CLIMATE RISK COUNTRY PROFILE

AFGHANISTAN

WORLD BANK GROUP

ASIAN DEVELOPMENT BANK

Graphic Design: Circle Graphics, Reisterstown, MD.

ACKNOWLEDGEMENTS

This profile is part of a series of Climate Risk Country Profiles that are jointly developed by the World Bank Group (WBG) and the Asian Development Bank (ADB). These profiles synthesize the most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The profile is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is co-led by Ana E. Bucher (Senior Climate Change Specialist, WBG) and Arghya Sinha Roy (Senior Climate Change Specialist, ADB).

This profile was written by Alex Chapman (Consultant, ADB), William Davies (Consultant, ADB) and Ciaran Downey (Consultant). Technical review of the profiles was undertaken by Robert L. Wilby (Loughborough University). Additional support was provided by Yunziyi Lang (Climate Change Analyst, WBG), MacKenzie Dove (Senior Climate Change Consultant, WBG), Adele Casorla-Castillo (Consultant, ADB), and Charles Rodgers (Consultant, ADB). This profile also benefitted from inputs of WBG and ADB regional staffs.

Climate and climate-related information is largely drawn from the Climate Change Knowledge Portal (CCKP), a WBG online platform with available global climate data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

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FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group (WBG) and the Asian Development Bank (ADB) are committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

Both institutions are investing in incorporating and systematically managing climate risks in development operations through their individual corporate commitments.

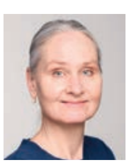
For the World Bank Group: a key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all International Development Association and International Bank for Reconstruction and Development operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the World Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one stop shop' for global, regional, and country data related to climate change and development.

For the Asian Development Bank: its Strategy 2030 identified "tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability" as one of its seven operational priorities. Its Climate Change Operational Framework 2017–2030 identified mainstreaming climate considerations into corporate strategies and policies, sector and thematic operational plans, country programming, and project design, implementation, monitoring, and evaluation of climate change considerations as the foremost institutional measure to deliver its commitments under Strategy 2030. ADB's climate risk management framework requires all projects to undergo climate risk screening at the concept stage and full climate risk and adaptation assessments for projects with medium to high risk.

Recognizing the value of consistent, easy-to-use technical resources for our common client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group and ADB's Sustainable Development and Climate Change Department have worked together to develop this content. Standardizing and pooling expertise facilitates each institution in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For common client countries, these profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

We hope that this combined effort from our institutions will spur deepening of long-term risk management in our client countries and support further cooperation at the operational level.



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KEY MESSAGES

- Afghanistan faces rates of warming higher than the global average with a potential rise of 1.4°C–5.4°C by the 2080s and the 2090s, compared with the baseline of 1986–2005. The range in possible temperature rises highlights the significant differences between 21st century emissions pathways.
- Rises in the annual maximum and minimum temperature are projected to be greater than the rise in average temperature, likely amplifying the pressure on human health, livelihoods, and ecosystems.
- Changes to Afghanistan's rainfall regime, and hence water resources, are highly uncertain, but an increase in the incidence of drought conditions is very likely, and the shifts in the runoff regime have already been documented. Over the long-term, loss of glaciers could fundamentally disrupt regional water and hydropower supplies.
- Arid land-cover is likely to expand either side of the Hindu Kush, leading to shifts in ecosystems and potentially loss of biodiversity.
- Events over the early 21st century show the extreme vulnerability of Afghanistan's communities to hazards such as drought and flash flooding. This vulnerability is amplified by poverty, undernourishment, food insecurity, and inequality.
- Temperature increases are likely to place strain on urban dwellers, outdoor laborers, and the country's energy network, with increased risk of heat-related sickness and fatalities under all emissions pathways.
- Comprehensive understanding of current and future climate risks across multiple sectors is severely constrained by a lack of data and research. This is an obstacle to adaptation and disaster risk reduction for Afghanistan.

COUNTRY OVERVIEW

Afghanistan is a landlocked nation at the juncture of the Central, West, and South Asian regions. Afghanistan's land surface includes considerable mountain cover, the Hindu Kush, with peaks as high as 7,000 meters (m). At lower altitudes are large expanses of arid steppe and a significant desert region found in the southwestern plateau. Though lacking in vegetation, these drier areas of the country nonetheless support biodiverse ecosystems and unique landscapes.

Afghanistan's communities are ethnically and culturally diverse, and generally less urbanized. As a result of long-running conflict and political turmoil, Afghanistan's population is among the world's most deprived, with a national poverty rate exceeding 50% in 2017, and the population also faces very significant issues with undernourishment (**Table 1**). Afghanistan has high unemployment and relies heavily on the agricultural sector, which constituted around 44% of employment in 2017, yet only 23% of gross domestic product (GDP).

TABLE 1. Key indicators

Indicator	Value	Source
Population Undernourished[1]	23% (2014–2016)	FAO, 2017
National Poverty Rate[2]	54.5% (2017)	CIA, 2019
Share Of Wealth Held by Bottom 20%[3]	N/A	World Bank, 2018
Net Annual Migration Rate[4]	0.29% (2010–2015)	UNDESA, 2017
Infant Mortality Rate (Between Age 0 And 1)[4]	6.86% (2010–2015)	UNDESA, 2017
Average Annual Change in Urban Population[5]	0.88% (2010–2015)	UNDESA, 2018
Dependents per 100 Independent Adults[4]	142.2 (2015)	UNDESA, 2017
Urban Population as % of Total Population[6]	25.5% (2018)	CIA, 2018
External Debt Ratio To GNI[7]	12.2% (2016)	ADB, 2018b
Government Expenditure Ratio to GDP[7]	24.4% (2017)	ADB, 2018b

The country's vulnerability is recognized by Afghanistan's Nationally Determined Contribution (NDC) submitted in 2016. Not only does the document highlight the nation's very modest contribution to the causes of climate change, but also the significant deficit in financial resources available to adapt to the diverse hazards already beginning to manifest as a result of human-induced climate change. Afghanistan's Second National Communication to the UNFCCC (NC2) highlights the country's commitment to increase its adaptation capabilities for the key sectors of agriculture, human health, energy and infrastructure as well as increase the population's overall awareness about climate change.

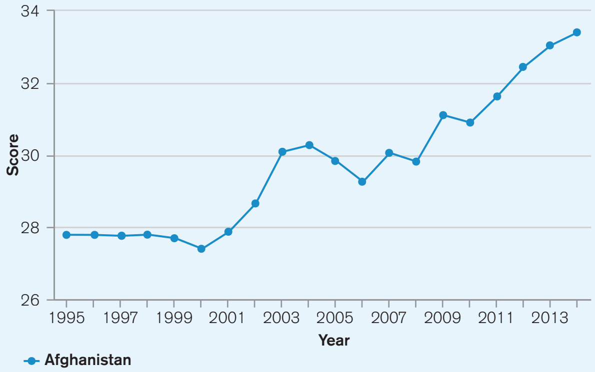
This document aims to succinctly summarize the climate risks faced by Afghanistan. This includes rapid onset and long-term changes in key climate parameters, as well as impacts of these changes on communities, livelihoods and economies, many of which are already underway. This is a high-level synthesis of existing research and analyses, focusing on the geographic domain of Afghanistan, therefore potentially excluding some international influences and localized impacts. The core data presented is sourced from the database sitting behind the World Bank Group's Climate Change Knowledge Portal (CCKP), incorporating climate projections from the Coupled Model Inter-comparison Project Phase 5 (CMIP5). This document is primarily meant for WBG and ADB staff to inform their climate action and to direct them to many useful sources of secondary data and research.

Due to a combination of political, geographic, and social factors, Afghanistan is one of the most vulnerable nations to climate change impacts in the world, ranked 176th out of 181 countries in the 2019 ND-GAIN Index.[8] The ND-GAIN Index ranks 181 countries using a score which calculates a country's vulnerability to

1 FAO, IFAD, UNICEF, WFP, WHO (2017). *The state of food security and nutrition in the world. Building Resilience for peace and food security*. FAO. Rome. URL: http://www.fao.org/3/a-i7695e.pdf
2 CIA (2019). *The World Factbook*. URL: https://www.cia.gov/library/publications/the-world-factbook/geos/af.html [accessed 07/05/19]
3 World Bank (2018). Income share held by lowest 20%. URL: https://data.worldbank.org/indicator/SI.DST.FRST.20 [accessed 26/02/2019]
4 UNDESA (2017). World Population Prospects 2017. URL: https://population.un.org/wpp/Download/Standard/Population/ [accessed 26/02/2019]
5 UNDESA (2018). World Urbanization Prospects 2018. URL: https://population.un.org/wup/Download/ [accessed 26/02/2019]
6 CIA (2018). *The World Factbook*. Central Intelligence Agency. Washington DC. URL: https://www.cia.gov/library/publications/the-world-factbook/
7 ADB (2018b). Key Indicators for Asia and the Pacific 2018, 49th Edition. Asian Development Bank. URL: https://www.adb.org/sites/default/files/publication/443671/ki2018.pdf
8 University of Notre Dame (2019). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/

climate change and other global challenges as well as their readiness to improve resilience. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 1** is a time-series plot of the ND-GAIN Index showing Afghanistan's development progress.

