Climate Centre

Country-level | Climate fact sheet

Egypt

1. Country overview

Figure 1: Map of Egypt. Source: maps.google.com

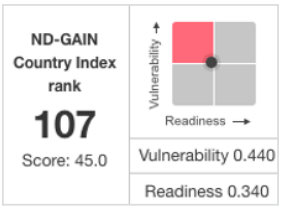

Figure 2: Egypt's ND-GAIN Ranking (ND-GAIN 2021).

Egypt, located in north-eastern Africa, is bordered by Libya to the west, Sudan to the south and Israel to the north-east. It also borders the Mediterranean Sea to the north and the Red Sea to the east. As of 2019, Egypt was home to 100,388,000 people (World Bank n.d.). In 2017, 11.7 per cent of the country's gross domestic product (GDP) came from the agricultural sector; 34.3 per cent from industrial production (a wide variety including textiles, chemicals, cement, pharmaceuticals etc.); and 54 per cent from the service sector (Central Intelligence Agency (CIA) n.d.).

Egypt ranks 107 out of 181 countries in the Notre Dame Global Adaptation Initiative (ND-GAIN) Index. The Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. This ranking indicates that Egypt has high vulnerability levels and low levels of readiness to adapt to climate change (ND-GAIN n.d.).

1.1 Climate

Egypt generally has a very dry, desert climate. There is very little rainfall in most of the country and no significant rainy season, as rainfall occurs irregularly (International Research Institute for Climate and Society (IRI) n.d.). The northernmost part of the country receives the most rainfall, about 200 millimetres (mm) per year, while the southernmost part receives nearly 0mm per year (Yassen *et al.* 2020).

Summer temperatures can be extreme in desert areas from June–August, with daytime temperatures exceeding 40°C in many places and dropping to about 25°C at night. Temperatures tend to be less extreme in the north and along the coast, with a maximum of about 32°C (IRI n.d.; Yassen *et al.* 2020).

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Most of Egypt's population lives along the Nile River or along the northern coast. Surface water from rivers is a main source of water, as well as groundwater from underground aquifers (Yassen *et al.* 2020). Rain falls along the coast during the mild winter, and the Khamsin Wind brings dust-storms in the spring (World Bank Group n.d).

1.2 Climate change

Historical climate	Projected climate
Temperature	
Temperatures have risen in Egypt over the last century, and most places in the country are about 1°C hotter now than they were 100 years ago (IRI n.d.).	Average temperatures will continue to increase with time, reaching more than 2°C higher than present day by the end of the century (World Bank Group n.d.), Extreme temperatures are expected to continue to rise in Egypt over the coming century. By the end of 2100, the hottest day per year could be 3–8°C hotter than it is now, assuming unmitigated climate change (World Bank Group n.d.).
Precipitation and water	
With very little rainfall (and very variable rainfall) across the country, there are few detected trends for rain in the past. There are also no significant trends in Nile River flows over time due to changes in climate or rainfall, although there have been wetter and drier decades over time in the Blue Nile Basin (Taye *et al.* 2015). Because temperatures have increased, evaporation has also increased everywhere in the country, especially in the summer. The most dramatic increases have happened in the south-east (Yassen *et al.* 2020).	Sea level rise is a threat to the coastal population of northern Egypt. The future of the Nile under climate change is uncertain. Some studies project a decline of up to 70 per cent and others an increase of around 15 per cent (USAID 2018; Taye *et al.* 2015) One study suggests that inter-annual fluctuations may also significantly increase (Siam and Eltahir 2017). Sand- and dust-storms may become more common due to increased desertification and drought (UNEP 2016).

