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Dutch Sustainability Unit

Climate Change Profile: YEMEN

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Climate Change Profile: Yemen

As climate change and rapid population growth put more and more pressure on critical resources, especially water, the Yemen of today shows what will happen in the region as a whole¹. Yemen is a predominantly arid country on the Arabian Peninsula with a history of food aid dependence. It experiences extreme water scarcity due to overexploitation of groundwater that leads to salt water intrusion in coastal areas such as Tihama. As a consequence, brackish water desalination is becoming more common, supported by the decrease of energy costs, due to increasing use of solar energy. Agriculture remains the most important sector, employing 54% of Yemen's labour force². The most commonly grown cash crop is qat, a high water requirement plant used for its mild stimulant effect. The strong market demand and efficient producer-consumer value chain encourages qat rather than grain and vegetable production. Climate change is expected to increase temperatures, variability of rainfall and heavy precipitation events. The increase in heavy rains in combination with rising temperatures, especially in the north, which will probably lead to shortened growing seasons. Shorter growing seasons threaten food security, and competition for dwindling natural resources could fuel conflict. Climate change will aggravate Yemen's fragile situation and may contribute to the current conflict.

Overall ranking

Yemen ranks 175 out of 180 countries in the ND-GAIN index³ (2014), which is slightly lower than its 2013 rank (174). It ranks 7th on vulnerability and is the 16th least ready country – meaning that it is extremely vulnerable to, yet very unready to address climate change effects. *Vulnerability* measures the exposure, sensitivity, and ability to cope with climate related hazards by accounting for the overall status of food, water, environment, health, and infrastructure within a country. *Readiness* targets those portions of the economy, governance and society that affect the speed and efficiency of adaptation.

Biophysical vulnerability

Current climate. Yemen is characterized by a desert climate in which two patterns are dominant: regular northerly winds and the southwest monsoon⁴. Yemen is characterized by five major ecological systems⁵ (see [Map 1](#) and [Map 2](#)): a Hot-humid Coastal Plain, Temperate Highlands, Yemen High Plateaus and Hadramout-Mahrah Uplands, the Desert Interior, and the Islands Archipelago.

Temperature in Yemen is generally high, with an annual average of 21 °C. Temperatures vary by location and season. The coastal regions are hot and dry. The southern coastal areas are characterized by limited rainfall (50 mm per year). **Rainfall** in the central highlands varies from

¹ World Bank (2014) *Future Impact of Climate Change Visible Now in Yemen* <http://www.worldbank.org/en/news/feature/2014/11/24/future-impact-of-climate-change-visible-now-in-yemen>

² McSweeney et al. (2010)

³ GAIN index summarizes a country's vulnerability to climate change and other global challenges in combination with readiness to improve resilience, <http://index.gain.org/country/yemen>

⁴ Climate Service Center Germany (2015). Climate-fact-sheet. Yemen, updated version 2015.

⁵ Global Climate Change Alliance (GCCA) (2012): Yemen Experience on Climate Change, <http://www.gcca.eu/sites/default/files/GCCA/Yemen-presentation.pdf>

400 mm to 800 mm per year. Northern regions and Wadi Hadhramawt are hot and dry throughout the year. In the highlands there is more seasonal variety: winter can be cold, with temperatures below 0°C, while the summers are temperate and rainy⁶.

Yemen's biophysical vulnerability to climate change is associated with potential changes in rainfall patterns, temperature increase, sea level rise, and the occurrence of extreme climate events. These are likely to result in water scarcity, short and heavy storms, floods, long dry periods, desertification, and land degradation and soil erosion⁷. The effects of climate change on water resources will exacerbate the current deterioration of the amount and quality of groundwater since groundwater replenishment is expected to decrease due to extreme precipitation patterns that cause erosion and runoff.

Current trends. Over the last 30 years, temperatures have significantly increased, at a rate of 0.19 °C per decade. Also, an increase of 29% in total annual precipitation over the last 30 years was observed⁸.

Climate change. The United Nations Development Programme (UNDP) states that there is insufficient daily precipitation data available to determine trends in heavy **rainfall** events⁹. Indeed, projections of future rainfall do not correspond, with some models projecting increases in rainfall while other models project decreases. These large uncertainties in future rainfall patterns are partly due to differences in modelled behaviour of the Inter-Tropical Convergence Zone over this region. The proportion of rainfall that falls in 'heavy' events shows an increase in most model projections¹⁰. The projected rainfall increases for June – October is offset by a decrease in October – December across the country, except for the Upper Highlands where a decrease is projected for the whole year¹¹. The majority of climate models tend to predict a tendency towards increased total annual precipitation. By 2100, a change in rainfall is expected ranging from -7% to +69%¹².

The mean annual **temperature** is expected to increase by 1.2–3.3 °C by 2060 and by 1.6–5.1 °C for the end of this century. Models predict a strong increase in the duration of heat waves, as well as a strong reduction in duration of cold spells¹³. The rate of warming is more rapid in the interior regions than in areas close to the coast (see [Map set 3](#)). This is consistent with the higher rates of warming that are projected for the Arabian Peninsula and East Africa, according to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

⁶ Climate Service Center Germany (2015). Climate-fact-sheet. Yemen, updated version 2015.

⁷ GCCA (2012)

⁸ Climate Service Center Germany (2015). Climate-fact-sheet. Yemen, updated version 2015.

⁹ McSweeney, C.; New, M.; Lizcano, G., (2010): *UNDP Climate Change Country Profiles: Yemen*, http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Yemen/Yemen.lowres.report.pdf

¹⁰ World Bank (2011): *Vulnerability, Risk Reduction, and Adaptation to Climate Change – Yemen profile*, http://sdwebx.worldbank.org/climateportal/doc/GFDRRCountryProfiles/wb_gfdr climate_change_country_profile_for_YEM.pdf

¹¹ Wiebelt, M.; Breisinger, C.; Ecker, O.; Al-Riffai, P.; Robertson, R.; Thiele, R., (2011): *Climate Change and Floods In Yemen: Impacts on Food Security and Options for Adaptation* (IFPRI Discussion Paper 01139) <http://www.ifpri.org/sites/default/files/publications/ifpridp01139.pdf>

¹² Climate Service Center Germany (2015). Climate-fact-sheet. Yemen, updated version 2015.

¹³ Climate Service Center Germany (2015). Climate-fact-sheet. Yemen, updated version 2015.