FIGURE 1. The ND-GAIN Index score (out of 100) summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience.[8]



CLIMATOLOGY

Climate Baseline

Overview

Afghanistan has an arid continental climate with considerable temperature and precipitation variation between seasons (**Figure 2**). Temperatures also vary greatly by altitude, with mountainous regions experiencing temperatures well below zero on an annual basis, yet southern arid regions regularly experiencing temperatures over 35°C. Precipitation varies considerably with topography, with the southwestern arid region typically experiencing less than 150 milimeters (mm) of precipitation each year, and the northeastern mountain range experiencing more than 1,000 mm.[9] Conditions in Afghanistan also have a complex intra-annual interaction with large-scale climate phenomena, specifically the El Niño Southern Oscillation (ENSO)[10] and the Indian Ocean Dipole.[11] The latter is associated with drought conditions in Afghanistan. **Figure 3** shows the spatial differences of observed temperature precipitation and rainfall in Afghanistan.

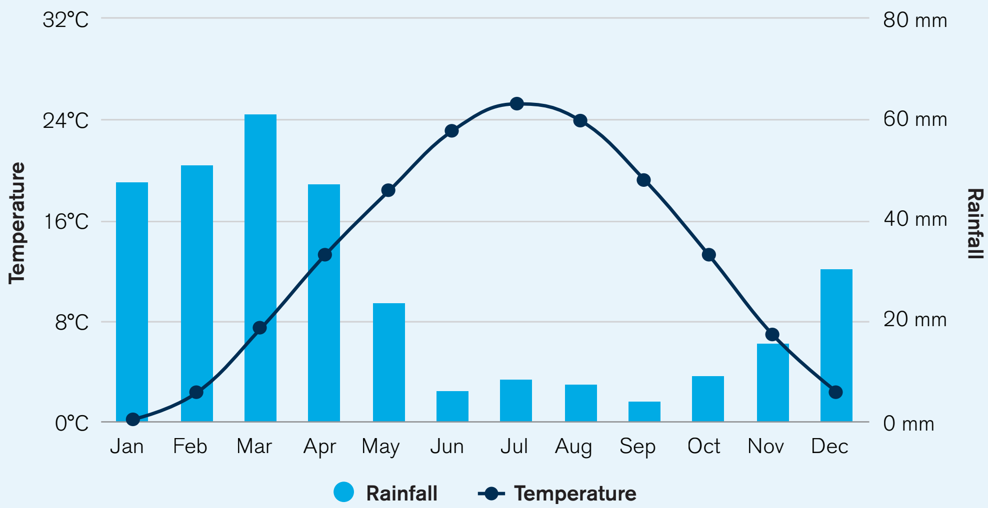
[9] Aich, V., Akhundzadah, N. A., Knuerr, A., Khoshbeen, A. J., Hattermann, F., Paeth, H., . . . Paton, E. N. (2017). Climate Change in Afghanistan Deduced from Reanalysis and Coordinated Regional Climate Downscaling Experiment (CORDEX)—South Asia Simulations. Climate, 5(2). URL: https://www.mdpi.com/2225-1154/5/2/38

[10] Dimri, A. P. (2013). Relationship between ENSO phases with Northwest India winter precipitation. International Journal of Climatology, 33(8), 1917–1923. URL: https://rmets.onlinelibrary.wiley.com/doi/epdf/10.1002/joc.3559

[11] Ummenhofer, C. C., D'Arrigo, R. D., Anchukaitis, K. J., Buckley, B. M., & Cook, E. R. (2013). Links between Indo-Pacific climate variability and drought in the Monsoon Asia Drought Atlas. Climate Dynamics, 40(5), 1319–1334. URL: https://academiccommons.columbia.edu/doi/10.7916/D8280JBH

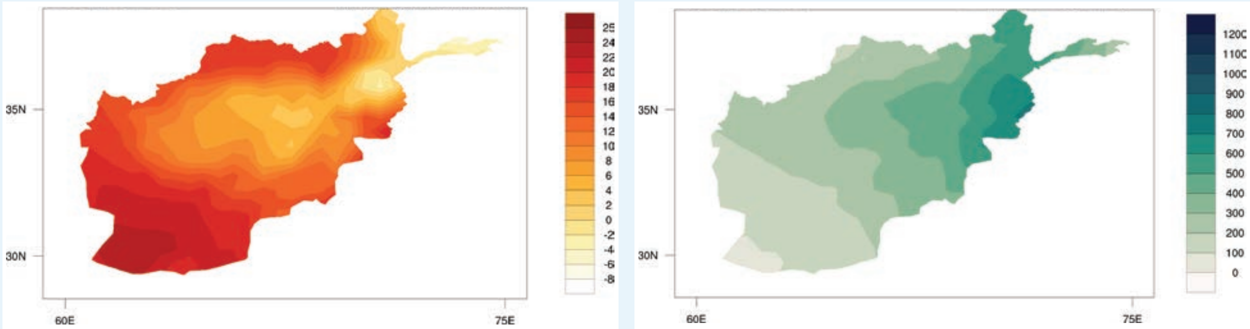
Annual Cycle

FIGURE 2. Average monthly temperature and rainfall in Afghanistan, 1901–2016[12]



Spatial Variation

FIGURE 3. Annual mean temperature (°C) (left), and annual mean precip (mm) (right) in Afghanistan over the period 1901–2019[13]



[12] WBG Climate Change Knowledge Portal (CCKP, 2019). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/afghanistan/climate-data-historical

[13] WBG Climate Change Knowledge Portal (CCKP, 2019). Afghanistan URL: https://climateknowledgeportal.worldbank.org/country/afghanistan/climate-data-historical

Key Trends

Temperature

While data availability for Afghanistan is somewhat limited, most records agree that there was warming of well over 1°C across most regions of Afghanistan over the 20th century. This is shown by the Berkeley Earth dataset,[14] which suggests an average change of around +1.5°C between the periods 1900–1917, and 2000–2017. Afghanistan's Second National Communication to the UNFCCC (NC2) (2019) also reports increased frequency of hot days and nights.[15] Warming has been strongest in Afghanistan's central and southwestern regions, and weakest in the northeast in the vicinity of Afghanistan's largest glaciers.[9]

Precipitation

Precipitation trends in Afghanistan over the past century have varied by region, with few areas of the country registering statistically significant changes. On the other hand, there has been a significant increase in the severity of drought in certain parts of the country. Between 1901 and 2010, there was a significant increase in drought severity in the southern provinces of Kandahar, Helmand and Nimruz during the wheat growing season (November to May), whereas drought intensity during the corn and rice growing seasons (primarily July to September) worsened significantly in the western third of Afghanistan's territory.[16] These changes in drought severity were most pronounced in the far western areas bordering Iran.[16] Some changes in precipitation patterns were observed between 1951–2010 across Afghanistan, including slight (<10%) reductions in mean annual rainfall across the west of the country, and less spring rainfall across all regions. However, these changes lie within the range of natural variability and, therefore, cannot be conclusively linked to climate change.[9]

A precautionary approach

Studies published since the last iteration of the IPCC's report (AR5), such as Gasser et al. (2018), have presented evidence which suggests a greater probability that earth will experience medium and high-end warming scenarios than previously estimated.[17] Climate change projections associated with the highest emissions pathway (RCP8.5) are presented here to facilitate decision making which is robust to these risks.

[14] Carbon Brief (2018). Mapped: How every part of the world has warmed – and could continue to. Infographics. 26 September 2018]. URL: https://www.carbonbrief.org/mapped-how-every-part-of-the-world-has-warmed-and-could-continue-to-warm

[15] National Environmental Protection Agency (2013). Afghanistan Initial National Communication to the UNFCCC. Islamic Republic of Afghanistan. URL: https://unfccc.int/sites/default/files/resource/afgnc1_0.pdf

[16] Qutbudin, I., Shiru, M.S., Sharafati, A., Ahmed, K., Al-Ansari, N., Yaseen, Z.M., Shahid, S. & Wang, X. (2019). Seasonal Drought Pattern Changes Due to Climate Variability: Case Study in Afghanistan. Water, 11, 1096. URL: https://www.mdpi.com/2073-4441/11/5/1096

[17] Gasser, T., Kechiar, M., Ciais, P., Burke, E. J., Kleinen, T., Zhu, D., . . . Obersteiner, M. (2018). Path-dependent reductions in CO2 emission budgets caused by permafrost carbon release. Nature Geoscience, 11, 830–835. URL: https://www.nature.com/articles/s41561-018-0227-0?WT.feed_name=subjects_carbon-cycle

Climate Future

Overview

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the Coupled Model Inter-comparison Project Phase 5 (CMIP5) models, which are utilized within the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), providing estimates of future temperature and precipitation. Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of greenhouse gas [GHG] emissions from all sources) pathway and level by 2100. In this analysis, RCP2.6 and RCP8.5, the extremes of low and high emissions pathways, are the primary focus: RCP2.6 represents a very strong mitigation scenario, whereas RCP8.5 assumes a business-as-usual. For more information, please refer to the RCP Database.

For Afghanistan, these models show a trend of consistent warming across different emissions scenarios. Projections in rainfall have greater uncertainty and vary by both RCP scenario as well as model. Projected precipitation trends indicate a minimal reduction in average daily rainfall, but an increase in intensity for extreme rainfall events. **Tables 2** and **3** below, provide information on temperature projections and anomalies for the four RCPs over two distinct time horizons; presented against the reference period of 1986–2005.