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2.Humanitarian sectors and climate change

2.1 Water and habitat

Water

Egypt is considered to be a particularly water scarce country. The country's current water shortage nears 13.5 billion cubic meters (m^3) per year, and this gap is expected to increase significantly in the coming years, due to increased demand and decreased supply (Omar and Moussa 2016). This deficit is partially met through recycling treated sewage, used water from agriculture, and industrial effluent (Omar and Moussa 2016). An additional three billion m^3/year of water is supplied by the Al Salam canal project which brings water from the Damietta tributary of the Nile (Othman *et al.* 2012; Michigan State University (MSU) 2014). Lake Nasser – the man-made lake on the Nile, where the country's largest hydrodam lies (called the Aswan Dam) – has a storage capacity of 160 × 109 m^3 of water (El-Shabrawy 2009). The aquifer of the Nile Delta is one of the largest in the world (El Kiki 2018). Increased pumping of the shallower sections are raising concerns over salinization and aquifer depletion and the search for deeper groundwater resources (Engelen *et al.* 2018). A massive land reclamation project called the 1.5 Million Feddan Project, which began in 2015, is an attempt to convert 1.5 million acres of desert land into arable land by diverting water from the Nile and drawing from groundwater sources (Elmansy *et al.* 2020). There are risks to the viability of this project due to changes in precipitation and groundwater recharge, as well as uncertainty about both of these trends (Elmansy *et al.* 2020).

Most of the country is classified as a hot desert climate (or BWh under the Köppen–Geiger classification – one of the most widely used climate classification systems that divides climates into five main groups), with an average of less than 80mm of precipitation/year. Even the wettest part of the country, around the city of Alexandria, only receives less than 200mm of precipitation annually (Climate-Data.org n.d.).

Egypt is highly dependent on the resource from the Nile river which is its only permanent river – 95 per cent of total domestic consumption comes from this river, which crosses ten countries from Zambia northwards, making Egyptian water management a highly transboundary issue[1]. The country is, therefore, particularly vulnerable to any shocks to this extensive hydrological system and any increased pressure on the resources. This pressure is already occurring; models are projecting a population of up to a billion in the countries through which the river flows (USAID 2018). The population of Egypt itself is projected to double by 2078 (World Population Review n.d.).

Researchers are still debating the future of the Nile under climate change scenarios. It is as yet unclear whether its levels will decrease significantly (some studies project a decline of up to

1 For instance, since 1959, Egypt has an agreement with Sudan that allocates 55.5 billion cubic metres (BCM)/year to Egypt. However, Ethiopia does not recognize this agreement (Kendie 1999). Construction of the Grand Ethiopian Renaissance Dam is currently underway and scientists estimate it will heavily impact the production capacity of the Aswan High Dam and Egypt's general water security (Mulat and Moges 2014).

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70 per cent) or increase (around 15 per cent) (USAID 2018; Taye *et al.* 2015). It is important to note that large amounts of uncertainty regarding population dynamics, climate scenarios and adaptation measures means that it is difficult to plan future water management (USAID 2018). For instance, many dam projects are planned higher up on the Nile, which would cut a proportion of the flow that reaches Egypt, straining water resources for domestic and commercial consumption. These projects will also impact the country's main hydroelectric dam, the Aswan High Dam which produces more than 10,042 Gigawatt hours (GWh) annually (USAID 2018; Britannica 2020).

Energy

Most of the country (99.8 per cent) is electrified (International Renewable Energy Agency (IRENA), 2018) and more than four-fifths of the country's electricity production is generated by thermal plants (Britannica 2020). However, energy shortages for domestic consumption are a well-documented issue, and agreements are being signed, notably for the building of liquid natural gas pipelines from Algeria, to help meet this gap (USAID 2018). These shifts in the country's energy envelope still show a high reliance on fossil fuels and increasing dependence on international trade agreements. Egypt is, therefore, particularly vulnerable to trends in oil prices and global movements away from fossil fuel production (USAID 2018; IRENA 2018). In 2013, 41 per cent of the country's energy consumption came from oil and 53 per cent from natural gas. Although it is not an Organization of the Petroleum Exporting Countries (OPEC) country, until the 1990s Egypt was known as a major oil producer and exporter; peaking at 900,000 barrels/day in the late 90s (American Security Project (ASP) 2014). In 2009/2010, however, the country became a net importer of oil as domestic demand grew and the amounts from the national oil refineries decreased (ASP 2014). Today, the country is the second largest producer of natural gas in the world, with 65.3 trillion cubic feet (ft^3) of proven reserves – 1 per cent of the world's total share; 82 per cent of the exports of natural gas go to Asia (ASP 2014). However, the production of natural gas, like oil, is decreasing annually, in this case by approximately 3 per cent and is not keeping up with domestic consumption which is rising by 7 per cent annually (ASP 2014). With shifts in oil prices, new trade patterns and global trends away from fossil fuels, Egypt is sitting on a tremendous amount of stranded assets[2] in gas and oil reserves. In fact, in 2014 the Egypt Oil and Gas company discussed at a large roundtable that more than 14 trillion ft^3 of gas reserves are now stranded assets, which are no longer financially viable to extract (Egypt Oil and Gas 2014).

