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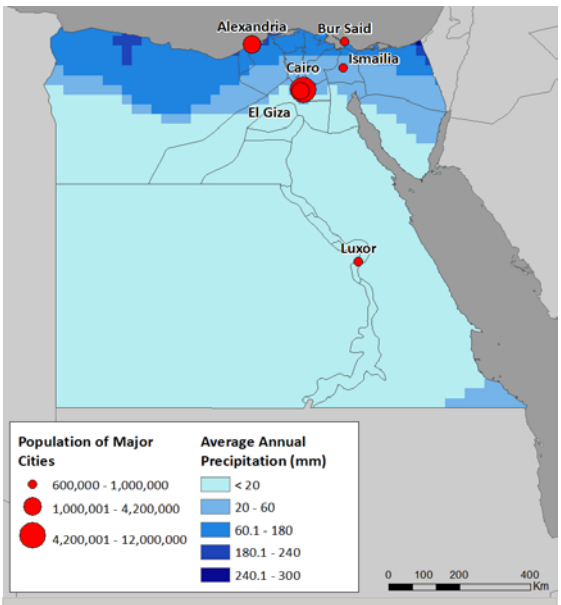
FACT SHEET

CLIMATE RISK PROFILE
EGYPT

COUNTRY OVERVIEW



ANNUAL PRECIPITATION IN EGYPT

Throughout Egypt's extensive history, its inhabitants have relied heavily upon the Nile and the productive agricultural sector it nurtures. Modern Egypt has one of the most diversified economies in the Middle East, with robust service, manufacturing, agricultural, and tourism sectors. However, Egypt's dependence on the Nile River for 95 percent of its freshwater leaves the country vulnerable to climate shocks and transboundary water conflict. Egypt shares land borders with Libya to the West, Israel and the Gaza Strip to the East, and the Sudan to the South. Egypt's relationship with Ethiopia, home to the source of the majority of the Nile River's flow, is both critical and strained. Egypt has undergone two significant political transitions since 2011, and the current government is engaged in significant development-oriented reforms including a massive land reclamation project known as the "1.5-Million Feddan Project," which seeks to draw water from aquifers and divert water from the Nile River to convert desert area into productive land. The upstream construction of the Grand Ethiopian Renaissance Dam, will further divert the Nile's water, implicating Egypt's water security. Other reforms include efforts to improve the social safety net, decrease the public debt, and increase economic growth and employment. High rates of inflation, increases in food prices, high unemployment, and a poverty rate of 25 percent continue to plague the economy, despite recent healthy growth in gross domestic product (GDP). Further, Egypt's economy remains sensitive to climate shocks due to its reliance on the Nile and the important role of agriculture in the Egyptian economy. Through its long-recorded history, Egypt has been vulnerable to climatic changes, resulting in famine and political unrest during periods of drought. (4,14,17,27,28,30,33,34)

CLIMATE PROJECTIONS

- Decrease in precipitation and likely increase in droughts
- 2°C-3°C increase in annual temperatures by 2050 and increased duration of heat waves
- 3 centimeter (cm) to 61 cm rise in sea levels by 2085

KEY CLIMATE IMPACTS

Agriculture
Reduced crop yields
Increased food insecurity
Livestock losses

Water
Changes to Nile River flow
Increased water demand
Increased transboundary tensions

Human Health
Increased heat stress
Increased rates of respiratory diseases
Death and injury due to storms

Tourism
Damage to antiquities
Increased beach erosion
Coral reef loss

Coastal Resources
Salt water intrusion in farmland
Erosion and intensified flooding
Fisheries decline

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CLIMATE SUMMARY

Egypt's climate ranges from semiarid in the north, with 50 millimeters (mm) to 200 mm of rainfall per year, to hyperarid in the south and interior which receives about 1 mm of rain per year and in some years there will be no annual precipitation. Egypt has two dominant seasons, a mild winter (November to April) and a hot summer (May to October). Months with the highest average rainfall across the country are December, January, and February, while April through November receive less than 3 mm average monthly rainfall. Average annual temperature is lowest in the Sinai Peninsula highlands (20°C), and highest in the southern interior near Aswan (26°C). The Nile Delta, home to most of the Egyptian population, has an average annual temperature of 21°C. While summertime daily maximum temperatures along the coast in Alexandria are typically around 30°C, they are around 41°C in Aswan. Average winter daily maximum temperatures in Alexandria and Aswan are 18°C and 23°C, respectively. Hot wind storms, known in Egypt as "khamsin", carry sand and dust swept from across the northern coast of Africa, Such storms, which typically occur between March and May,can increase the temperature by 20°C in two hours, and they may last for days. (9,14,30,33)