TABLE 2. Projected anomaly (changes °C) for maximum, minimum, and average daily temperatures in Afghanistan for 2040–2059 and 2080–2099, from the reference period of 1986–2005 for all RCPs. The table shows the median of the CCKP model ensemble and the 10th–90th percentiles in brackets[18]

	Average Daily Maximum Temperatures		Average Daily Temperatures		Average Daily Minimum Temperatures	
Scenario	**2040–2059**	**2080–2099**	**2040–2059**	**2080–2099**	**2040–2059**	**2080–2099**
RCP2.6	1.5 (–0.1, 3.4)	1.5 (–0.3, 3.4)	1.5 (0.0, 3.1)	1.4 (–0.1, 3.1)	1.5 (–0.1, 3.3)	1.3 (–0.3, 3.2)
RCP4.5	2.1 (0.4, 3.9)	2.9 (1.7, 4.9)	2.0 (0.4, 3.6)	2.7 (1.0, 4.5)	1.9 (0.2, 3.9)	2.6 (0.7, 4.8)
RCP6.0	1.7 (0.3, 3.6)	3.7 (1.9, 5.8)	1.7 (0.4, 3.2)	5.4 (2.0, 3.8)	1.7 (0.0, 3.3)	3.3 (1.6, 5.3)
RCP8.5	2.7 (0.9, 4.6)	5.8 (3.8, 8.1)	2.6 (1.1, 4.3)	5.5 (3.8, 7.5)	2.6 (0.7, 4.5)	5.5 (3.4, 7.6)

[18] World Bank Climate Change Knowledge Portal (2018). Climate Data: Projection. URL: https://climateknowledgeportal.worldbank.org/country/afghanistan/climate-data-projections

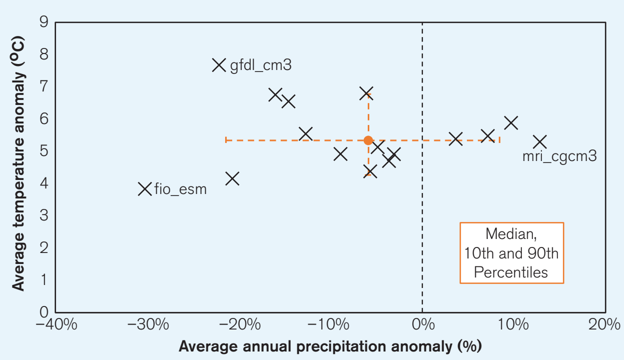
TABLE 3. Projections of average temperature changes (°C) in Afghanistan for different seasons (3-monthly time slices) over selected time horizons and emissions pathways, showing the median estimates of the full CCKP model ensemble and the 10th and 90th percentiles in brackets[18]

	2040–2059		2080–2099	
Scenario	**Jun–Aug**	**Dec–Feb**	**Jun–Aug**	**Dec–Feb**
RCP2.6	1.8 (0.3, 3.4)	1.4 (0.0, 3.0)	1.7 (–0.1, 3.5)	1.3 (–0.3, 2.8)
RCP4.5	2.2 (0.4, 3.8)	1.9 (0.4, 3.4)	3.0 (1.2, 5.0)	2.7 (1.2, 4.5)
RCP6.0	2.0 (0.6, 3.4)	1.7 (0.1, 2.8)	3.7 (2.5, 5.8)	3.4 (1.7, 5.0)
RCP8.5	2.7 (1.3, 4.2)	2.5 (0.8, 4.1)	5.8 (4.2, 7.9)	5.3 (3.4, 7.3)

Model Ensemble

Climate projections presented in this profile are derived from datasets available through the CCKP, unless otherwise stated. These datasets are processed outputs of simulations performed by multiple General Circulation Models (GCM) (for further information see Flato et al., 2013).[19] Collectively, these different GCM simulations are referred to as the 'model ensemble'. Due to the differences in the way GCMs represent the key physical processes and interactions within the climate system, projections of future climate conditions can vary widely between different GCMs, this is particularly the case for rainfall related variables and at national and local scales. The range of projections from 16 GCMs on the indicators of average temperature anomaly and annual precipitation anomaly for Afghanistan under RCP8.5 is shown in **Figure 4**. Future projections of annual temperature and precipitation for mid and late century are presented in **Figure 5**.

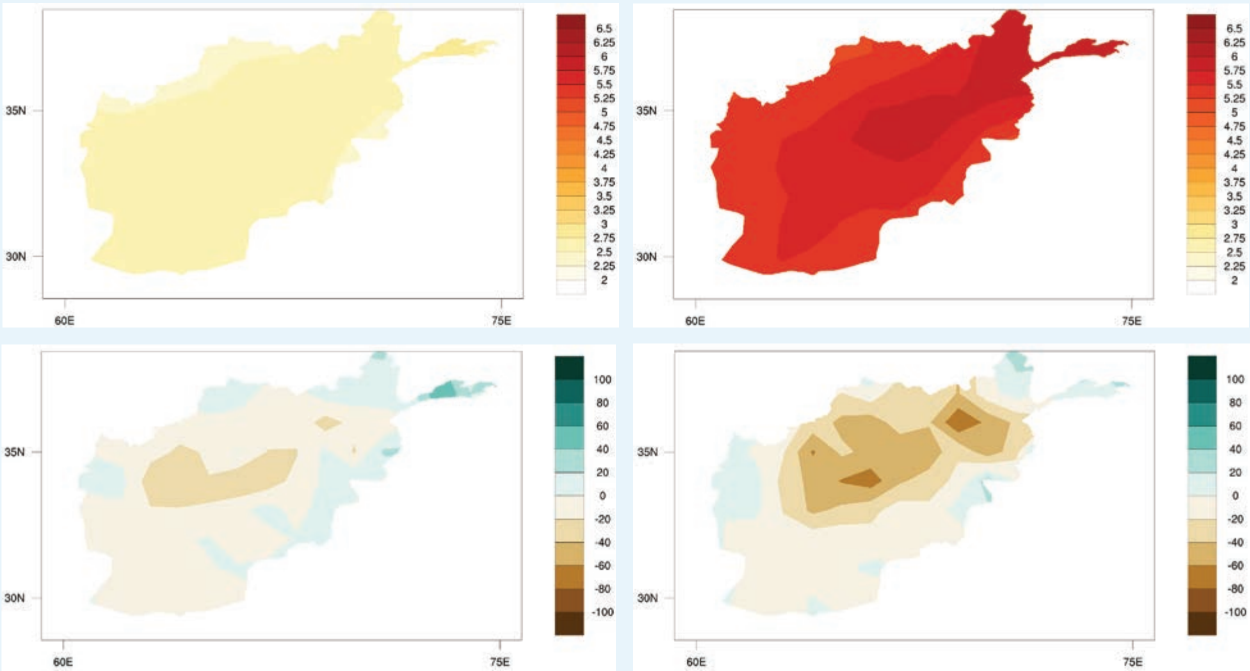
FIGURE 4. 'Projected average temperature anomaly' and 'projected annual rainfall anomaly' in Afghanistan. Outputs of 16 models within the ensemble simulating RCP8.5 over the period 2080–2099. Models shown represent the subset of models within the CMIP5 ensemble which provide projections across all RCPs and, therefore-are most robust for comparison. Three models are labelled.



[19] Flato, G., Marotzke, J., Abiodun, B., Braconnot, P., Chou, S. C., Collins, W., . . . Rummukainen, M. (2013). Evaluation of Climate Models. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 741–866. URL: http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

Spatial Variation

FIGURE 5. CMIP5 ensemble projected change (32 GCMs) in annual temperature (top) and precipitation (bottom) by 2040–2059 (left) and by 2080–2090 (right) relative to 1986–2005 baseline under RCP8.5[20]



Temperature

Projections of temperature change are presented in three primary formats. **Table 2** shows the changes (anomalies) in daily maximum and minimum temperatures over the given time period, as well as changes in the average temperature. **Figures 6** and **7** display the annual and monthly average temperature projections. While similar, these three indicators can provide slightly different information. Monthly and annual average temperatures are most commonly used for general estimation of climate change, but the daily maximum and minimum can explain more about how daily life might be impacted in a region, via key variables such as the viability of ecosystems, health impacts, productivity of labor, and the yield of crops, which are often disproportionately influenced by temperature extremes.

[20] WBG Climate Change Knowledge Portal (CCKP 2019). Afghanistan. Climate Data. Projections. URL: https://climateknowledgeportal.worldbank.org/country/afghanistan/climate-data-projections

FIGURE 6. Historic and projected mean annual temperature in Afghanistan under RCP2.6 (blue) and RCP8.5 (red) estimated by the model ensemble. Shading represents the standard deviation of the model ensemble.[21]

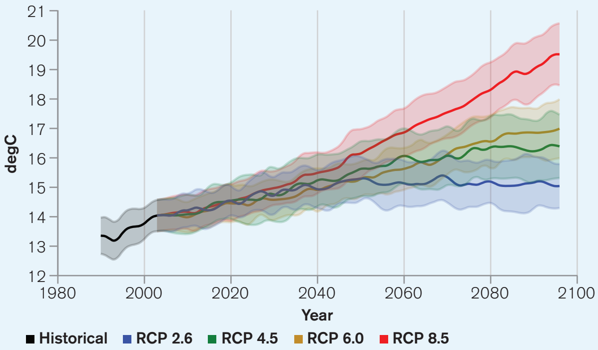
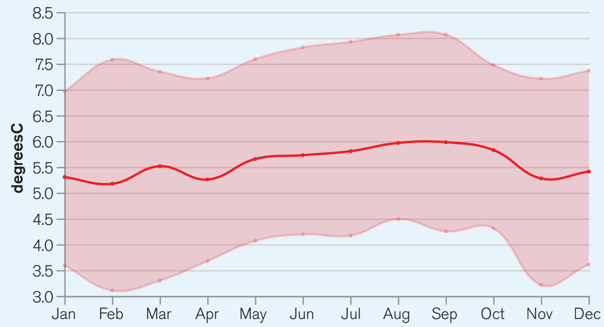


FIGURE 7. Projected change in monthly temperature, shown by month, for Afghanistan for the period 2080–2099 under RCP8.5. The values shown represent the median of the model ensemble with the shaded areas showing the 10th–90th percentiles.[22]



There is good agreement among climate models that Afghanistan can expect levels of warming above the global average. The ensemble projects an average rise of 5.5°C by the 2080s and the 2090s, under the highest emission pathway (RCP8.5). This is significantly higher than the projected global average rise of 3.7°C over the 1986–2005 baseline. In comparison, the rise projected under the lowest emission pathway (RCP2.6) of 1.4°C highlights what could be achieved through dramatic reductions in global greenhouse gas emissions. Such efforts might also protect Afghanistan from even more extreme projected rises in minimum and maximum temperature. There is some evidence in the CCKP model ensemble that temperature rises may be greater in the late summer months of August and September, but further modelling is required to better constrain these estimates.