Hydropower is an important source of Egypt's domestic energy production – one, perhaps, that will be particularly important as demand increases. Around 22–28 per cent of all energy produced in Egypt in 1985–1995 came from hydropower, significant evidence of the importance of this resource to the country's energy independence (Rashad and Ismail 2000). Climate change significantly threatens this energy source, however. Research has shown a visible decrease in hydropower potential caused by lower discharge levels in the Nile which, in turn, is caused by increasing water demands upstream of Egypt and changes in precipitation patterns, as explained above.

2 Stranded assets are defined as resources or infrastructure that once were valuable but are no longer, often due to external factors such as changes in technology, habits, acceptability etc. These assets are understood to be at the end of their economic life, no longer valuable enough to meet the owner's rate of return. Currently, the term is often used to refer to fossil fuel assets that have not yet been extracted and have lost their investment value, notably due to the energy transition.

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Small fractions of this consumption (below 3 per cent) are other renewables (ASP 2014). The country currently only has a small proportion of installed solar and wind power technology, approximately 0.9 gigawatts-worth (IRENA 2018), but with a high potential for the development of these sources (IRENA 2018). This is increasingly attractive as the country attempts to diversify its energy production to be more resilient and aligned with its national commitments to climate change mitigation. Indeed, the country has pledged that renewables will make up 20 per cent of its electricity mix by 2022 and 42 per cent by 2035 (United Nations Framework Convention on Climate Change (UNFCCC) 2017; IRENA 2018). A 2018 study by IRENA highlights the potential of a focus on the renewable sector to boost employment as well as the resilience of energy independence.

Infrastructure

Egypt's infrastructure that is arguably most at risk of the physical impacts of climate change are the buildings, roads and public structures built on land bordering the Nile Delta. Indeed, this region is the most exposed to flooding, saltwater intrusions and erosion (NAP-GSP 2018). As the risk of unpredictable and extreme weather events increases, Egypt's infrastructure is being put under strain. For instance, in March 2015, severe rainfall and floods in Cairo reportedly collapsed buildings, tore down electrical poles and overwhelmed the sewer system – experts blamed the significant weather impacts on overcrowded urban development and crumbling public infrastructure (The National 2020).

2.2 Economic security

Egypt is considered to be a lower middle-income country (World Bank n.d.) and one of the world's most diversified economies. While this economy was highly centralized in the period 1940–1970s under President Gamal Abdel Nasser, it has opened up significantly under a succession of more recent presidents, despite the complex political and conflict situations (CIA n.d.). In 2017, 11.7 per cent of the country's GDP came from the agricultural sector; 34.3 per cent from industrial production (a wide variety including textiles, chemicals, cement, pharmaceuticals etc.); and 54 per cent from the service sector (CIA n.d.). Although the country's average income is growing steadily, income inequality remains high with over 27 per cent of the population living below the poverty line and an unemployment rate of around 12 per cent (CIA n.d.).

In Egypt, climate change will most visibly impact the central agricultural and tourism sectors. Trends in the global economy around climate change mitigation and decreased reliance on fossil fuels may also impact the country's energy supply as it is increasingly dependent on international agreements to support its growing energy demand (USAID 2018).

Egypt's agricultural sector is a central part of its economy. The Nile valley has historically been a very fertile region, with the relatively narrow strip of land along the river being a key driver of the development of the civilization of Ancient Egypt. Almost all of the arable land lies near the banks of the river, directly irrigated and fertilized by the Nile's annual floods. Currently, the Egyptian agricultural sector takes up 3 per cent of the country's total land area, but contributes almost one-eighth of its total GDP and over a quarter of its employment (Britannica 2020; CIA n.d.). It also represents 80 per cent of the country's water demand (USAID 2018). With increased stress on water resources along with the increased severity and length of droughts, concerns about the sustainability of this sector under a future climate are growing. This arable land of the Nile valley lies below sea level and is connected to characteristics of the Mediterranean Sea. Research has