(IPCC)¹⁴. The projected average temperature increase is 2.3 °C, with increases over 3 °C for specific months (2011)¹⁵.

The projected changes by 2025 per **region** are as follows:

- Sa'adah (north-west): precipitation +10%, temperature +1.8 °C;
- Sana'a (central-west): precipitation +2%, temperature +1 °C;
- Aden (south-west): precipitation +10%, temperature unknown¹⁶.

Yemen is a disaster-prone country that faces a number of **natural hazards** every year with floods as the most important and recurring form of disaster. While *regular* flooding has historically been beneficial for agriculture in Yemen, *high-magnitude* flooding often leads to losses of cropland, uprooting of fruit trees, death of animals caught in high floodwater surges, and destruction of infrastructure, such as irrigation facilities and rural roads. The damages done by floods tend to be exacerbated by ongoing desertification processes and land degradation, partly caused by climate change. In addition, several models project higher rainfall levels for Yemen, thus potentially increasing the frequency and severity of **floods**¹⁷. Rising sea levels are expected to accelerate coastal erosion, damage key infrastructure, force community relocations, and threaten marine ecosystems and low-lying coastal wetlands¹⁸. Greater variability in rainfall patterns will reduce food security because of the increasing severity of droughts and floods. In October 2008 alone, flood damage in the country inflicted costs equal to 6% of GDP¹⁹.

Climate change is globally affecting food prices due to harvest losses, diminishing yields per hectare, and decreasing absolute crop volume. In combination with increasing global food prices, the impact of climate change on **food security** can be a considerable hazard to physical and social welfare. Prior to the current conflict, agriculture and related processing contributed about 13%²⁰ or 21%²¹ to GDP. About three quarters was produced in the highly populated agro-ecological zones 1 and 2 (the Upper and Lower highlands, with 30–40% of the total population living in these zones). Qat accounted for over one-third of agricultural GDP and about 40% of total water resource use. Qat covers 38% of Yemen's irrigated areas; in places, food crops are being replaced with it. Vegetables and fruits made up another one-third of agricultural GDP²². Agriculture remained the most important sector employing 54% of Yemen labour force²³.

An analysis of regional climate change impacts on agriculture in Yemen shows a mixed pattern, with production increases in the highlands (from Sa'adah to Taiz) due to higher temperatures.

¹⁴ Wiebelt et al. (2011)

¹⁵ Wiebelt et al. (2011)

¹⁶ Haidera, M.; Alhakimi, S.A.; Noaman, A.; Al Keksi, A.; Noaman, A.; Fencel, A.; Dougherty, B.; Swartz, C., (2011): Water scarcity and climate change adaptation for Yemen's vulnerable communities, Local Environment: The International Journal of Justice and Sustainability 16(5), <http://www.tandfonline.com/doi/abs/10.1080/13549839.2011.565465#>

¹⁷ Wiebelt et al. (2011)

¹⁸ Climate Investment Funds (2012): *Pilot Programme for Climate Resilience*, http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/PPCR_Yemen.pdf

¹⁹ Climate Investment Funds (2012)

²⁰ Climate Investment Funds (2012)

²¹ McSweeney et al. (2010)

²² Climate Investment Funds (2012)

²³ McSweeney et al. (2010)

Significant yield reductions are expected in some lower and hotter areas such as around Raymah in the west, Abyan in the south, and in the eastern half of the country (see [Map 4](#))²⁴. Annual desertification of cultivated land is 3–5%²⁵, which negatively affects food production and decreases overall availability of arable land. The countrywide food insecurity impact of *floods* is minor; however, there are substantial consequences at the local level where the consequences can be severe, especially in the areas that are directly affected by floods. The rural population and especially farmers in the Internal Plateau zone are hardest hit and, to a lesser extent, the rural population in the neighbouring Arabian Sea and Desert zones²⁶. Within agricultural subsectors, fruits are the hardest hit by floods, followed by sesame and tomatoes²⁷.

Fisheries' contribution to GDP is over 2.4% and its export value reaches more than USD 213 million per year with an estimated work opportunity for more than 350,000 people of which 60,000 to 80,000 fishermen and their families depend on fishing for their livelihoods²⁸. The rise in the sea level and, as a result, deterioration of the coastal ecosystem as a result will lead to a diminished fisheries sector increasing the vulnerability of fishermen who are dependent on fish for sustaining in their livelihoods.

Yemen's **water availability** per capita is the lowest in the world²⁹. Extraction of groundwater has exceeded the level of replenishment capacity, causing water depletion. Since Yemen over-extracts an estimated 0.9 billion cubic meter of water each year from its deep aquifers, groundwater aquifers are declining one to seven meters each year. It is anticipated that climate change combined with high population growth, inadequate agricultural development and policies, qat growth, and a lack of law enforcement to regulate water³⁰ will put continuing pressure on Yemen's water resources and contribute to its water crisis³¹. The overexploitation of groundwater resources and the rising sea level due to climate change will result in increased salt water intrusion, especially in coastal aquifers.

Projections suggest that aquifers such as Abyan, Tuban, and Sa'adah will be depleted by 2025. Depletion of the Tuban aquifer is the most rapid (2015, versus 2019 for Abyan) because of a greater reliance on groundwater relative to discharge in the Tuban sub-basin³². Moreover, Aden is one of the top 20 cities in the world where the most people will be at the greatest risk from sea level rise and storm surges in the developing world³³.

²⁴ World Bank (2010): *Yemen: Assessing the Impacts of Climate Change and Variability on the Water and Agricultural Sectors and the Policy Implications*, http://ynccf.net/pdf/Climate_change_and_development/Yemen_Climate_Change_Study_April_8_2010.pdf

²⁵ Climate Investment Funds (2012)

²⁶ Wiebelt et al. (2011)

²⁷ Wiebelt et al. (2011)

²⁸ McSweeney et al. (2010)

²⁹ Glass, N. (2010): *The Water Crisis in Yemen: Causes, Consequences and Solutions*, *Global Majority E-Journal* 1(1), https://www.american.edu/cas/economics/ejournal/upload/global_majority_e_journal_1-1_glass.pdf

³⁰ Glass (2010)

³¹ E.g. Al Omari (2008) and Wardam (2009) in Glass (2010)

³² Haidera et al. (2011)

³³ Dasgupta, et al, (2009) Center for Global Development, in GCCA (2012)

Socio-economic vulnerability

Key facts:

GDP (PPP) per capita (2013) ³⁴ :	USD 3,790
Population (July 2016) ³⁵ :	27,484,604
Projected population (2050) ³⁶ :	47,170,020
Population density per km ² (2014) ³⁷ :	50
Human Development Index (2014) ³⁸ :	160 out of 188 countries
Corruption Perceptions Index (2015) ³⁹ :	154 out of 168 countries
Gender Inequality Index (2014) ⁴⁰ :	155 out of 188 countries
Fragile States Index (2015):	7 out of 178 countries
Adult literacy (2015) ⁴¹ :	70.1 (male 85.1%; female 55%)

Yemen is the poorest country in the Middle East. Prior to the current conflict it was estimated that 33%⁴² or 43% of its people were living in chronic poverty, and among the most food-insecure countries in the world, with 32% of the population being food insecure⁴³. Given the country's high levels of food import dependency, food insecurity, and poverty, both global and local climate change impacts are likely to significantly influence its future development and food security. Yemen ranked number 9 in the World Risk Report 2012 that presented 15 of countries with the greatest lack of coping capacities⁴⁴. In March 2015, Yemen descended into widespread-armed conflict, further exacerbating an already severe humanitarian situation where 15.9 million people are in need of some form of humanitarian assistance⁴⁵. Recent estimates suggest over two million IDPs within Yemen ⁴⁶

Climate change risks are projected to not only impede the national capacity to achieve sustainable development but also to reverse the economic development that has occurred. Impacts of climate change on the most vulnerable groups (rural poor, women) include increased exposure to extreme weather events in combination with decreased financial resources available for reconstruction and preparedness due to lower (agricultural) incomes. Vulnerable groups are also more exposed to terrorist recruitment since they lack adequate alternatives for providing sufficiently in their livelihood, especially if these alternatives are less attractive in terms of risks (extreme weather influencing the agricultural production, insecure food prices, inaccessible markets due to extreme weather conditions etc.). Moreover, Yemen's

³⁴ World Bank Data – GDP per capita, PPP. <http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD>. Data for 2015 is not available.

³⁵ World Population Review – Yemen, <http://worldpopulationreview.com/countries/yemen-population/>

³⁶ UNDESA (2015): *World Population Prospects: The 2015 Revision*, http://esa.un.org/wpp/unpp/panel_population.htm

³⁷ World Bank Data – Population density, <http://data.worldbank.org/indicator/EN.POP.DNST>

³⁸ UNDP (2014) <http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components>

³⁹ Transparency International (2015) <http://www.transparency.org/cpi2015/results>

⁴⁰ UNDP (2014) <http://hdr.undp.org/en/content/table-4-gender-inequality-index>

⁴¹ CIA (2015). The World Factbook – Yemen. Available via <https://www.cia.gov/library/publications/the-world-factbook/geos/ym.html>

⁴² Climate Investment Funds (2012)

⁴³ Wiebelt et al. (2011)

⁴⁴ United Nations University (2012): *WorldRiskReport 2012*, <https://www.ehs.unu.edu/file/get/10487.pdf>

⁴⁵ European Commission (2015): *Yemen ECHO Factsheet*, http://ec.europa.eu/echo/files/aid/countries/factsheets/yemen_en.pdf

⁴⁶ FEWS NET (April 2016), Yemen Food Security Outlook Update. <http://www.fews.net/east-africa/yemen/food-security-outlook/august-2016>

population growth is projected at 3.1%, increasing the vulnerable position of the country by raising the demand for food, water, and other natural resources. Rural households are harder hit than urban households, and among the rural households the non-farm households suffer most from declining (access) to natural resources.

Yemen's economy has been dominated by the oil sector, which prior to the conflict accounted for 27% of the GDP, 50% of the national budget revenue and 70% of the exports⁴⁷. There is recognition that declining oil revenues and resource depletion render it necessary to diversify economic activity. The Government of Yemen has consequently scaled up its efforts to spur non-oil growth and create jobs in sectors such as agriculture, fisheries, natural gas, urban manufacturing, services, and the financial sector⁴⁸. With little arable land and small farms (1.7 ha per farm), agriculture nonetheless remains the most important sector employing 54% of the labour force and contributes around 19% of Yemen's GDP⁴⁹. Except for qat, production is mostly focused on subsistence farming. Since over 90% of water consumption is used for irrigation, the government of Yemen is concerned that climate change will decrease the frequency and amount of rainfall, thereby destroying the country's agricultural production. This would not only result in a water crisis, but also in food and economic crises. The severity of the crisis is expressed in the projection that Sana'a is the only capital city in the world that may run out of fresh water within the next decade⁵⁰.

Yemen imports 70–90% of its cereals and is a net importer of many other food items as well⁵¹. Maize, millet, sorghum, and wheat are cultivated in Yemen, yet mainly for household or village level consumption (see [Map 5](#) for production details per zone). The ancient terraces designed to be flood-irrigated are becoming high risk with changes in climate as the seed can germinate and then die due to lack of water⁵². As can be seen in the table below, wheat is considered the most vulnerable crop, followed by maize. In zone 3, sorghum and millet experience high yield increases and at the same time they account for a larger share of agricultural value-addition than in any other zone, whereas the grains with declining yields (maize and wheat) are hardly produced⁵³ since these are not preferred crops for agricultural production.

⁴⁷ <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Yemen/1/Yemen%20INDC%2021%20Nov.%202015.pdf>

⁴⁸ World Bank (2011)

⁴⁹ CIA (2015). The World Factbook – Yemen. Available via <https://www.cia.gov/library/publications/the-world-factbook/geos/ym.html>

⁵⁰ Glass (2010)

⁵¹ Glass (2010) and Wiebelt et al. (2011)

⁵² World Bank; UN; EU; Islamic Development Bank (IDB), 2012: Joint Social and Economic Assessment for the Republic of Yemen, <https://openknowledge.worldbank.org/bitstream/handle/10986/11920/693880ESW0P1300sment0pub08031012web.pdf?sequence=1>

⁵³ Wiebelt et al. (2011)