HISTORICAL CLIMATE

Climate trends include:

- Average decrease in total annual precipitation of 6 percent per 30 year-period from 1901-2013, with significantly higher decrease of 22 percent in total annual precipitation from 1983-2013.
- Decreases in precipitation are strongest in the winter and early spring months.
- There is evidence of increased frequency and severity of flash flooding in recent years
- 0.1°C per decade increase in average annual temperature from 1901-2013, increasing to 0.5°C per decade increase in average annual temperature from 1983-2013.
- Greater warming has been observed during the summer than the winter (0.31°C and 0.07°C per decade increase in average temperatures since 1960, respectively)
- Daily minimum temperatures have increased throughout Egypt, with fewer cool nights and more warm nights since 1960. (14,30,33)

FUTURE CLIMATE

Projected changes include:

- Increase in mean annual temperature of between 2°C to 3°C by 2050, with highest increases in the summer months of July-September and more rapid increases in the interior regions
- Projections for sea level rise[1] in the Nile delta suggest an increase of between 3 cm and 61 cm by 2085 with increases in Alexandria of between 20 cm and 82 cm.
- While projected extent of precipitation changes remains highly uncertain, there is a general tendency toward slightly drier conditions in most months by 2050. Projected drying is strongest in the dry months of June-October
- Increase in heavy rains, and potential increase in drought, particularly due to increased temperatures by 2050
- Increased intensity and frequency of dust storms and sand storms
- Significant increase in duration of long-lasting heat waves, with likely increase in duration of between 9 to 77 days by 2085
- Decrease in duration of long-lasting cold spells, with likely decrease in duration of 3 to 6 days by 2085. (14,30,33)

[1] Significant land subsidence adds to increases in the Mediterranean Sea level

SECTOR IMPACTS AND VULNERABILITIES

WATER RESOURCES

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Increased temperatures	Increased variability in Nile River flow
	Increased water demand
Changes in precipitation	Decreased water availability for irrigation, drinking, and energy generation
Increased drought	Decreased hydropower supply
	Increased domestic and transboundary water conflict

Because rainfall is scarce in much of Egypt, the Egyptian population and economy rely on the Nile River for about 95 percent of all water needs. There is significant uncertainty regarding the anticipated impacts of climate change on the flow of the Nile River. Some studies suggest increased evaporation due to rising temperatures could decrease water availability in the Nile River by up to 70 percent, while other studies suggest the projected increases of rainfall in the Ethiopian highlands and Blue Nile River Basin could increase flow by 15 to 25 percent. With the Nile River's sources located outside Egypt, the country is highly vulnerable to changing climate conditions and shocks both within and outside its borders. Given uncertainties in future flow, there is need to prepare for potential changes in both flood and drought incidence in Egypt. The vast majority of the Egyptian population lives in close proximity to the Nile River, leaving them highly exposed to floods. The urban poor and marginalized communities are particularly vulnerable to flood impacts. Projected increases in temperature and potential decreases in rainfall throughout Egypt will likely increase water demand, particularly by the agricultural sector, which consumes about 80 percent of all freshwater resources. Increases in water demand are likely to be exacerbated by significant population increases both within Egypt, which is expected to be home to 111 million people by 2025, and in the countries along the Nile River, which are expected to host around a billion people by 2050. This combination of population growth and increased water demand could result in increased internal conflict among water uses. Such conflict would likely disproportionately affect women, who often have limited power in decision-making and can be exposed to greater risk of physical and sexual violence (e.g., when traveling farther distances to access water). Additionally, planned dams upstream of Egypt, which are expected to provide a large amount of clean energy for the continent, also have the potential to significantly cut flow of the Nile River to Egypt. This could impact not only agricultural, industrial, and domestic water uses, but also cut hydropower generation at Egypt's Aswan dam. Thus, the interaction of climatic and international pressures on the Nile River have the potential to not only affect economic activity and water availability in Egypt but also to raise tensions within Egypt and among Egypt's neighbors. (4,7,8,9,10,27,33,35)

AGRICULTURE

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Increased temperatures	Increased water demand
	Reduced crop yields
Increased drought frequency and duration	Changing incidence of plant pathogens
	Increased livestock disease and mortality
	Loss of agricultural employment
Changes in rainfall patterns	Decreased water availability for irrigation
Sea level rise	Salt water intrusion
	Loss of arable land

