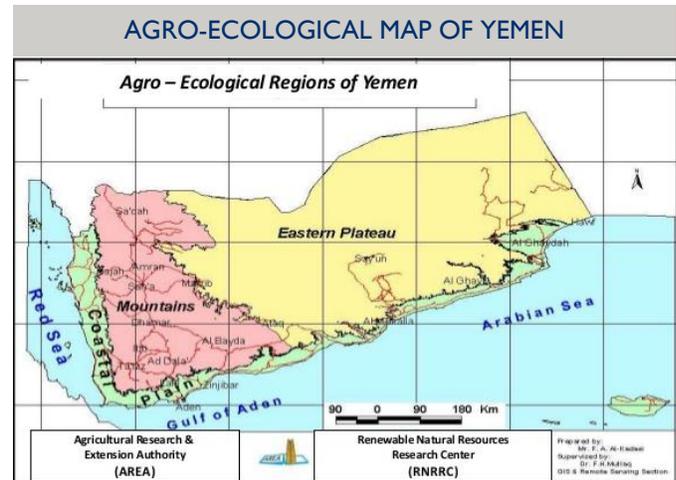




CLIMATE CHANGE RISK PROFILE YEMEN

COUNTRY OVERVIEW

As the poorest and most water-insecure country in the Middle East and North African region (its capital city Sana'a risks running out of water as early as 2017), Yemen faces serious risks from climate change that threaten the already fragile state of the country. More than half of Yemen's population of 27 million people live on incomes below the poverty line, and the mostly rural population continues to grow rapidly. Severe food insecurity and water scarcity, worsening gender inequality, widespread poverty, and a lack of economic growth in Yemen are all compounded by ongoing armed conflict that began in 2014. These challenges intersect with and are intensified by climate change impacts. For instance, frequent droughts in recent decades have contributed to food shortages. In 2015, the unusually strong Cyclone Chapala, resulting in part from high, record-breaking sea surface temperatures, made landfall in Yemen, causing widespread flooding. Increased temperatures, extreme weather events, and sea level rise are likely to worsen food insecurity and water scarcity and adversely affect coastal zones. Ongoing conflict and a lack of adequate environmental management policies (among other factors) position Yemen at a great disadvantage in facing future impacts of climate change. (1, 4, 5, 6, 12, 14, 16, 17)



CLIMATE



Increase in temperatures of 1.2 to 3.3°C by 2060



More extreme weather, with intense precipitation, floods and droughts



Rising sea level

KEY CLIMATE

Agriculture

Reduced agricultural productivity; degradation of arable land and desertification



Water Resources

increased water scarcity; reduced water quality



Human Health

increased food insecurity; increased transmission of climate-sensitive diseases



Coastal Zones

increased coastal erosion; displacement of coastal communities; destruction of coastal ecosystems and low-lying wetlands; intensification of storm surges



October 2016

This document was prepared under the Global Environmental Management Support Project (GEMS) and is meant to provide a brief overview of climate risk issues. The key resources at the end of the document provide more in-depth country and sectoral analysis. The contents of this report do not necessarily reflect the views of USAID or the United States government.

CLIMATE SUMMARY

Yemen has a semi-arid to arid tropical climate. However, significant variation in climate exists due to topographical differences. Yemen can be divided into as many as 14 agro-climate zones, with three overarching climatic sub-regions: the coastal plains, temperate western highlands, and the northeastern desert plain. Data for annual temperatures, rainfall, and humidity are presented in the table below.