	<i>Maize</i>	<i>Millet</i>	<i>Sorghum</i>	<i>Wheat</i>
Yemen (total)	+0.1 – 1.4%	+0.1 – 4.0%	+0.3 – 2.7%	-0.1 – +0.1%
Upper Highlands	+0.3 – 1.3%	+1.0 – 3.6%	+0.8 – 2.4%	-0.1 – +0.1%
Lower Highlands	-0.1 – +1.7%	+0.0 – 3.3%	+0.1 – 2.4%	-0.3 – +0.3%
Red Sea/Tihama	-0.5 – -0.4%	+0.1 – 4.0%	+0.2 – 4.0%	-1.0 – -0.5%
Arabian Sea	-0.3 – +0.2%	+ 0.2 – 4.0%	+0.3 – 4.0%	-0.3%
Internal Plateau	-0.7 – +0.7%	+ 0.8 – 4.0%	+0.2 – 4.0%	-0.4 – +1.6%
Desert	-0.5 – -0.4%	-0.9 – +4.0%	-0.8 – 4.0%	-0.8 – -0.6%

Main expected rain fed crop yield changes 2000–2050 for six regions in Yemen⁵⁴

Prior to the anticipated climatic changes, in general there is poor physical access to local markets due to a lack of means of transport, road infrastructure, and gender issues (women with limited freedom of movement). Considering that qat is moved efficiently, there seem to be insufficient incentives and investment in the processing and transport of food crops. The three most influential factors governing the rise in food insecurity are the humanitarian crisis, extortionate transportation costs, and high levels of physical insecurity. Contributing to food insecurity is the domination of the market by a small number of importers, which can result in increases in food prices even when economic circumstances are relatively stable. Insecure and unstable (political) situations add to food insecurity. In Sana'a city, for example, more than half the population is said to have had reduced physical access to food as a result of the (2013) protests. In the current crisis, over 1.6 million people are suffering from acute malnutrition, including 840,000 girls and boys (6–59 months old), of which approximately 170,000 are severely malnourished and in need of direct nutritional support⁵⁵. This adds to an estimated 2.2 million chronically malnourished children in the country.

While the expected consequences of climate change will bear substantial costs in terms of lives and livelihoods, it will impact disproportionately vulnerable populations, such as women and youth. As water access declines, women and young girls, already travelling long distance for water, will experience further challenges to their health, safety, and ability to receive education¹⁷. The absence of adequate natural resources management in combination with ongoing conflicts is likely to diminish Yemen's climate readiness in terms of governance and economic prosperity.

⁵⁴ Wiebelt et al. (2011)

⁵⁵ European Commission (2015)

National government strategies and policies

Climate change adaptation and mitigation does not dominate Yemen's policymaking and political activity. According to the Climate Investment Fund (CIF), Yemen's development planning is dictated largely by the immediate survival needs of its population, which constrains the government's ability to invest in longer-term strategies for sustainable resource use and climate risk reduction⁵⁶.

Yemen ratified the UN Convention on Biological Diversity (CBD) for which it elaborated a Biological Diversity National Strategy and Plan of Action in 2005⁵⁷, the Convention to Combat Desertification (CCD)⁵⁸ for which it did not elaborate a National Plan of Action, the Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol. Yemen drafted its Initial National Communication in 2001, and submitted its Second National Communication (SNC) to the UNFCCC in 2013. It also completed its Greenhouse Gas (GHG) inventory as part of the SNC. The latter moreover specifies projects to be implemented in the field of water resources and coastal zone management, and agricultural assessments (adaptation), as well as renewable energy assessments (mitigation)⁵⁹. Climate change was mainstreamed into key developmental and sector policies including agricultural as well as fishery sector development strategies.

In Yemen's National Adaptation Programme of Action (NAPA), major vulnerabilities are listed for seven economic sectors. These include water, agriculture/food security, coastal areas, and coastal infrastructure. The NAPA was developed in 2009 and its primary goal was to identify priority measures to adapt to climate change and climate variability, and translate them into project-based activities that can address Yemen's urgent needs for adapting to the adverse impacts of climate change. As a follow-up to its NAPA, Yemen submitted 12 NAPA projects to the UNFCCC in 2013⁶⁰. The projects promote traditional land and coastal management approaches that are resilient in the context of current challenges, including climate change impacts⁶¹. However, due to a lack of valid data, low awareness of climate change, and political instability, little progress is made so far.

Through the development of its NAPA, Yemen also identified a number of barriers to taking action to assess and adapt to climate change. These barriers include: weak institutional structures and environmental legislations, lack of appropriate data and inadequate institutional, technical and financial capacity to develop, modify or interpret existing models and methodologies. Entrenched poverty conditions worsen local conditions and constrain efforts to build resilience⁶².

⁵⁶ Climate Investment Funds (2015): *Yemen*, <https://www.climateinvestmentfunds.org/cifnet/?q=country/yemen>

⁵⁷ Yemen Ministry of Water and Environment, Environment Protection Authority (EPA) (2002): *National Biodiversity Strategy and Action Plan* <http://www.cbd.int/doc/world/ye/ye-nbsap-01-en.pdf>

⁵⁸ United Nations Convention to Combat Desertification, (2014): <http://www.unccd.int/Lists/SiteDocumentLibrary/convention/Ratification%20list%20May2014.pdf>

⁵⁹ Republic of Yemen (2013): *Second National Communication under the UNFCCC* <http://unfccc.int/re-source/docs/natc/yemnc2.pdf>

⁶⁰ UNFCCC (2013): *Index of NAPA Projects by Country*. http://unfccc.int/files/cooperation_support/least_developed_countries_portal/napa_project_database/application/pdf/napa_index_by_country.pdf

⁶¹ Zubrycki, K.; Crawford, A.; Hove, H.; Parry, J-O., (2011): *Review of Current and Planned Adaptation Action: North Africa*, Adaptation Partnership. <http://www.adaptationpartnership.org/resource/north-africa-current-and-planned-adaptation-action>

⁶² YEPA (2009), in Zubrycki et al (2011)

With support from UNDP, Yemen began the preparation of a Low-Emission Development Strategy (LEDS) in 2013 with the development of a roadmap⁶³. In this LEDS Roadmap⁶⁴ it was noted that Yemen had not yet designated a dedicated national institution for administering climate change policies and strategies.

Intended Nationally Determined Contribution (INDC)

In spite of the country's conflict, Yemen submitted its Intended Nationally Determined Contribution (INDC) in November 2015. Yemen only contributes an estimated 0.1% of global GHG emissions, but is highly vulnerable to climate change impacts⁶⁵. The country commits to a **14% GHG-emission reduction** by 2030 compared to a Business-as-Usual (BAU) scenario, of which **13% is contingent on international support and 1% will be covered by national sources**.