The fertility of the Nile Basin has allowed for robust agriculture along the river's banks for millennia, and agriculture remains an important part of the Egyptian economy. Agriculture accounts for 12 percent of the GDP and around 30 percent of employment in Egypt, with many more engaged in informal or unpaid agriculture work, particularly women. However, only 2.8 percent of Egypt's land is arable, largely in areas along the Nile and some oases in the Sinai Peninsula. Egypt's agriculture is predominantly irrigated and almost entirely dependent on the flow of the Nile River, with a small fraction of water sourced from aquifers. Increases in temperature and decreases in the already limited rain are likely to result in an increase in water demand for all crops produced in Egypt. The increased water demand combined with increased variability and potential overall decreased flow of the Nile River leave agriculture

particularly vulnerable to changing climate conditions. Further, as most of Egypt's agriculture takes place in the Nile Delta, which is below sea-level and sits along the coast of the Mediterranean Sea, sea level rise has the potential to impact yields. Water with elevated salinity will likely penetrate far into the delta, potentially leaving current cropland unsuitable for production and significantly affecting fisheries in the lakes in and around the delta. Increasing temperatures and changing precipitation patterns will have different impacts for Egypt's primary crops. Cotton yields, for example, could increase by around 20 percent by 2060 largely due to the impact of increasing temperatures lengthening growing seasons, while yields for crops such as wheat, rice, maize, and citrus could decrease between 10 percent and 20 percent over the same time horizon. Changing incidence of plant pathogens due to changing rainfall patterns and increased temperatures could also affect crop yields. Livestock rearing, which is dominated by cattle, water buffalo, sheep, and goats, may be impacted by increases in heat stress and climate-related changes to the distribution of diseases such as Rift Valley fever and bluetongue disease, both of which have already negatively impacted production. Decreased agricultural and livestock productivity would affect employment in the agricultural sector and potentially increase prices of agricultural products in Egypt. While some producers could benefit from increased prices, this could also decrease the purchasing power of Egyptian consumers, increase food insecurity, and potentially heighten domestic tensions. These impacts could disproportionately affect women and increase their risk to gender-based violence. (1,4,8,9,12,24,33)

HEALTH

The anticipated increase in extreme weather events, particularly heat waves, dust storms, and storms along the Mediterranean coast, are likely to have a significant impact on human health in Egypt. The urban poor are at particularly high risk to such impacts. Heat stress already results in increased mortality, with over 100 deaths recorded in 2015 due to extreme summer heat waves. The combination of increasing temperatures and longer heat waves can be expected to increase heat-related deaths, particularly among the elderly, for whom mortality could increase from the baseline of 1 death per 100,000 to 47 deaths per 100,000 by 2080. Increased heat stress could also affect labor productivity, particularly for workers carrying out heavy labor (e.g., agricultural and industrial workers). The intensity and frequency of dust storms and sand storms, already a common feature of Egyptian weather, are likewise expected to increase with climate change. Such dust and sand storms are associated with numerous infectious diseases (e.g., influenza and pneumonia) and non-infectious diseases (e.g., asthma and pulmonary fibrosis) and pose significant respiratory health risks to children, the elderly, and those with chronic cardiopulmonary diseases. Similarly, projected increases in heavier rainfall and potential increases in inland river flooding, which already affects nearly 1 million people annually as of 2010, may cause acute health impacts through injury and drowning, and result in longer-term health impacts through decreased food security, decreased drinking water quality, and an increase in waterborne and vector-borne diseases. Malnutrition and water scarcity will likely have greatest impact on marginalized and vulnerable groups, particularly women and young children. Women are at greater risk of anemia due to malnutrition, and they also experience increased burden during water scarcity due to their responsibility for collecting and managing household water supplies. Egypt has made significant progress in decreasing the prevalence of vector- and waterborne diseases, and deaths due to diarrheal disease are expected to continue to fall, even with climate change. However, climate change threatens to slow that progress. (3,8,9,22,25,35)

Climate Stressors and Climate Risks HUMAN HEALTH

Stressors	Risks
Increased temperatures	Increased heat stress
More frequent and/or intense dust and sand storms	Increased cardiopulmonary disease
Increased drought and flooding	Increased injury and mortality from flooding and storms
Sea level rise	Potential increase in vector-borne disease
	Decreased nutrition and food security
	Reduced water quality and availability