REGION	COASTAL PLAINS	TEMPERATE WESTERN HIGHLANDS	NORTHEASTERN DESERT PLAIN
Annual Average Temp	24°C to 35°C (common for temperature to exceed 50°C)	10°C to 22°C (below freezing temperatures occur occasionally during winter)	19°C to 33°C
Annual Average Rainfall (mm/yr)	10 to 100	100 to 600 (some areas, including lbb, can average as much as 1,000)	50 to 100
Annual Average Humidity	50% to 70%	Unavailable	Low

Monsoon climate patterns dictate the seasons, with winter (December-March) and summer (June-September) corresponding to different monsoon seasons. Spring (April-May) and fall (October-November) are transition periods that separate the seasons. (7)

HISTORICAL CLIMATE

Key climate changes since the 1960s include:

- Increased temperature (1.8°C+) at a rate of approximately 0.39°C per decade, with most rapid rate of increase occurring during the summer months (June-August); rate of warming is more rapid than the global average.
- Decrease in average rainfall at a rate of 1.2mm per month (-9%) per decade, generally affecting the drier seasons, with declines particularly noted in the Highlands.
- Insufficient data to determine trends in frequency of hot and cold days and nights and trends in heavy rainfall events. (11)

FUTURE CLIMATE

Projected changes include:

- Mean annual temperature increasing by 1.2°C to 3.3°C by 2060, with warming occurring more rapidly in the country's interior than in the coastal areas.
- Substantial increase in frequency of hot days and nights (exceeding temperature of hottest 10% historical days/nights); decrease in frequency of cold days and nights.
- Wide range of projections (increases and decreases) for rainfall, with probable increases in September-November rainfall.
- Proportion of total rain falling in heavy events occurring September-November is expected to increase.
- Amounts of rain in maximum 1- and 5-day events occurring September-November are expected to increase.
- Increase in sea level rise of 0.30 m to 0.54 m by 2100. (7, 11, 15)

SECTORS IMPACTS AND VULNERABILITIES

AGRICULTURE

The agriculture sector contributes 11.4% to GDP and employs the majority of Yemen’s work force. Cultivated food crops include cereals, fodder, fruits, vegetables, and legumes. Cash crops include qat and coffee, although coffee production has declined somewhat. Yemen’s agricultural sector is dominated by small, subsistence farms and derives from a terrace system with one planting season from July to August. Rainfall during these months can be intense, leading to flooding that causes soil erosion and loss of agricultural land. Agriculture activities in the coastal plains and deserts are most vulnerable to floods. During other months, dry periods and drought lead to desertification, accounting for 3-5% annual loss in arable land. Both floods and drought have contributed to diminishing crop yields. Water scarcity continues to be the largest hindrance to agricultural productivity in Yemen, and further depletion of water resources is expected to reduce agricultural productivity by up to 40 percent. In addition, the production of qat, whose leaves have a mild narcotic effect, consumes almost 40% of available water resources. Qat, a lucrative product critical to sustaining livelihoods, uses 38% of Yemen’s irrigated land, contributing further to a decline in land area for food cultivation. Overall, future climate change impacts on Yemeni agriculture are expected to worsen, especially with more intense rainfall and prolonged droughts. However, future climate change impacts on agriculture vary among regions given Yemen’s regional climate variability. For example, higher temperatures may actually increase crop yields in the highlands, whereas significant decreases in crop yields are expected in the south. (4, 5, 7, 8, 13, 15)

Climate Risks and Potential Impacts AGRICULTURE	
Climate Risk	Potential Impacts
Increased temperatures	Overall decreased agricultural productivity (although changes in crop yields vary among regions)
Drought	Loss of arable land due to desertification
Floods	Increased soil erosion
Increased rainfall variability	Migration from rural to urban areas due to crop failures and loss of livelihoods

WATER RESOURCES

Sana’a is the world’s most water-stressed city and draws water from the world’s most water-stressed aquifer, the Arabian Aquifer System. The rate of groundwater extraction currently exceeds a sustainable rate at which water can be replenished, depleting groundwater sources at a rate of 1 to 7 meters per year. At this rate, Yemen’s groundwater reserves will likely be depleted within 20 to 30 years regardless of climate change. Greater rainfall variability in the future could increase drought periods, diminishing water supplies more rapidly. Similarly, increased temperatures could lead to higher evapotranspiration rates, further slowing the replenishment of water sources. Such extremes of water shortages can lead to mass displacement, loss of economic viability, and conflict. Furthermore, overexploitation of groundwater resources and rising sea levels due to climate change increase the likelihood of salt-water intrusion. This causes the water to become brackish and unsuitable for human consumption unless treated. (1, 5, 6, 7, 13, 15)