Mitigation. Mitigation measures focus on energy, agriculture and waste. Unconditional measures are scheduled on already in-progress and include a wind farm project, a rural energy access project and expansion of solar power technology. Conditional (international funding) mitigation measures are concentrated on energy (power generation) and include for example installation of combined-cycle gas turbines (CCGT) and combined heat and power systems (CHP); increasing use of renewable energy sources for electricity. Other sectors include transport (improving efficiency), industry, agriculture (introducing solar water pumping for irrigation and land management to reduce methane from soils), water (methane captures from wastewater treatment plants, desalination through renewable energy based techniques) and waste (landfill gas capture). Estimated costs for these conditional measures are still to be prepared and are not provided in the INDC.

Adaptation. Apart from the continuing implementation of several national policies, the following adaptation measures are foreseen:

- upscaling of rainwater harvesting;
- promoting drought management in agriculture;
- planning and implementing land resources management programs;
- livelihood approaches for integration natural resources management and preservation of ecosystems;
- disaster risk management (floods and droughts);
- capacity building and awareness raising (in general, for integrated coastal zones and marine resources management and institutional capacity for climate resilience).

⁶³ UNDP (2013), Development of National Low-Emission Development Strategy (LEDS) in Yemen. [http://www.undp.org/content/dam/yemen/E&E/Docs/UNDP-YEM-Development%20of%20National%20Low-Emission%20Development%20Strategy%20\(LEDS\)%20in%20Yemen.pdf](http://www.undp.org/content/dam/yemen/E&E/Docs/UNDP-YEM-Development%20of%20National%20Low-Emission%20Development%20Strategy%20(LEDS)%20in%20Yemen.pdf)

⁶⁴ UNDP (2013)

⁶⁵ Republic of Yemen (2015). Intended Nationally Determined Contribution (INDC) under the UNFCCC. Available via <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Yemen/1/Yemen%20INDC%2021%20Nov.%202015.pdf>

Climate finance

Yemen joined the Global Environment Facility (GEF) in 1994 and completed GEF enabling activities (to qualify for funding), including a National Biodiversity Strategy and Action Plan (NBSAP)⁶⁶ and a country self-assessment. Since it has joined the GEF, Yemen received GEF grants totalling USD45 million – that leveraged USD129 million in co-financing resources for 24 national projects. These include eight projects in biodiversity, three multi-focal area projects, eleven projects in climate change, and one in persistent organic pollutants⁶⁷. Yemen, considered prior to the conflict as a state with lower-middle incomes, received USD 41,270,000 in climate funds between 2004 and 2014 – placing the country at number 31 of the climate finance approved ranking list, which is composed of 135 countries. Also, due to its vulnerability, it is ranked 10th in the top ten recipients of adaptation finance and their national vulnerability⁶⁸.

Yemen is a pilot country for CIF's Pilot Project for Climate Resilience (PPCR), the purpose of which is to help developing countries to integrate climate resilience into development planning. According to CIF, one third of Yemen's population lives in poverty, making Yemen one of the poorest countries in the Middle East and North Africa (MENA) region⁶⁹. As the poorest country in the Middle East, the Yemen CIF/PPCR strategic program is designed to reduce the vulnerability of coastal populations and integrate climate resilience and adaptation planning and capacity into the water and agricultural sectors⁷⁰ with investments in three focus areas: Integrated Coastal Zone Management (USD 20 million k), Natural Resource Management and Rural Livelihoods (USD 11 million), and Climate Services (USD 19 million)⁷¹.

Yemen has not submitted any Nationally Appropriate Mitigation Actions (NAMAs) to the UNFCCC⁷², nor has it designated institutional structures for NAMA.

⁶⁶ Yemen Ministry of Water and Environment, Environment Protection Authority (EPA) (2002)

⁶⁷ GEF (2013): *Country profile Yemen*, <https://www.thegef.org/gef/sites/thegef.org/files/publication/Yemen%20-%20Fact%20Sheet%20-%20Nov2013.pdf>

⁶⁸ Nakhooda, S.; Norman, M. (2014): *Climate Finance: Is it making a difference? A review of the effectiveness of Multilateral Climate Funds*. ODI. <http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9359.pdf>

⁶⁹ Climate Investment Funds (2015)

⁷⁰ Climate Investment Funds (2012b): *PPCR Yemen factsheet*. http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/PPCR_Yemen.pdf

⁷¹ Climate Investment Funds (2012b)

⁷² UNFCCC (2015) NAMA Registry <http://www4.unfccc.int>

Climate change projects

According to the Adaptation Partnership, Yemen has executed relatively few projects in comparison to North–African countries in the domain of climate change up to May 2011 and is not actively involved in regional initiatives on adaptation to climate change. Moreover, proposed projects directly address adaptation needs of the country but give limited attention to the transfer of lessons learnt and sharing of experiences⁷³.

Nonetheless, in its INDC there are a number of mitigation and adaptation programmes reported to be underway⁷⁴. These include:

Mitigation:

- energy projects: Mocha Wind Farm, Rural Energy Access, Marib Gas turbine Power Station, and Expansion of Solar Power Technology in Yemen.

Adaptation:

- key programs identified in the NAPA are planned or under implementation, such as national early warning systems and climate vulnerability assessment of the country's key sectors;
- pilot project for Climate Resilience (PPCR), funded by World Bank/Climate Investment Fund (CIF) (see above);
- agriculture: small holder Agricultural Productivity Enhancement Program (SAPEP, under GAFSP); Rural Growth program; Rain-fed Agriculture and Livestock project; Climate resilience of Rural Communities (CRCC) project;
- environment: conservation and sustainable use of biodiversity.

The conflict has put on hold the implementation of climate relevant projects as well as other initiatives that are not humanitarian aid. In 2015 the European Commission did however allocate €52 million to assist populations across the country affected by acute malnutrition, conflict and forced displacement⁷⁵.

For a list of projects in Yemen funded through bilateral/multilateral climate funds, see the [Annex](#).