Precipitation

The CCKP climate model ensemble suggests minimal change to the average annual precipitation total over the 21st century, as well as little change to the intensity of multi-day precipitation extremes in Afghanistan. However, there is considerable uncertainty in these projections. This is shown by the range in **Figure 8** and the different directions of change projected by individual models in **Figure 4**. Large uncertainty is also reported by other modelling studies looking at Afghanistan.[9] Some downscaling analyses have been conducted on a limited subset of models for the Kabul river basin region in the East of Afghanistan, which indicate 10%–20% increases in annual precipitation[23], as well as projections of a decrease.[24]

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[21] World Bank Climate Change Knowledge Portal (2018). Climate by Sector: Interactive Climate Indicator Dashboard. URL: https://climateknowledgeportal.worldbank.org/country/afghanistan/climate-sector-energy

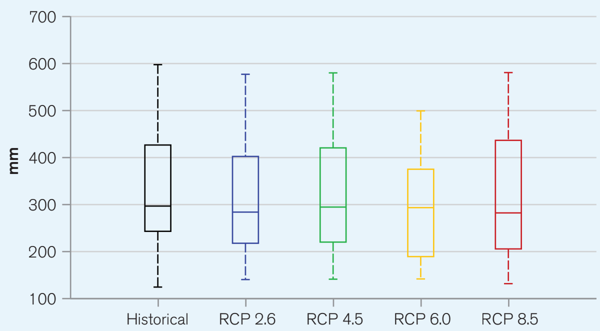
[22] World Bank Climate Change Knowledge Portal (2018). Climate by Sector: Interactive Climate Indicator Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=AFG&period=2080-2099

[23] Iqbal, M. S., Dahri, Z. H., Querner, E. P., Khan, A., & Hofstra, N. (2018). Impact of Climate Change on Flood Frequency and Intensity in the Kabul River Basin. Geosciences, 8(4). URL: https://www.mdpi.com/2076-3263/8/4/114

[24] Bokhari, S. A. A., Ahmad, B., Ali, J., Ahmad, S., Mushtaq, H., & Rasul, G. (2018). Future Climate Change Projections of the Kabul River Basin Using a Multi-model Ensemble of High-Resolution Statistically Downscaled Data. Earth Systems and Environment, 2(3), 477–497. URL: http://www.lead.org.pk/lead/Publications/Future%20Climate%20Change%20Projections%20of%20the%20Kabul%20River%20Basin%20using%20a%20multi-model%20ensemble%20of%20High-Resolution%20Statistically%20Downscaled%20Data.pdf

While considerable uncertainty surrounds projections of local, long-term precipitation changes, some global trends are evident. The intensity of sub-daily extreme rainfall events appears to be increasing with temperature — a finding supported by evidence from different regions of Asia.[25] There is some limited evidence of this trend emerging in Afghanistan, with 10%–25% increases in flash rainfall intensity documented in northeastern, eastern, and southern regions.[26] However, as this phenomenon is highly dependent on local geographical contexts, further research is required to constrain its impact in Afghanistan.

FIGURE 8. Projected average annual precipitation for Afghanistan in the period 2080–2099[27]



CLIMATE-RELATED NATURAL HAZARDS

Afghanistan faces some of the highest levels of natural hazard risk in the world. This is reflected in its ranking as the 5th most at-risk country in the INFORM 2019 Index.[28] Risk is driven by hazard exposure, notably communities face very significant impacts from flood (and associated threats from land and mudslide), and drought. Risk is further amplified by very high levels of social vulnerability and a large deficit in coping capacity (**Table 4**).

TABLE 4. Selected indicators from the INFORM 2019 Index for Risk Management for Afghanistan. For the sub-categories of risk (e.g. "Flood") higher scores represent greater risks. Conversely the most at-risk country is ranked 1st. Global average scores are shown in brackets.

Flood (0–10)	Tropical Cyclone (0–10)	Drought (0–10)	Vulnerability (0–10)	Lack of Coping Capacity (0–10)	Overall Inform Risk Level (0–10)	Rank (1–191)
7.2 [4.5]	0.0 [1.7]	7.9 [3.2]	8.2 [3.6]	7.2 [4.5]	8.0 [3.8]	5

[25] Westra, S., Fowler, H. J., Evans, J. P., Alexander, L. V., Berg, P., Johnson, F., Kendon, E. J., Lenderink, G., Roberts, N. (2014). Future changes to the intensity and frequency of short-duration extreme rainfall. Reviews of Geophysics, 52, 522–555. URL: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014RG000464

[26] National Environment Protection Agency/UNEP/WFP (2016). Climate change in Afghanistan: What does it mean for rural livelihoods and food security? United Nations Environment Programme (UNEP). URL: https://postconflict.unep.ch/publications/Afghanistan/Afg_CC_RuralLivelihoodsFoodSecurity_Nov2016.pdf

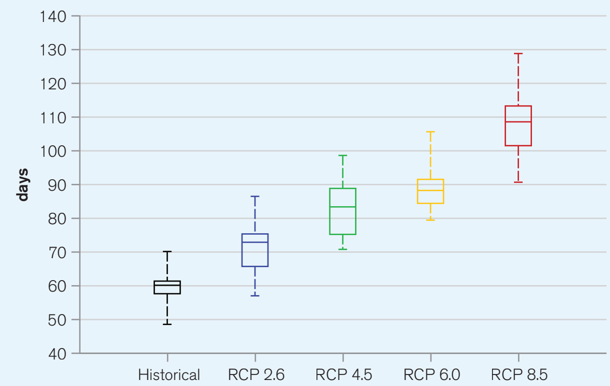
[27] WBG Climate Change Knowledge Portal (CCKP 2019). Afghanistan Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/water/land-use-/-watershed-management?country=AFG&period=2080-2099

[28] European Commission (2019). INFORM Index for Risk Management. Afghanistan Country Profile. URL: https://drmkc.jrc.ec.europa.eu/inform-index/Countries/Country-Profile-Map

Heat Waves

Afghanistan regularly experiences high maximum temperatures. The national average monthly maximum is around 20°C, with July maximum averages around 33°C. These national averages hide considerable sub-national variations and some extremely hot areas such as the cities of Kandahar (pop. 550,000) and Herat (pop. 440,000), which experience average July maxima of around 40°C and 37°C, respectively. The World Bank's GFDRR ThinkHazard! Portal designates the extreme heat hazard faced in Afghanistan's lower altitudes zones as 'high'.[29] Given the significant projected rises in temperature, the heatwave hazard (intensity and frequency) is expected to increase significantly.[9] Projections suggest that an extreme heatwave could occur every 6–10 years in Afghanistan under the RCP4.5 emissions pathway, or at every 1–2 years under the highest emissions pathway (RCP8.5).[30] Under all but the lowest emissions pathway (RCP2.6) temperatures will more regularly exceed 35°C (**Figure 9**) and, particularly under the highest emissions pathway (RCP8.5), could reach levels that are unsafe for human life.

FIGURE 9. Historical (1986–2005) and projected (2080–2099) frequency of days in which maximum temperature surpasses 35°C[31]



Drought

Two primary types of drought affect Afghanistan, meteorological (usually associated with a precipitation deficit) and hydrological (usually associated with a deficit in surface and subsurface water flow, potentially originating in the region's wider river basins). These issues may also combine with land and crop management practices to result in agricultural drought. At present, Afghanistan faces significant drought issues which have direct impacts on livelihoods and the economy.[32] Although there are few studies that have quantified their precise impact, drought events such as that of 2011 have been known to push millions into food insecurity and poverty. Water resources provided by runoff from mountainous regions are not well distributed to those sectors and communities who need them most and are often lost to inadequate and derelict infrastructure.[33]

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29 ThinkHazard! (2019). Afghanistan Extreme Heat. URL: http://thinkhazard.org/en/

30 Russo, S., Dosio, A., Graversen, R.G., Sillmann, J., Carrao, H., Dunbar, M.B., Singleton, A., Montagna, P., Barbola, P. & Vogt, J.V., (2014). Magnitude of extreme heat waves in present climate and their projection in a warming world. Journal of Geophysical Research: Atmospheres, 119, 12500–12512. URL: http://www.theurbanclimatologist.com/uploads/4/4/2/5/44250401/extremeheatwaves.pdf

31 WBG Climate Change Knowledge Portal (CCKP 2019). Afghanistan Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/water/land-use-/-watershed-management?country=AFG&period=2080-2099

32 Pervez, M. S., Budde, M., & Rowland, J. (2014). Mapping irrigated areas in Afghanistan over the past decade using MODIS NDVI. Remote Sensing of Environment, 149, 155–165. URL: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1850&context=usgsstaffpub

33 Ward, F. A., Amer, S. A., & Ziaee, F. (2013). Water allocation rules in Afghanistan for improved food security. Food Security, 5(1), 35–53. URL: https://water-research.nmsu.edu/files/2016/09/afghan-water-nov-2012.pdf

Research into the situation of farming households in Herat Province, in the west of the country indicates the numerous negative economic, social and environmental impacts of drought in Afghanistan.[34] Within this context, drought was found to severely reduce the availability of employment for unskilled workers, impacting their living standards and financial situation. The social implications of drought included conflict over water resources, an increase in migration and knock-on effects on mental and physical health and educational outcomes. Existing adaptation strategies in use in Herat Province were found to be ineffective in cases of severe drought.[35]

The nation's southeastern region is already chronically drought-impacted. As a proportion of Afghanistan's total land surface, the area affected is likely to expand considerably as a result of climate change. Naumann et al. (2018) provide a global overview of changes in drought conditions under different warming scenarios and highlight a potential doubling or tripling in the frequency of extreme drought events in Afghanistan by the middle of the century.[36] Meteorological drought issues are already increasing as a result of reduced spring precipitation and increased evaporation rates across the northwest, central and northeastern regions. At the same time hydrological drought has also emerged in the northeast due to reduced snowfall feeding of river systems.[37] Historically, this glacial meltwater has been vital to maintaining Afghanistan's water supply during drought years. The ongoing reduction in glacial mass in the region is projected to lead to reduced runoff in the second half of the 21st century, which would exacerbate the impact of drought on water supply in Afghanistan.[38] In depth research into these trends is urgently needed, but what evidence has been assembled suggests there is widespread livelihood vulnerability to these risks across Afghanistan.