Climate Risks and Potential Impacts WATER RESOURCES	
Climate Risk	Potential Impacts
Increased temperatures	Reduced recharge rates and increased rate of depletion
Drought	Increased lack of access to safe drinking water
Sea level rise	Increased conflict over water
	Saltwater intrusion of groundwater sources

COASTAL ZONES

Yemen is particularly susceptible to coastal damage due to increased storm surges and sea level rise. More than 50% of Yemen’s coastal areas are at risk, affecting more than 55% of Yemen’s coastal population and 52% of areas contributing to GDP from coastal areas. Yemen is in the top 10 low-income countries most susceptible to coastal damage, threatening coastal infrastructure, ecosystems, and communities. Rising sea levels may cause accelerated coastal erosion, saltwater intrusion, increased frequency of floods, damage to ecosystems, and mass displacement and economic upheaval in coastal communities. Rising sea levels may also diminish the fisheries sector (2.4% contribution to GDP), increasing the vulnerability of up to 80,000 fishermen who depend on this sector for work. (3, 5, 7)

HUMAN HEALTH

Declining agricultural productivity, water scarcity, and ongoing conflict contribute to the fragile state of Yemen’s health sector. Yemenis suffer from serious vector-borne diseases, including malaria. Climate change may affect the prevalence and morbidity and mortality rates of such diseases. Recent outbreaks of cholera in Yemen have resulted from declining availability of safe drinking water sources. Ongoing conflict in Yemen has exacerbated water scarcity and food insecurity issues, leaving 2 million people (1.3 million children) malnourished. Projected losses in agricultural productivity due to impacts brought about by climate change could intensify Yemen’s severe food insecurity. Furthermore, increased storm surges and floods could lead to displacement, injuries, and loss of life. Floods resulting from a tropical storm in 2008 killed 180 and displaced 20,000 people, causing losses and damages amounting to US\$1.6 billion. Extreme weather events also affect water and road infrastructure and agriculture, contributing to food and water issues, as well as limiting access to healthcare. Women and children, two already disadvantaged demographics, are particularly vulnerable to the potential adverse impacts on public health brought about by climate change. (2, 14, 17)

Climate Risks and Potential Impacts COASTAL ZONES	
Climate Risk	Potential Impacts
Sea level rise	Deterioration of coastal ecosystems and low-lying wetlands
	Accelerated coastal erosion
	Displacement of coastal communities
	Diminished fisheries and economic livelihoods
Floods	Saltwater intrusion into groundwater sources
Increased storm surges	

Climate Risks and Potential Impacts HUMAN HEALTH	
Climate Risk	Potential Impacts
Increased temperatures	Reduced quality and quantity of safe drinking water, leading to increased risk of waterborne illnesses (e.g., cholera)
	Spread and growth of vector-borne diseases (e.g., malaria)
Increased rainfall variability	Heightened food insecurity leading to increased and severe malnutrition (particularly in children)
Drought	Displacement, injuries, and death from floods and storms
Floods	
Increased storm surges	Deterioration of vital infrastructure (e.g., water, roads, etc.) and reduced access to healthcare

POLICY CONTEXT

INSTITUTIONAL FRAMEWORK

In 2003, the Environment Protection Authority (EPA) was launched in Yemen to establish, implement, oversee, and enforce environmental policies and strategies. This also includes coordinating national, regional, and international action on environmental protection in Yemen. Yemen ratified the UN Framework Convention on Climate Change (UNFCCC) in 1996 and the Kyoto Protocol in 2008 as a Non-Annex I country, and the EPA serves as a focal point for their implementation. In 2009, Yemen established the Inter-Ministerial Committee for Climate Change (IMCCC) to bolster national coordination and climate change leadership. (7, 10)