⁷³ Zubrycki et al (2011)

⁷⁴ <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Yemen/1/Yemen%20INDC%2021%20Nov.%202015.pdf>

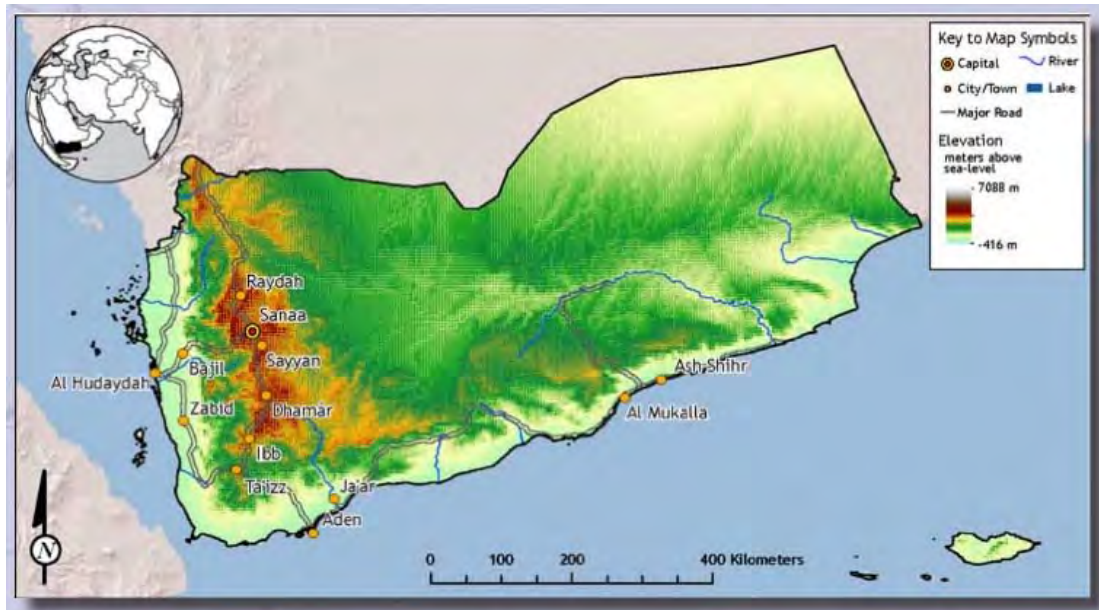
⁷⁵ European Commission (2015), http://ec.europa.eu/echo/files/infographics/infographic_yemen_en.pdf#view=fit

Climate contribution of the Netherlands Embassy: Pitch & Bid

Beginning in 2014, embassies with development programs have been annually preparing a climate Pitch & Bid. The *Pitch* communicates the embassy's climate-smart actions that will address climate change. Based on the actions described in the Pitch, assignment of the Rio Markers and budget information, each embassy prepares a *Bid* which is an estimate of how much of its budget is likely to be spent on projects that are relevant for climate in the coming three years. The embassy in Yemen's Bid estimated that during the 2016–2018 period its climate-smart development programs will contribute an estimated amount of € 1,190,583 to climate finance [2016: €385,200; 2017: €805,383; no budget allocated for 2018]. The activities being implemented support climate adaptation.

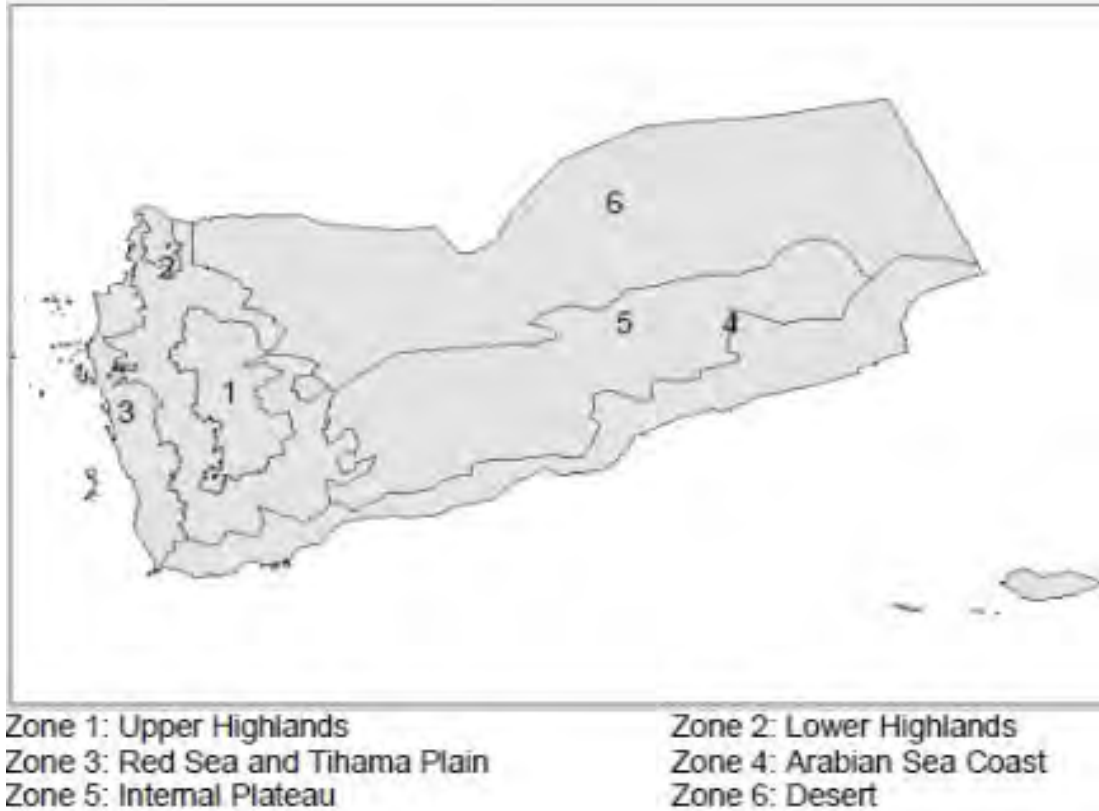
The Embassy's Pitch noted that for 2016 (and most likely for the period that Yemen is in war) the Embassy will seek to support organizations that manage to address (humanitarian) WASH needs in Yemen. New support will focus on WASH activities in the Sana'a basin to enable synergy between WASH- and water management activities.