TOURISM

Climate Stressors and Climate Risks TOURISM	
Stressors	Risks
Increased temperatures	Damage to ancient monuments and antiquities
Changing rain patterns	Potential for coral reef deterioration in the Red Sea
Increased flooding	Increased beach erosion
Sea level rise	Damage to tourism infrastructure

Tourism is a key economic sector in Egypt, and widespread economic impacts result from tourism downturns. Millions of tourists travel to visit Egypt's ancient monuments, beaches, and coral reefs. Increasing temperatures and changing rainfall patterns threaten the longevity of Egypt's primary draw for tourism, its famous ancient Egyptian palaces, temples, monuments, and artifacts. For example, Luxor, the home of Pharaonic tombs and many of Egypt's antiquities and treasures, traditionally has a dry and predictable climate, ideal for the preservation of antiquities. However, increased rains, temperature, and humidity, interacting with increasing population may damage structures that have survived for millennia. Increasingly frequent rain events in Egypt's dry interior have eroded mud-brick structures and have the potential to flood archeological sites. Increased temperatures have hampered official archeological excavation, and the heat has resulted in the cracking of granite structures in Aswan, damaging ancient inscriptions. The speed of temple deterioration increased following the Aswan dam, combined with year-round agriculture. Temples suffer from rising levels of ground water and increased humidity from evaporation, leading to salt crystallization and eventually shattering temple sandstones. Egypt's warm climate and location along two warm water seas also make it an attractive beach destination. However, erosion and inundation of beaches affected by sea level rise and coastal storms may adversely impact the attractiveness of Egypt as a beach destination. Sea level rise can also impact coastal tourism infrastructure and hotels. Nearly half of the area dedicated to the tourism sector in Alexandria's tourism industry could be underwater with only 0.5 meters of sea-level rise. Warming in the Red Sea is expected to exceed the global rate of oceanic temperature change. As temperature increase would contribute drives coral bleaching, warming seas would reduce the recreational appeal of coral reefs. Degradation of many of the tourism attractions in Egypt has the potential to discourage visitors and shrink the tourism sector. (5,8,9,11,15,16,26,29)

COASTAL ZONES

Climate Stressors and Climate Risks COASTAL ZONES	
Stressors	Risks
Sea level rise	Damage to coastal infrastructure
Increased temperatures	Salt water intrusion
	Reduced tourism industry
Increasing storms and storm surge	Loss of agriculture and fishery productivity

A little over one third of Egypt's coast runs along the Mediterranean Sea, with the remainder stretching along the Red Sea and the Gulfs of Suez and Aqaba. The coasts are particularly vulnerable to sea level rise, salt water intrusion, and coastal storms, all of which affect sustainability of the abundant natural resources (both biological and mineral), maritime transport arteries, infrastructure, and population centers. With limited social mobility and adaptive capacity, women and their livelihoods have increased vulnerability to these impacts. Around 15 percent of Egypt's total population is in the coastal zones, primarily along the Mediterranean Sea. The shoreline along the Mediterranean Sea has a relatively low elevation, with large swaths of the Nile Delta below sea level, leaving it especially vulnerable to sea level rise. In addition to major population centers, such as Alexandria, Rosetta, Damietta, Port Said, Suez, and Hurghada, coastal zones host a large proportion of industrial activities, particularly in the petroleum and chemical sectors. Inundation due to sea level rise and coastal storms therefore threatens lives, property, environmental health, and the structural integrity and functioning of critical infrastructure. The inundation combined with salt water intrusion threatens agriculture in the coastal areas along the Nile Delta. Saltwater intrusion may also significantly impact important fisheries. For example, saltwater combined with potential decreases in Nile River flow, may result in increased salinity of the lakes in and around the Nile Delta, making these habitats unsuitable for many types of fish. These impacts, along with increasing temperatures, are expected to affect breeding grounds and food chains for fish and other marine life, particularly in the coastal wetlands. The effects of sea level

rise, increased coastal storms, and increasing temperatures on beaches, biodiversity, and coral reefs are likely to have a significant negative impact on tourism and Egypt's broader economy. (2,8,9,13,16,19,21,33)

