million	USAID	2017-2020	Tetra Tech
Greening Prey Lang	$21 million	USAID	2018-2023	Tetra Tech
Sustainable Water Partnership	$3 million	USAID	2017-2021	Winrock International