Map 1: Yemen geography



Source: World Bank (2011)

Map 2: Yemen agro-ecological zones

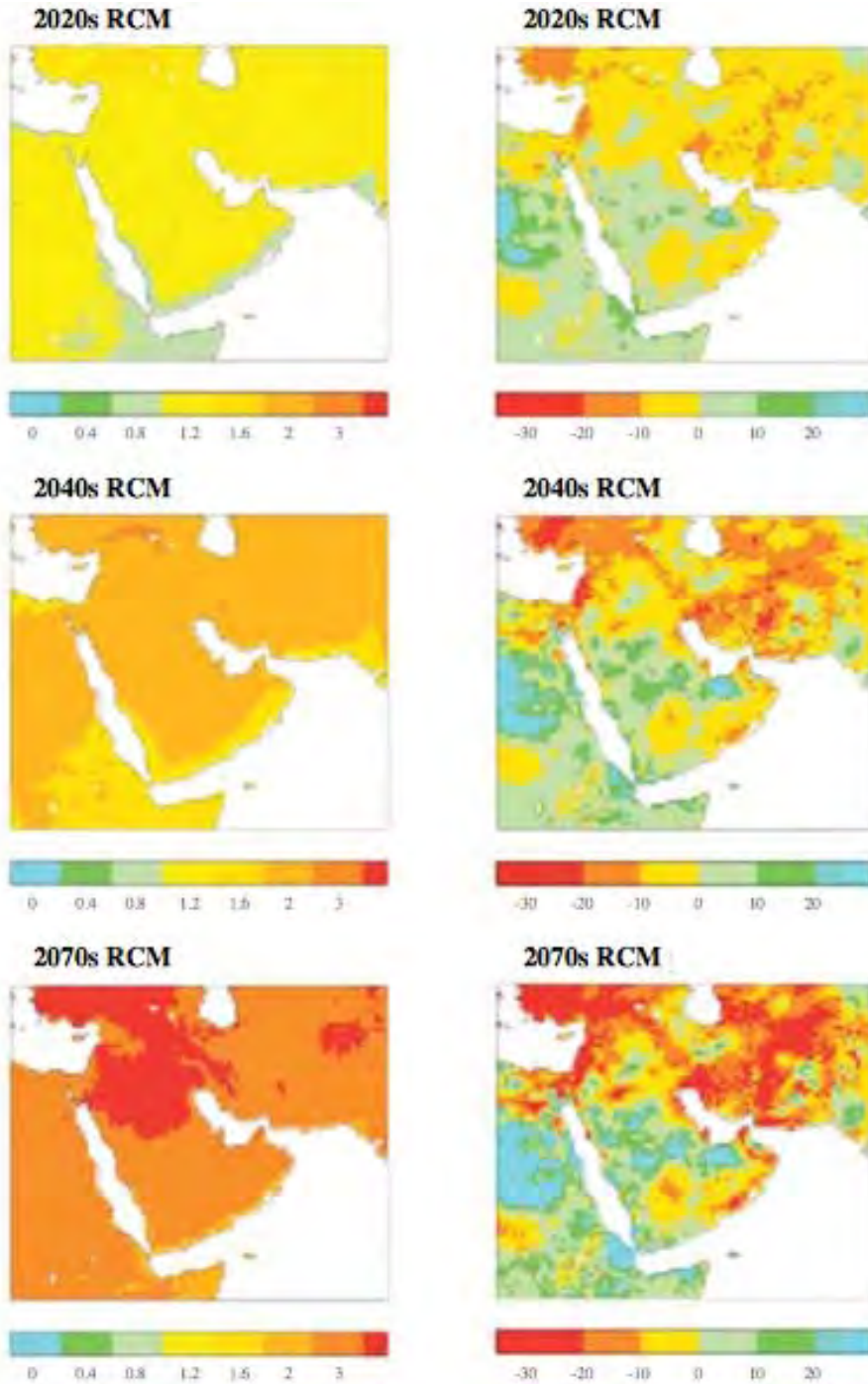


Source: Wiebelt et al. (2011)

Map set 3: Regional climate models for temperature and precipitation in the Gulf region

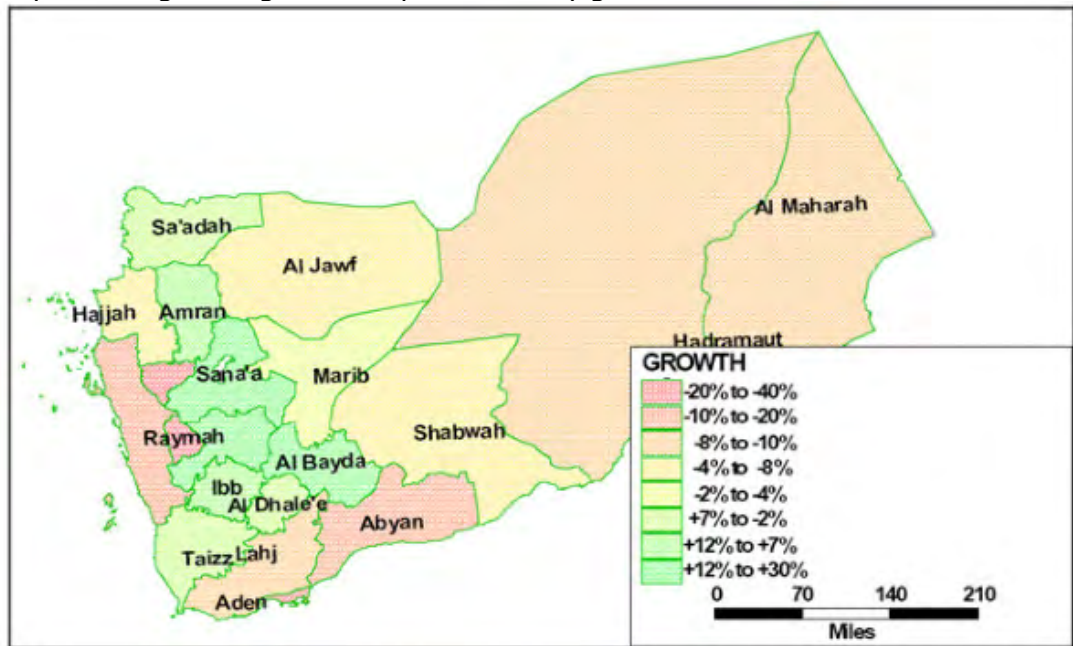
Left: projections of average temperature changes (in degrees Celsius) for the 2020s, 2040s and 2070s, relative to the 1990s.

Right: projections of precipitation changes (in percentage) for the 2020s, 2040s and 2070s, relative to the 1990s.