POLICY CONTEXT

Egypt lacks a comprehensive legal framework for climate change adaptation and mitigation, and implementation of climate policies is split among multiple institutional bodies. However, Egypt has taken several actions toward both climate mitigation and adaptation through isolated projects, such as an effort to transition El Gouna City to carbon neutrality, and through several strategies and institutions dedicated to climate adaptation. For example, the Egyptian Cabinet released a National Strategy for Adaptation to Climate Change in 2011, and, in 2013, the Ministry of Water Resources and Irrigation developed a climate change strategy targeting adaptation and increasing water use efficiency. Gender considerations in the context of climate change have received significant attention from the government, with the Egyptian Environmental Affairs Agency releasing a National Strategy on Mainstreaming Gender in Climate Change in Egypt. The country has also been active in the international climate policy arena and was an early signatory of the UN Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement. Although Egypt's individual adaptation plans and policies are relatively robust, implementation of these policies faces significant barriers. Other development priorities often command more resources and attention from the government. (6,8,20,31,32)

INSTITUTIONAL FRAMEWORK

Implementation of climate initiatives is split among two institutions: the Egyptian Environmental Affairs Agency (EEAA) and Ministry of State for Environmental Affairs. The first climate unit was established in the EEAA in 1992. This later evolved into the Central Department for Climate Change. A National Committee of Climate Change was established in 1997 to coordinate climate-related actions among various institutions, with EEAA serving as chair. The Ministry of Water Resources and Irrigation (MWRI), the Ministry of Agriculture and Land Reclamation (MALR), the Ministry of Electricity and Energy (MOEE) and the New and Renewable Energy Authority have roles in the implementation of climate adaptation and mitigation policies. (6,17,19)

NATIONAL STRATEGIES AND PLANS

- Sustainable Development Strategy: Egypt Vision 2030 (2016)
- Egypt Third National Communication Under the United Nations Framework Convention on Climate Change (2016)
- Egypt Intended Nationally Determined Contribution (2015)
- Proposed Climate Change Adaptation Strategy for the Ministry of Water Resources & Irrigation in Egypt (2013)
- National Strategy for Mainstreaming Gender in Climate Change in Egypt (2011)
- Egypt's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction (2011)
- National Environmental, Economic, and Development Study for Climate Change (2010)
- Promulgating the Environmental Law and its Executive Regulation (1994)

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[2]This "Key Resources" section lists works cited in preparing the Climate Risk Profile.

SELECTED ONGOING EXPERIENCES[3]

Selected Program	Amount	Donor	Year	Implementer
Enhancing Climate Change Adaptation in the North Coast of Egypt	$105.2 million	Green Climate Fund, UNDP	2017-2024	Egypt Ministry of Water Resources and Irrigation
Sustainable Agriculture Investments and Livelihoods Project	$86.9 million	Global Environment Facility	2014-2023	Ministry of Agriculture and Land Reclamation
Building Resilient Food Security Systems to Benefit the Southern Egypt Region	$6.9 million	World Food Programme	2013-2018	Ministry of Agriculture and Land Reclamation and Ministry of Environment
Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management	$16.9 million	Global Environment Facility, UNDP	2009-2017	Ministry of Water Resources and Irrigation
1.5 Million Feddan Project	$2.3 billion	N/A	2014-2030	Ministry of Agriculture and Land Reclamation
Third Fiscal Consolidation, Sustainable Energy & Competitiveness DPF	$1.15 billion	World Bank	2017-2019	Ministry of International Cooperation
EG-Enhanced Water Resources Management	$8.4 million	World Bank	2012-2016	Ministry of Water Resources
Feed the Future Egypt Food Security and Agribusiness Support	$23 million	USAID	2015-2020	Culturing New Frontiers in Agriculture
Egypt Utilities Management	$30 million	USAID	2014-2019	GoE Holding Company for Water and Wastewater
Groundwater Lowering Projects	$14.8 million	USAID	2011-2018	American Research Center in Egypt, Camp Dresser & McKee/Smith, Government of Egypt: National Organization for Potable Water and Sanitary Drainage
Egyptian-German Joint Committee for Renewable Energy, Energy Efficiency and Environmental Protection		GIZ	2015-2019	Ministry of Electricity and Renewable Energy
Water Management Reform Programme		GIZ	2015-2018	Ministry of Agriculture and Land Reclamation

[3] This "Selected Ongoing Projects" section lists a selection of ongoing development projects and interventions directly or indirectly relevant to climate risk management and adaptation in Egypt. Projects were identified primarily via desk review of USAID, multi-lateral development bank, and other international donor programming. Projects listed are not meant to be comprehensive.