NATIONAL STRATEGIES AND PLANS

- [Initial National Communication](#) (2001) and [Second National Communication](#) (2013)
- [National Adaptation Programme of Action](#) (2009)
- [National Action Plan to Combat Desertification](#) (2000)
- Other related sectoral policies include: the [National Agriculture Sector Strategy 2012-2016](#), the [National Strategy for Environmental Sustainability](#), and the [National Biodiversity Strategy and Action Plan](#).

KEY RESOURCES

1. Al Harazi, F. (World Bank). 2014. [Future Impact of Climate Change Visible Now in Yemen](#).
2. Al-Jazeera. 2016. [UNICEF: Cholera outbreak hits war-torn Yemen](#).
3. Dasgupta, S., et al. 2009. [Climate Change and the Future Impacts of Storm-Surge Disasters in Developing Countries](#).
4. Food and Agriculture Organization. 2012. [FAO Country Programming Framework \(CPF\) for the Republic of Yemen](#).
5. Netherlands Commission for Environmental Assessment: Dutch Sustainability Unit. 2015. [Climate Change Profile: Yemen](#).
6. Purvis, K. 2016. [Where are the world's most water-stressed cities?](#)
7. Republic of Yemen. 2013. [Second National Communication under the UNFCCC](#).
8. Republic of Yemen. 2015. [Intended Nationally Determined Contribution \(INDC\) under the UNFCCC](#).
9. Republic of Yemen Environment Protection Authority. 2009. [Yemen National Adaptation Programme of Action \(NAPA\)](#).
10. United Nations Development Programme. 2012. [Synthesis Paper: Governance of Climate Change in Yemen](#).
11. United National Development Programme. 2012. [Yemen: Climate Change Country Profile](#).
12. Worland, J. 2015. [Why Yemen Was Hit by a Rare Tropical Cyclone](#).
13. World Bank. 2010. [Yemen – Assessing the Impacts of Climate Change and Variability on the Water and Agricultural sectors and the Policy Implications](#).
14. World Bank. 2016. [Yemen Overview](#).
15. World Bank. n.d. [Climate Change Knowledge Portal: Yemen](#).
16. World Bank. n.d. [Yemen](#).
17. World Bank Group. 2014. [Turn Down the Heat: Confronting the New Climate Normal](#).

Map from: Agricultural Research and Extension Authority (AREA). n.d. [Strip Rust Current Situation at the Different-Agro-Ecological Zones in Yemen](#).

SELECTED ONGOING EXPERIENCES

Selected Program	Amount	Donor	Year	Implementer
Climate Information System and PPCR Program Coordination	\$19 million	Climate Investment Funds/World Bank	2013-2019	EPA, Republic of Yemen
Adaptation to Climate Change through Integrated Water Harvesting Technologies in Yemen	\$4.9 million	Least Developed Country Fund (LDCF)	2013-2015	Ministry of Water and Environment, Republic of Yemen; UNDP
Integrated Coastal Zone Management in Yemen	\$5.02 million	Least Developed Country Fund (LDCF)	2010-2016	Ministry of Fish Wealth; EPA, Ministry of Water and Environment, Republic of Yemen
Rural Growth Programme	\$10 million	Adaptation for Smallholder Agriculture Programme (ASAP)	2013-2020	Republic of Yemen
Rural Adaptation in Yemen	\$10 million	Least Developed Country Fund (LDCF)	2013-unknown	International Fund for Agricultural Development (IFAD)
Yemen: Preparation of SREP Investment Plan	\$0.3 million	World Bank	Ongoing	Ministry of Energy and Electricity, Republic of Yemen