Flood

Flood risk is widespread in Afghanistan, despite the generally arid, low-precipitation, environment. Data are severely limited, but there is sufficient evidence to say that flooding causes at least 100 deaths per year (likely a considerable underestimate), and that Afghanistan is a regionally significant disaster hotspot.[39] Flooding also increases the risk of waterborne diseases and has been identified as a causal factor in high rates of anemia among women of reproductive age in Afghanistan.[40] There have been attempts to remotely map flood hazard across Afghanistan.[41,42] Flash flooding together with land and mudslides are of particular concern. As

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34 Iqbal, M.W, Donjadee, S., Kwanyuen, B., & Liu, S.Y. (2018). Farmers' perceptions of and adaptations to drought in Herat Province, Afghanistan. Journal of Mountain Science 15(8). URL: https://link.springer.com/content/pdf/10.1007%2Fs11629-017-4750-z.pdf

35 National Environmental Protection Agency (2013). Afghanistan Initial National Communication to the UNFCCC. Islamic Republic of Afghanistan. URL: https://unfccc.int/sites/default/files/resource/afgnc1_0.pdf

36 Naumann, G., Alfieri, L., Wyser, K., Mentaschi, L., Betts, R. A., Carrao, H., . . . Feyen, L. (2018). Global Changes in Drought Conditions Under Different Levels of Warming. Geophysical Research Letters, 45(7), 3285–3296. URL: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2017GL076521

37 National Environmental Protection Agency (2013). Afghanistan Initial National Communication to the UNFCCC. Islamic Republic of Afghanistan. URL: https://unfccc.int/sites/default/files/resource/afgnc1_0.pdf

38 Pritchard, H.D. (2019). Asia's shrinking glaciers protect large populations from drought stress. Nature, 569, 649–654. URL: https://www.ncbi.nlm.nih.gov/pubmed/31142854

39 Elalem, S., & Pal, I. (2015). Mapping the vulnerability hotspots over Hindu-Kush Himalaya region to flooding disasters. Weather and Climate Extremes, 8, 46–58. URL: https://www.sciencedirect.com/science/article/pii/S2212094714000929

40 Oskorouchi, H.R., Nie, P. & Sousa-Poza, A. (2018). The effect of floods on anemia among reproductive age women in Afghanistan. PloS One, 13, p.e0191726. URL: https://www.ncbi.nlm.nih.gov/pubmed/29425219

41 Hagen, E., Shroder, J. F., Lu, X. X., & Teufert, J. F. (2010). Reverse engineered flood hazard mapping in Afghanistan: A parsimonious flood map model for developing countries. Quaternary International, 226(1), 82–91. URL: https://courses.nus.edu.sg/course/geoluxx%5Cnotes/2010%20Emlyn%20Hagen%20et%20al%20in%20QI.pdf

42 Bahadurzai, M., Shrestha, A. (2009). Flash flood risk assessment for Afghanistan. International Centre for Integrated Mountain Development (ICIMOD). URL: http://lib.icimod.org/record/26743/files/c_attachment_648_5831.pdf

well as floods triggered by intense precipitation events, Afghanistan's mountainous regions are also exposed to the risk of glacier lake outburst floods (GLOFs), which occur when the natural 'moraine' dam holding back glacier meltwater breaches. Analysis of satellite images has shown that glacial lakes in the area of the sources of the Amu Darya (including northeastern regions of Afghanistan) grew significantly in size between 1968 and 2009, suggesting an increased risk of GLOFs in the years to come.[43] Finally, Afghanistan's communities are also exposed to river 'fluvial' flooding. The World Resources Institute's AQUEDUCT Global Flood Analyzer can be used to establish a baseline level of river flood exposure. As of 2010, assuming protection for up to a 1-in-10-year event, the population annually affected by flooding in Afghanistan is estimated at 334,700 people and the impact on GDP is estimated at $411.1 million.[44]

There is limited research on climate change and flooding trends in Afghanistan. Some global models, such as that of Willner et al. (**Table 5**) and the AQUEDUCT model[44] suggest either no change, or small reduction in the number of people exposed to river flooding as a result of climate change. This trend links to the projected drying of Afghanistan, including some of its water courses, but will miss potentially increasing risks of surface water (pluvial) flooding. Other studies have suggested that some sections of the Helmand river basin have already experienced increases in flood risk due to snow and glacier melt.[26] Further studies utilizing limited sets of downscaled climate models have suggested increased river flood risk. For example, one study found that a 1 in 50-year flow in the Kabul river basin could become a 1 in 10-year event by the 2030s to the 2050s.[23] These findings are highly uncertain and, given the ongoing melting of many of Afghanistan's glaciers, further research is urgently required to understand future trends.[45]

TABLE 5. Estimated number of people in Afghanistan affected by an extreme river flood (extreme flood is defined as being in the 90th percentile in terms of numbers of people affected) in the historic period 1971–2004 and the future period 2035–2044. Figures represent an average of all four RCPs and assume present day population distributions (Willner et al., 2018).[46]

Estimate	Population Exposed to Extreme Flood (1971–2004)	Population Exposed to Extreme Flood (2035–2044)	Increase in Affected Population
16.7 Percentile	1,140,068	1,095,624	–44,444
Median	1,201,590	1,150,562	–51,028
83.3 Percentile	1,278,706	1,231,190	–47,516

[43] Mergili, M., Müller, J.P. and Schneider, J.F. (2013). Spatio-temporal development of high-mountain lakes in the headwaters of the Amu Darya River (Central Asia). Global and Planetary Change, 107, 13–24. URL: https://www.sciencedirect.com/science/article/pii/S092181811300091X?via%3Dihub

[44] WRI (2018). AQUEDUCT Global Flood Analyzer. URL: https://floods.wri.org/ [Accessed: 22/11/2018]

[45] Bajracharya, S. R., Maharjan, S. B., Shrestha, F., Guo, W., Liu, S., Immerzeel, W., & Shrestha, B. (2015). The glaciers of the Hindu Kush Himalayas: current status and observed changes from the 1980s to 2010. International Journal of Water Resources Development, 31(2), 161–173. URL: https://www.tandfonline.com/doi/pdf/10.1080/07900627.2015.1005731?needAccess=true

[46] Willner, S., Levermann, A., Zhao, F., Frieler, K. (2018). Adaptation required to preserve future high-end river flood risk at present levels. Science Advances: 4:1. URL: https://advances.sciencemag.org/content/4/1/eaao1914

Natural Resources

Water

Afghanistan's water resources situation is nuanced. The nation is arid, water scarce, and regularly drought afflicted, but simultaneously has access to significant water resource derived mainly (80%) from runoff from mountains over 2,000 m.[47] The most significant rivers by discharge volume are: the Amu Darya, running along the country's northern border; the Helmand river (and its wider drainage basin) in the south; and the Kabul/Kunar river network in the east. Analysis has suggested that Afghanistan contains several rivers which are already regionally significant in terms of their vulnerability across environmental, governance, economic, and social indicators. The Helmand River Basin is particularly vulnerable, and there is also concern about the Hari Rud and Amu Darya.[48] Multiple common water management issues include siltation of reservoirs, lack of flow monitoring, and inefficient infrastructure maintenance and operation.[49]

Traditional water sources for those living further from rivers in Afghanistan are also vulnerable to the impacts of climate change. Karezes (hand-dug systems of tunnels) have traditionally been used to supply water to areas at the southern and western fringes of the Hindu Kush and Paropamisus mountains.[50] Many of these karezes, which access ground water via subsurface canals, have dried up in the past two decades.[50] This reduction in water supply is likely to be compounded by projected temperature increases, via an accompanying reduction in snow cover at the sources of karezes.