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shown that, with heightened sea levels along Egypt's coast, saline intrusions into the surface and groundwater of the delta will increase (Abdelhamid and Abd-Elaty 2017). Government officials have also highlighted the risk and damage of saltwater intrusions to agricultural land, saying that about 10–12 per cent of farmland could be impacted by projected sea level rise in the Mediterranean[3]. This is already being felt – a study from 2018 estimates that around 25–30 per cent of farmland is already affected by these saline intrusions (Shahid and Zaman 2018). The impacts of climate change on the country's most important staple crops will be significant. Indeed, the productivity of wheat and maize are projected to decline by 15 per cent and 19 per cent respectively by 2050 (UNFCCC 2017). Finally, the impacts of climate change on animal health in Egypt are significant. As cropland productivity decreases through increased temperatures and decreased water supply, competition for fodder is increasing (Kalifa 2014; Rabie 2020). Additionally, the range of certain animal diseases is expanding into Egypt; these include devastating outbreaks like rift valley fever and bluetongue disease (Kalifa 2014).

As the physical impacts of climate change threaten the country's agricultural and service sectors; in particular risks to political stability and safety may be highlighted. For instance, high inflation rates and heighted food prices are a growing concern (USAID 2018). Although caution must be taken to draw links between these phenomena, there is a debate that economic grievances, and notably youth unemployment, can lead to unrest in the country and region at large. For instance, in 2011, the year of the Egyptian revolution, youth unemployment had reached 30 per cent (World Economic Forum 2018; Gordon 2018).

Tourism is another key economic sector in the country, bringing in an equivalent of 12 per cent of the country's GDP (Trading Economics n.d.; Knoema n.d.). A USAID report from 2018 highlights that increased temperatures, changes in precipitation patterns and seasons, flooding, dust-storms and sea level rise will not only impact the appeal of Egypt for this industry but also degrade the country's monuments, antiquities and historical sites which are key to attracting tourism (USAID 2018; Ahmed and Hefny). Research has also highlighted that damages to coastal infrastructure, the erosion of beaches, destruction of marine ecosystems, and flooding of facilities are already having a negative impact on the tourism sector (Shaaban and Razmy 2010). These concerns are in fact highlighted in Egypt's national climate change adaptation plans, evidence that it remains a priority (Shaaban and Razmy 2010). Sea level rise near highly populated cities like Alexandria and Port Said will be particularly damaging (Shaaban and Razmy 2010; Shaltout *et al.* 2015).

3 The IPCC projects that the seal level of the Mediterranean will rise between 30 centimeters (cm) and one metre (m) before the end of the century (Zayed 2010).

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2.3 Health

The Center for Global Health and Development (GHD) notes that Egypt's health indicators have significantly improved since 1960 with internationally recognized hospitals, declines in preventable childhood illness, low rates of waterborne diseases and increases in vaccinations, to the point where its profile is considered similar to high-income countries (GHD n.d.). However, climate change threatens to slow down this progress by changing disease patterns, increasing exposure and vulnerability, and increasing the frequency and intensity of certain phenomena (USAID 2018).

Research has quantified many impacts of climate change on health in Egypt. First, the increasing intensity, frequency and duration of heatwaves that is projected will particularly impact those over 65 years old, those with underlying health conditions, and the urban poor (USAID 2018). In Egypt's increasingly dense cities, this impact may be multiplied; for instance, over 100 deaths related to heatwaves were recorded in the summer of 2015 (USAID 2018). Projections indicate that heat-related mortality could increase from 1 per 100,000 currently up to 47 per 100,000 by 2080 (World Health Organization (WHO) 2015). Second, the impacts of sand- and dust-storms are particularly concerning for the country's healthcare sector. They are a frequent hazard in Egypt; one that causes a series of respiratory diseases (such as pneumonia and influenza) and non-infectious diseases (such as asthma) (USAID 2018). With increased desertification and drought, this phenomena may become even more common (UNEP 2016).