Source: Hemming D., Betts R., & Ryall D. (2007) <http://www.arab-hdr.org/publications/other/ahdrps/paper02-en.pdf>

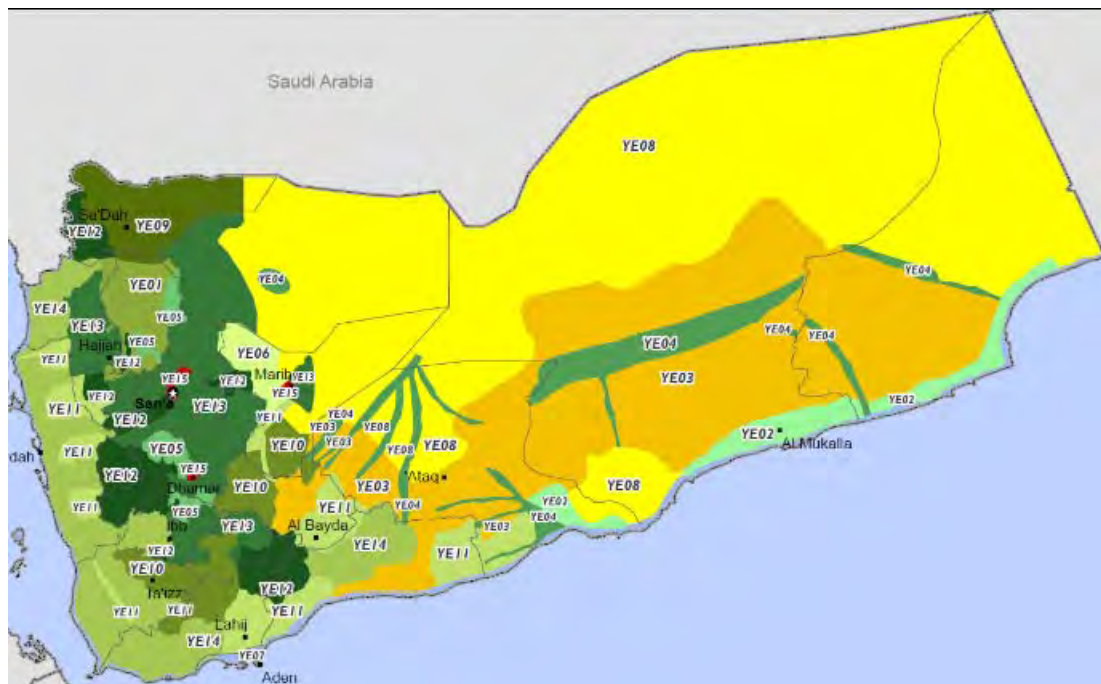
Map 4: Changes in agricultural production by governorate ('mid' scenario 2080)



Assumed temperature increase of 3.1% and rainfall decrease of 3%.

Source: World Bank (2010): *Yemen: Assessing the Impacts of Climate Change and Variability on the Water and Agricultural Sectors and the Policy Implications*. http://yncf.net/pdf/Climate_change_and_development/Yemen_Climate_Change_Study_April_8_2010.pdf

Map 5: Main production items per zone



- YE01 - Amran Rainfed Sorghum, Barley, Qat, and Livestock Zone
- YE02 - Arabian Sea Coastal Irrigated Tropical Fruit, Fodder and Livestock Zone
- YE03 - Central and Eastern Plateau Agro-Pastoral Zone
- YE04 - Central and Eastern Wadi Palm, Wheat, Vegetable and Livestock Zone
- YE05 - Central Highland Potato, Vegetable and Livestock Zone
- YE06 - Eastern Plateau Sorghum, Millet and Livestock Zone
- YE07 - Greater Yemen Coastal and Island Fishing Zone
- YE08 - Northern and Eastern Desert Pastoral Zone
- YE09 - Sa'adah Irrigated Wheat, Fruit, Vegetable, Qat, and Livestock Zone
- YE10 - Western and Central Highland Qat, Grain, Fodder and Livestock Zone
- YE11 - Western and Central Wadi Sorghum, Millet, Vegetable, Fruit and Livestock Zone
- YE12 - Western Central Highland Coffee, Qat, Sorghum and Livestock Zone
- YE13 - Western Central Highland Wheat, Sorghum, Qat, and Livestock Zone
- YE14 - Western Coastal Plain Sorghum, Millet, and Livestock Zone
- YE15 - Urban

Regional vulnerabilities

Overall: crop failure, crop and livestock disease
 YE02-03-04: rain failure, floods
 YE05: rain failure, frost
 YE08-09: rain failure
 YE14: lack of groundwater, water salinity

Source: FEWS NET (2011): Livelihoods Zoning "Plus" Activity in Yemen,
http://www.fews.net/sites/default/files/ye_zonedescriptions_en.pdf

Annex: List of projects in Yemen under multilateral climate funds

Source: *Climate Funds Update (2016)*: <http://www.climatefundsupdate.org/data>

Name of Project	Fund	Funding Approved (USD millions)	Disbursed (USD millions)	Fund Type
Development of a National Adaptation Programme of Action	Least Developed Countries Fund (LDCF)	0.2	0.2	Multilateral
Integrated Water Harvesting Technologies to Adapt to Climate Change Induced Water Shortage	Least Developed Countries Fund (LDCF)	5		Multilateral
Rural Adaptation in Yemen	Least Developed Countries Fund (LDCF)	10.1		Multilateral
Rural Growth Programme	Adaptation for Smallholder Agriculture Programme (ASAP)	10	0	Multilateral
Design of national Strategic Programs for Climate Resilience (SPCR) (phase 1 funding)	Pilot Programme for Climate and Resilience (PPCR)	1.5	1.01	Multilateral
Pilot Programme for Climate and Resilience (PPCR): <ul style="list-style-type: none"> • Climate Information System and PPCR Program Coordination (IBRD) • Integrated Coastal Zone Management • Natural Resource Management and Rural Livelihoods 	CIF/PPCR	50 For 3 focal areas		Multilateral
Yemen Geothermal Development Project	Global Environment Facility (GEF4)	1	1	Multilateral

Name of Project	Fund	Funding Approved (USD millions)	Disbursed (USD millions)	Fund Type
Investment Plan Preparation Grant	Scaling-Up Renewable Energy Program for Low Income Countries (SREP)	0.3		Multilateral
Third National Communication and First Biennial Update Report to the UNFCCC	Global Environment Facility (GEF5)	0.9	0.9	Multilateral
Mocha Wind Park Project ⁷⁶	World Bank	20		Multilateral
Rural Energy Access Project ⁷⁷	World Bank	25		Multilateral

⁷⁶ http://www.worldbank.org/projects/search?lang=en&searchTerm=&countrycode_exact=RY

⁷⁷ http://www.worldbank.org/projects/search?lang=en&searchTerm=&countrycode_exact=RY