The need for improved management practices is clear, but the status of the snow and glaciers which feed these rivers will also be of paramount importance to the future of Afghanistan's water resources. The available analysis suggests that the total ice mass held within the glacier systems, which feeds Afghanistan's rivers is declining.[45] In the short-term (i.e. current-day to the 2050s) it is likely that the runoff from major river systems will maintain or even increase as a result of glacier melting. Depending on changes in regional precipitation, loss of glaciers is likely to significantly reduce runoff over the longer-term. Changes to the runoff regime are also likely to develop over coming decades as the smoothing effect of glacier melt reduces, and spring and early-summer runoff peaks grow.[51] Studies suggest

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47 Shroder, J. F., & Ahmadzai, S. J. (2016). Transboundary Water Resources in Afghanistan: Climate Change and Land-Use Implications. Elsevier. URL: https://www.elsevier.com/books/transboundary-water-resources-in-afghanistan/shroder/978-0-12-801886-6

48 Varis, O., & Kummu, M. (2012). The Major Central Asian River Basins: An Assessment of Vulnerability. International Journal of Water Resources Development, 28(3), 433–452. URL: https://www.tandfonline.com/doi/abs/10.1080/07900627.2012.684309

49 Goes, B. J. M., Howarth, S. E., Wardlaw, R. B., Hancock, I. R., & Parajuli, U. N. (2016). Integrated water resources management in an insecure river basin: a case study of Helmand River Basin, Afghanistan. International Journal of Water Resources Development, 32(1), 3–25. URL: https://www.tandfonline.com/doi/full/10.1080/07900627.2015.1012661

50 Macpherson, G.L., Johnson, W.C., & Liu, H. (2017). Viability of karezes (ancient water supply systems in Afghanistan) in a changing world. Applied Water Science, 7, 1689–1710. URL: https://link.springer.com/article/10.1007/s13201-015-0336-5

51 Siegfried, T., Bernauer, T., Guiennet, R., Sellars, S., Robertson, A. W., Mankin, J., . . . Yakovlev, A. (2012). Will climate change exacerbate water stress in Central Asia? Climatic Change, 112(3), 881–899. URL: https://ideas.repec.org/a/spr/climat/v112y2012i3p881-899.html

a potential decline in runoff from the Amu Darya of 10%–20% by the 2070s to the 2090s.[52] These declines, in combination with temperature, evaporation and carbon dioxide (CO_2)-level changes, are likely to place significant strain on irrigation systems which will in turn create trans-boundary water management challenges[53] and potentially crop production losses. These changes, in the context of ongoing, rapid, and weakly regulated development, place increasing importance on land use planning, regulation and protection of ecosystem services, such as forest cover, which stabilize water resources.[54]

Land, Soil, and Biodiversity

Over recent decades, Afghanistan has seen rapid removal of its forest and shrub cover **(Figure 10)**. Alongside extensive overgrazing, these changes in vegetation cover have accelerated soil erosion, land degradation, and biodiversity loss.[55] As a result of projected increases in temperature and drought, many of Afghanistan's ecosystems are projected to undergo an ecological transition. Under higher emissions pathways, regions in both the west and east of Afghanistan's Hindu Kush mountain range are expected to convert from a sub-humid to semi-arid classification. A likely consequence of climate-driven shifts in ecozones will be a realignment of the viable ranges for many plant and animal species. In some cases, such as the snow leopard, there may be significant shrinkage of the viable habitat.[56] For others, such as the date palm tree, habitat lost in traditional locations may be replaced in other more northerly regions of the country.[57] In general terms, shifts are expected to be either away from the equator (northerly) or upslope (to higher altitudes),[58] hence the outlook for species currently inhabiting very high-altitude areas is precarious.

Economic Sectors

Agriculture

There is a high dependence on agriculture for livelihood and subsistence in Afghanistan, with the sector employing almost half the working population. Natural hazards represent a regular threat to local production and communities in the agricultural sector. As reported in Afghanistan's NC1, the nation was persistently affected by drought throughout the period 1997–2007, which was an influential factor in a 50% reduction in livestock

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52 White, C. J., Tanton, T. W., & Rycroft, D. W. (2014). The Impact of Climate Change on the Water Resources of the Amu Darya Basin in Central Asia. Water Resources Management, 28(15), 5267–5281. URL: https://pureportal.strath.ac.uk/en/publications/the-impact-of-climate-change-on-the-water-resources-of-the-amu-da

53 Laghari, A.N., Vanham, D. & Rauch, W. (2012). The Indus basin in the framework of current and future water resources management. Hydrology and Earth System Sciences, 16, 1063–1083. URL: https://www.hydrol-earth-syst-sci.net/16/1063/2012/

54 Najmuddin, O., Deng, X., & Siqi, J. (2017). Scenario analysis of land use change in Kabul River Basin – A river basin with rapid socio-economic changes in Afghanistan. Physics and Chemistry of the Earth, Parts A/B/C, 101, 121–136. URL: https://app.dimensions.ai/details/publication/pub.1090583150?and_facet_journal=jour.1294780&and_facet_for=2558

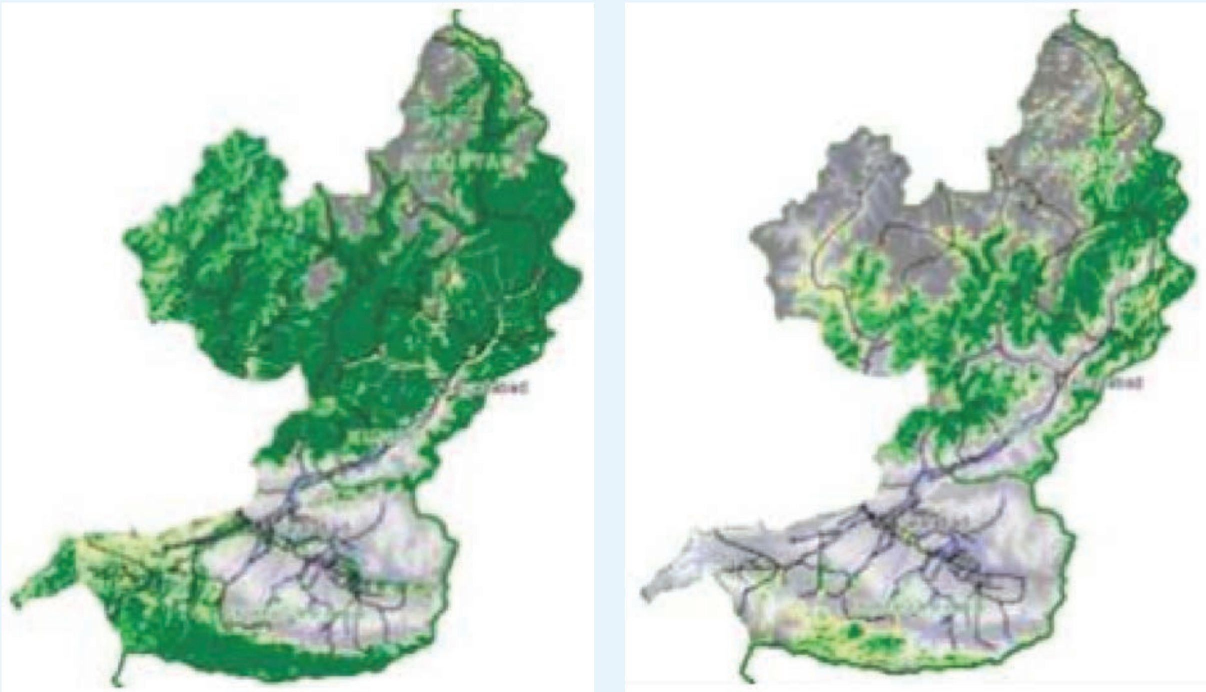
55 Shroder, J. F. (2012). Afghanistan: rich resource base and existing environmental despoliation. Environmental Earth Sciences, 67(7), 1971–1986. URL: https://pubag.nal.usda.gov/catalog/372575

56 Lovari, S., Ventimiglia, M., & Minder, I. (2013). Food habits of two leopard species, competition, climate change and upper treeline: a way to the decrease of an endangered species? Ethology Ecology & Evolution, 25(4), 305–318. URL: https://www.tandfonline.com/doi/abs/10.1080/03949370.2013.806362

57 Shabani, F., Kumar, L., & Taylor, S. (2012). Climate Change Impacts on the Future Distribution of Date Palms: A Modeling Exercise Using CLIMEX. PLOS ONE, 7(10), 1–12. URL: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0048021

58 Shah, R. D. T., Shah, D. N., & Domisch, S. (2012). Range shifts of a relict Himalayan dragonfly in the Hindu Kush Himalayan region under climate change scenarios. International Journal of Odonatology, 15(3), 209–222. URL: https://www.tandfonline.com/doi/abs/10.1080/13887890.2012.697399

FIGURE 10. Change in Afghanistan Forestry Cover, 1977 (left) to 2002 (right)[59]



numbers. Staple crops such as wheat are also highly susceptible to water shortages, with yields reducing by up to 50% during droughts in 2017–2018.[60] Studies have also shown that the irrigated agricultural production area can reduce by as much as 30% in years of water scarcity, indicating major livelihood impacts.[32] Due to its resilience to drought, cultivation of the opium poppy is correlated with drought conditions and has seen resurgence in the early 21st century.[61]

Despite the relative size of its agricultural sector, Afghanistan remains a net food importer in financial value terms, and as such is vulnerable to external price shocks. In recent years, annual cereal imports have been equivalent to 29% of annual domestic cereal production, driven in part by a lack of wheat milling capacity within the country.[62] At the same time, the population is heavily reliant on wheat for their food consumption, with this staple crop providing up to two-thirds of the average person's daily caloric intake.[63] The countries exporting wheat to Afghanistan, such as Kazakhstan, which has accounted for a large proportion of the country's imports

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[59] National Environmental Protection Agency (2013). Afghanistan Initial National Communication to the UNFCCC. Islamic Republic of Afghanistan. P. 16. URL: https://unfccc.int/sites/default/files/resource/afgnc1_0.pdf

[60] Government of the Islamic Republic of Afghanistan (2018). Country Statement. URL: https://www.unisdr.org/files/globalplatform/afghanistancountrystatement.pdf [accessed 08/05/2019]

[61] Parenti, C. (2015). Flower of War: An Environmental History of Opium Poppy in Afghanistan. SAIS Review of International Affairs 35(1), 183–200. URL: https://muse.jhu.edu/article/582537/pdf

[62] FAO (2019). GIEWS Country Brief: Afghanistan. URL: http://www.fao.org/giews/countrybrief/country/AFG/pdf/AFG.pdf [accessed 15/08/2019].