This is particularly an issue when combined with increasing rates of air pollution in Egyptian cities; for instance, in 2011, the capital city of Cairo's air pollution was almost seven times over the WHO's threshold (WHO 2015). Additionally, as seen above, climate change is having significant impacts on Egypt's agricultural sector through droughts, damages to crops, decreased soil productivity due to saline intrusions, increased water demand due to higher temperatures etc. Up to 60 per cent of Egypt's food is produced domestically (Yassin 2016), and the growing burden of climate change on this economic activity has significant implications on food prices and food security (Hashem 2020). There is already a 7 per cent prevalence of malnutrition in children under the age of 5 years old in the country – a statistic that may worsen with increased droughts and population pressure on food (WHO 2015).

2.4 Protection

The climate change dimension of protection in Egypt has often been related to conflict. However, climate change also poses risk for internal displacement. An oft-cited study from the World Bank estimated that, in 2007, a 1m rise in sea level would force 10 per cent of the country's total population to move. Similarly, potential declines in agricultural productivity is also pushing migration from rural areas to the country's already densely populated cities, putting pressure on space and resources (Dasgupta *et al.* 2007). Displaced people, including internally displaced people (IDP) and refugees, are often particularly vulnerable to climate extremes. This includes flood events that can quickly destroy the limited infrastructure in camps, as well as heatwaves that leave people with few options for cooling and shelter. As of 2019, there were 324,740 refugees and asylum seekers in Egypt (United Nations High Commissioner for Refugees (UNHCR) 2020) as well as 65,000 IDP (Internal Displacement Monitoring Centre (IDMC) 2019). The large and rapid movement of refugees into Egypt creates difficult conditions for adequate refugee protection and humanitarian assistance. The UNHCR has recently asked for critical

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support in this matter, highlighting the economic and social vulnerability of these communities and particularly of the approximately 40 per cent of them who are children (UNHCR 2019).

Around the world, people in detention frequently have heightened vulnerability to natural disasters due to: spatial marginalization resulting from prison locations on hazard-prone land and/or isolation from emergency evacuation services; limited to no connections to social networks which are crucial aspects to hazard resilience; and political marginalization, including lack of policies and services to prevent disaster impacts on imprisoned populations (Gaillard and Navizet 2012). While specific information is not available for Egypt, vulnerabilities such as these, coupled with more frequent and intense disasters due to climate change, may leave prison populations in especially precarious positions to hazards such as extreme heat and floods.

2.5 Policy

Egypt has signed and ratified the Paris Agreement and submitted its first Intended Nationally Determined Contribution (INDC) in 2017. This states that the key to the country's mitigation efforts will be the development of low carbon energy systems with policies targeting energy efficiency, increased use of renewable energy, "locally-appropriate and more-efficient fossil fuel technologies" including nuclear, and reforms on energy subsidies. The INDC also makes mention of the retrofitting and repair of infrastructure as well as investment in carbon capture and storage and biomass/cogeneration (UNFCCC 2017). Adaptation is a larger component of the INDC, and at the forefront; it highlights the impacts described above and emphasizes national adaptation policies.

Egypt's third communication to the UNFCCC in 2016 highlights the country's efforts in adaptation and mitigation which include "water conservation measures in agriculture, industry and municipal supplies, upgrading water quality and sanitation to minimize pollution, construction of infrastructure for water collection in flash flood areas (e.g. Sinai, Red Sea and Upper and Middle Egypt), use of renewable energy (solar and wind) for water desalination, storage of drainage and fresh water in coastal lakes and public awareness campaign on water scarcity and water shortages [...]."

It is important to note that much policy and legislation on climate does exist at the national level. This includes the 2011 National Strategy for Adaptation to Climate Change and Disaster Risk Reduction, the 2013 Proposed Climate Change Adaptation Strategy for the Ministry of Water Resources & Irrigation in Egypt, the 2016 Sustainable Development Strategy: Egypt Vision 2030. Additionally, the country has a Climate Change Gender Action Plan that emphasizes gender considerations to adaptation policy, highlighting understanding of differential impacts of climate change which make women and children particularly affected by climate shocks and phenomena (Climate Links 2011). However, there are limited institutional and legal frameworks, and many other barriers make the application of climate action particularly difficult in the country (USAID 2018). Indeed, an analysis of Egypt's INDC highlights the lack of quantification of mitigation and broad statements (Abdallah 2020) which make progress difficult to measure.

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