[63] d'Amour, C.B., Wenz, L., Kalkuhl, M., Steckel, J.C. and Creutzig, F. (2016). Teleconnected food supply shocks. Environ. Res. Lett, 11(035007). URL: https://iopscience.iop.org/article/10.1088/1748-9326/11/3/035007/meta

of wheat flour in recent years,[64] are expected to experience significant warming and an increase in drought frequency, which is likely to lead to reductions in crop yields in the absence of adaptation.[65] Potential reductions in wheat exports in drought years, either through reduced crop yields or export restrictions from major producers, may lead to food shortages in Afghanistan among the poorest households.[63]

Climate change will influence food production via direct and indirect effects on crop growth. Direct effects include alterations to carbon dioxide availability, precipitation and temperatures. Indirect effects include through impacts on water resource availability and seasonality, soil organic matter transformation, soil erosion, changes in pest and disease profiles, the arrival of invasive species, and decline in arable areas due to land degradation and desertification. On an international level, these impacts are expected to damage key crop yields, even on lower emissions pathways. Tebaldi and Lobell (2018) estimate 5% and 6% declines in global wheat and maize yields, respectively, even if the Paris Climate Agreement is met and warming is limited to 1.5°C. Shifts in the optimal and viable spatial ranges of certain crops are also very likely, though the extent and speed of those shifts remains dependent on the emissions pathway.[66]

Impacts from climate change may also have positive impacts on the country's agriculture, such as the increases in atmospheric CO_2 and lengthening of the growing season are projected by some studies to increase the potential revenue.[67] However, four key factors will constrain whether these gains are realizable: (i) efficient water management will be critical, especially in the context of disruption of traditional sources and runoff regimes (as discussed above); (ii) far reaching roll-out of adaptation technologies (new crop varieties, information and early warning systems etc.)[9]; (iii) preparing farmers for the arrival of new pests and disease[68]; and (iv), the role of intensified natural hazards, and preventing disaster with risk reduction will be vital. These factors depend on a more equal distribution of financial resources, power, and knowledge – all significant barriers identified by Afghanistan's (2016) Nationally Determined Contribution.[69]

A further, and perhaps lesser appreciated influence of climate change on agricultural production is through its impact on the health and productivity of the labor force. Dunne et al. (2013) suggest that global labor productivity during peak months has already dropped by 10% as a result of warming.[70] A further decline of up to 20% might be expected by mid-century under the highest emissions pathway (RCP8.5). More research is needed to understand how this issue might affect Afghanistan's lowland communities. In combination, it is highly likely that the above

[64] Observatory of Economic Complexity (2019). Where does Afghanistan import wheat flours from? URL: https://oec.world/en/visualize/tree_map/hs92/import/afg/show/1101/2017/ [accessed 15/08/2019]

[65] Pavlova, V.N., Varcheva, S.E., Bokusheva, R. and Calanca, P. (2014). Modelling the effects of climate variability on spring wheat productivity in the steppe zone of Russia and Kazakhstan. Ecological Modelling, 277, pp.57–67. URL: https://econpapers.repec.org/article/eeeecomod/v_3a277_3ay_3a2014_3ai_3ac_3ap_3a57-67.htm

[66] Tebaldi, C., & Lobell, D. (2018). Differences, or lack thereof, in wheat and maize yields under three low-warming scenarios. Environmental Research Letters: 13: 065001. URL: https://iopscience.iop.org/article/10.1088/1748-9326/aaba48

[67] Mendelsohn, R. (2014). The Impact of Climate Change on Agriculture in Asia. Journal of Integrative Agriculture, 13(4), 660–665. URL: https://www.sciencedirect.com/science/article/abs/pii/S2095311913607017

[68] Shabani, F., Kumar, L., & Esmaeili, A. (2014). Future distributions of Fusarium oxysporum f. spp. in European, Middle Eastern and North African agricultural regions under climate change. Agriculture, Ecosystems & Environment, 197, 96–105. URL: https://www.researchgate.net/publication/264709434_Future_distributions_of_Fusarium_oxysporum_f_spp_in_European_Middle_Eastern_and_North_African_Agricultural_Regions_under_Climate_Change

[69] Afghanistan (2016). Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Afghanistan%20First/INDC_AFG_20150927_FINAL.pdf

[70] Dunne, J. P., Stouffer, R. J., & John, J. G. (2013). Reductions in labour capacity from heat stress under climate warming. Nature Climate Change, 3(6), 563–566. URL: http://www.precaution.org/lib/noaa_reductions_in_labour_capacity_2013.pdf

processes will have a considerable impact on national food consumption patterns both through direct impacts on internal agricultural operations, and through impacts on the global supply chain. Without effective adaptation, and without development of disaster insurance and resilience building mechanisms the diverse risks, many of which are already impacting Afghanistan's communities, threaten to exacerbate malnutrition, poverty, and inequality.[26]

Urban and Energy

Prior research has established a reasonably well constrained relationship between heat stress and labor productivity, household consumption patterns, and (by proxy) household living standards.[71] In general terms, the impact of an increase in temperature on these indicators depends on whether the temperature rise moves the ambient temperature closer to, or further away from, the optimum temperature range. The optimum range varies depending on local conditions and adaptations, but studies have shown the potential for high-risk increases in temperature in many global cities, including Kabul, Afghanistan.[72]

The effects of temperature increase and heat stress in urban areas are compounded by the phenomenon of the Urban Heat Island efect (UHI). Dark surfaces, residential and industrial sources of heat, an absence of vegetation, and air pollution[73] can all push temperatures higher than those of the rural surroundings, commonly in the range of 0.1°C–3°C in global mega-cities.[74] As well as impacting on human health (see Communities) the temperature peaks resulting from combined UHI and climate change, as well as future urban expansion, are likely to damage the productivity of the service sector economy, both through direct impacts on labor productivity, but also through the additional costs of adaptation. However, there is limited work on UHI in Afghanistan.[75]

Research suggests that on average, a one degree increase in ambient temperature can result in a 0.5%–8.5% increase in electricity demand.[76] Notably, this serves business and residential air-cooling systems, however, this increase in demand places strain on energy generation systems which is compounded by the heat stress on the energy generation system itself, commonly due to its own cooling requirements, which can reduce its efficiency.[77] In Afghanistan's case, large proportions of the population do not have access to a reliable electricity

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[71] Mani, M., Bandyopadhyay, S., Chonabayashi, S., Markandya, A., Mosier, T. (2018). South Asia's Hotspots: The Impact of Temperature and Precipitation changes on living standards. South Asian Development Matters. World Bank, Washington DC. URL: https://openknowledge.worldbank.org/handle/10986/28723

[72] Milner, J., Harpham, C., Taylor, J., Davies, M., Le Quéré, C., Haines, A., & Wilkinson, P. (2017). The Challenge of Urban Heat Exposure under Climate Change: An Analysis of Cities in the Sustainable Healthy Urban Environments (SHUE) Database. Climate, 5(4). URL: https://www.mdpi.com/2225-1154/5/4/93

[73] Cao, C., Lee, X., Liu, S., Schultz, N., Xiao, W., Zhang, M., & Zhao, L. (2016). Urban heat islands in China enhanced by haze pollution. Nature Communications, 7, 1–7. URL: https://www.ncbi.nlm.nih.gov/pubmed/27551987

[74] Zhou, D., Zhao, S., Liu, S., Zhang, L., & Zhu, C. (2014). Surface urban heat island in China's 32 major cities: Spatial patterns and drivers. Remote Sensing of Environment, 152, 51–61. URL: https://www.researchgate.net/publication/263283084_Surface_urban_heat_island_in_China's_32_major_cities_Spatial_patterns_and_drivers

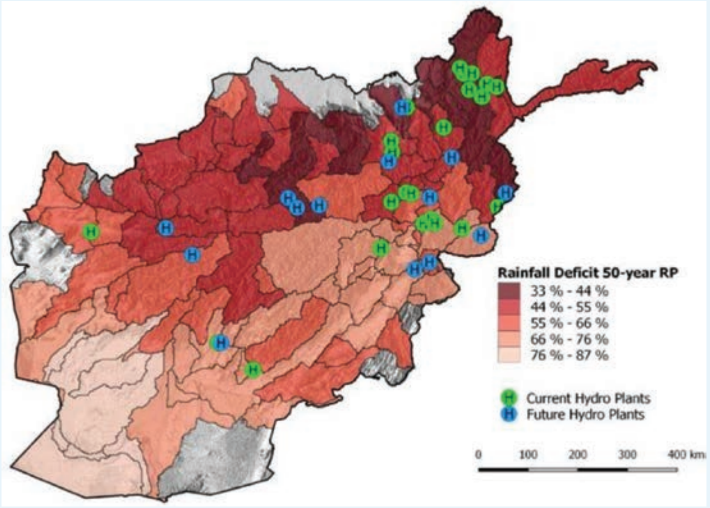
[75] Kotharkar, R., Ramesh, A., & Bagade, A. (2018). Urban Heat Island studies in South Asia: A critical review. Urban Climate, 24, 1011–1026. URL: https://www.semanticscholar.org/paper/Urban-Heat-Island-studies-in-South-Asia%3A-A-critical-Kotharkar-Ramesh/095dc014c2ed2cbec1a8830f085ac3847ec9b44e

[76] Santamouris, M., Cartalis, C., Synnefa, A., & Kolokotsa, D. (2015). On the impact of urban heat island and global warming on the power demand and electricity consumption of buildings—A review. Energy and Buildings, 98, 119–124. URL: https://pdfs.semanticscholar.org/17f8/6e9c161542a7a5acd0ad500f5da9f45a2871.pdf

[77] ADB (2017). Climate Change Profile of Pakistan. Asian Development Bank. URL: https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf

source (only 30% received electricity from the grid in 2013–14), nor cooling technology. Most of the grid's local electricity generation is hydropower and more plants are planned. Small-scale local hydropower is also important to communities.[78] An existing vulnerability in this system is that peak runoff does not coincide with peak energy demand. The ways in which climate change will influence this system are poorly understood and understudied. There is potential for changes in the precipitation regime, and intensified meteorological drought, to reduce hydropower potential in the short-term **(Figure 11)**, but projections are uncertain. Over the long-term, it is likely that glacier loss will reduce the hydropower generation potential in Afghanistan. However, with sufficient investment this deficit may be compensated by other renewable energy sources at the nation's disposal.[78] Afghanistan has abundant potential for solar and wind energy generation, with recent estimates suggesting that the country's generation potential from either one of those renewable sources exceeds the country's total projected power demand in 2032.[79]

FIGURE 11. Rainfall deficit in 2017 with respect to the reference period 1958–2001 for a 50 year return period meteorological drought, along with the current and planned hydro power plants[78]



Communities

Poverty, Inequality, and Vulnerability

Poverty and food insecurity are highly prevalent in Afghanistan (**Table 1**) and are concentrated in the rural areas. Events such as the drought of 2011, which contributed to malnutrition in over 100,000 children, and the drought in 2018 and 2019, which displaced over 400,000 people,[80] underscore the risks presented by climate change.[47] These threats can also be articulated in economic terms. For example, drought in 2018 reduced wheat yields by more than 60% and a $550 million deficit was needed to feed the nation's livestock (2.8% of GDP). The humanitarian response to the 2018–2019 drought raised $612 million (3% of the nation's GDP). As the drought crisis was unfolding in 2019, Afghanistan was also hit by flash flooding. This led to the displacement of 42,000 people, at least 63 deaths,

78 World Bank (2018). Afghanistan Renewable Energy Development Issues and Options. Washington, D.C.: World Bank Group. P. 87. URL: http://documents.worldbank.org/curated/en/352991530527393098/pdf/Afghanistan-Renewable-Energy-Development-Issues-and-Options.pdf

79 Fahimi, A. & Upham, P. (2018). The renewable energy sector in Afghanistan: Policy and potential. Wiley Interdisciplinary Reviews: Energy and Environment, 7(2), p.e280. URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/wene.280

80 OCHA (2019). Afghanistan integrated drought response, February 2019. United Nations Office for the Coordination of Humanitarian Affairs. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/drought_response_dashboard_20190327.pdf [accessed 09/05/2019]

and loss and damage to several thousand properties.[81] There is evidence to suggest that the hazards which led to these disasters may already have been made more likely and more intense by human-induced climate change.[26] Further intensification is projected.[26]

Many of the climate changes projected are likely to disproportionately affect the poorest groups in society. For instance, exposure is typically higher in poor rural areas and heavy manual labor jobs are commonly among the lowest paid whilst also being most at risk of productivity losses due to heat stress.[82] Poorer businesses are least able to afford air conditioning; an increasing need given the projected increase in cooling days. Poorer farmers and communities are also least able to afford local water storage, irrigation infrastructure, and technologies for adaptation. These processes are poorly studied in Afghanistan but threaten to exacerbate an already extreme situation of permanent and temporary (disaster-induced) deprivation, damage and loss, and health impacts.

Human Health

Nutrition

The World Food Program estimates that without adaptation the risk of hunger and child malnutrition on a global scale could increase by 20% by the 2050s.[83] Springmann et al. (2016) assessed the potential for excess, climate-related deaths associated with malnutrition.[84] The authors identified two key risk factors that are expected to be the primary drivers: a lack of fruit and vegetables in diets, and health complications caused by increasing prevalence of people underweight. The projections suggest there could be approximately 40.8 climate-related deaths per million population linked to lack of food availability in Afghanistan by the 2050s, under RCP8.5 (at present day population-levels this represents approximately 1,400 people). This does not account for the additional nutritional impact of climate-related disaster events which damage food production systems and economic conditions.

Additionally, children from households with lower incomes and/or lower dietary diversity in Afghanistan are significantly more likely to suffer from stunting.[85] To the extent that the projected increase in drought probability and average temperatures may constrain agricultural yields, children in rural areas of Afghanistan are likely to be at greater risk of stunted growth and the associated severe long-term consequences for their health.

Heat-related mortality

Research has placed a threshold of 35°C (wet bulb ambient air temperature) on the human body's ability to regulate temperature, beyond which even a very short period of exposure can present risk of serious ill-health and

81 ReliefWeb (2019). Afghanistan: Flash Floods – Mar 2019. URL: https://reliefweb.int/disaster/ff-2019-000018-afg [accessed 09/05/2019]

82 Kjellstrom, T., Briggs, D., Freyberg, C., Lemke, B., Otto, M., Hyatt, O. (2016). Heat, human performance, and occupational health: A key issue for the assessment of global climate change impacts. Annual Review of Public Health: 37: 97–112. URL: https://www.ncbi.nlm.nih.gov/pubmed/26989826

83 WFP (2015). Two minutes on climate change and hunger: A zero hunger world needs climate resilience. The World Food Programme. URL: https://docs.wfp.org/api/documents/WFP-0000009143/download/

84 Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H. C. J., Gollin, D., . . . Scarborough, P. (2016). Global and regional health effects of future food production under climate change: a modelling study. The Lancet: 387: 1937–1946. URL: https://www.ncbi.nlm.nih.gov/pubmed/26947322

85 Kim, R., Mejía-Guevara, I., Corsi, D.J., Aguayo, V.M. & Subramanian, S.V. (2017). Relative importance of 13 correlates of child stunting in South Asia: insights from nationally representative data from Afghanistan, Bangladesh, India, Nepal, and Pakistan. Social Science & Medicine, 187, pp.144–154. URL: https://www.ncbi.nlm.nih.gov/pubmed/28686964

death.[86] Temperatures significantly lower than the 35°C threshold of 'survivability' can still represent a major threat to human health. Climate change will push global temperatures closer to this temperature threshold both through slow onset warming and intensified heat waves. Honda et al. (2014)[87] utilized the A1B emissions scenario from CMIP3 (most comparable to RCP6.0) to estimate that without adaptation, annual heat-related deaths in the Central Asian region, will increase 139% by the 2030s and 301% by the 2050s. The potential reduction in heat-related deaths achievable by pursuing lower emissions pathways is significant, as demonstrated by Mitchell et al. (2018).[88] To an extent, low humidity levels will shelter Afghanistan from some of the most dangerous temperature conditions in comparison with other Asian nations.[89] However, the implications of significant projected increases in maximum temperatures, and potential interactions with the UHI effect, remain understudied.

Disease

Climate change pressures, such as increased incidence of drought, extreme rainfall and flood, as well as higher temperatures, represent environmental drivers of vector and water-borne diseases. Diarrheal disease is a significant health risk to children in Afghanistan. UNICEF estimates that around 7,300 children under five years of age died as a result of diarrheal disease in 2016.[90] This represents around 9% of all under five deaths in Afghanistan. Although overall deaths are projected to decline significantly, WHO estimates the number of diarrheal deaths in under 15-year-olds attributable to climate change under the A1B scenario in the Central and South Asia regions could rise by around 5%–15% in the 2030s and by around 7%–24% in the 2050s.[91]

Climate change in Afghanistan may also increase the prevalence of diseases relating to dust storms and air quality in the coming decades. Dust storms, which were particularly prevalent in the area surrounding Lake Hamun on the Iran-Afghanistan border during a multi-year drought in the early 2000s, correlated with an increase in hospital admissions for chronic obstructive pulmonary disease and asthma in that region.[92] These dust storms occur during periods when the lake beds run dry. In this way, climate change may increase the risk of dust storms in this western border region in the coming decades, both through the projected increase in drought frequency in Afghanistan and in the longer-term via the forecast reduction in glacial mass in the Hindu Kush, which may constrain the snowmelt that feeds into Lake Hamun.[93] Other potential issues include spread of malaria to new areas which, as identified in Afghanistan's NC2, may undermine the country's attempts at eradication. Further study is required to understand whether other diseases with known links to climate hazards, such as leptospirosis, are also cause for concern.[94]

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86 Im, E. S., Pal, J. S., & Eltahir, E. A. B. (2017). Deadly heat waves projected in the densely populated agricultural regions of South Asia. Science Advances, 3(8), 1–8. URL: https://advances.sciencemag.org/content/3/8/e1603322

87 Honda, Y., Kondo, M., McGregor, G., Kim, H., Guo, Y-L, Hijioka, Y., Yoshikawa, M., Oka, K., Takano, S., Hales, S., Sari Kovats, R. (2014). Heat-related mortality risk model for climate change impact projection. Environmental Health and Preventive Medicine 19: 56–63. URL: https://www.ncbi.nlm.nih.gov/pubmed/23928946

88 Mitchell, D., Heaviside, C., Schaller, N., Allen, M., Ebi, K. L., Fischer, E. M., . . . Vardoulakis, S. (2018). Extreme heat-related mortality avoided under Paris Agreement goals. Nature Climate Change, 8(7), 551–553. URL: https://www.ncbi.nlm.nih.gov/pubmed/30319715

89 Matthews, T. K. R., Wilby, R. L., & Murphy, C. (2017). Communicating the deadly consequences of global warming for human heat stress. Proceedings of the National Academy of Sciences, 114(15), 3861–3866. URL: https://www.ncbi.nlm.nih.gov/pubmed/28348220

90 UNICEF (2019). Data: Diarrhoeal Disease. URL: https://data.unicef.org/topic/child-health/diarrhoeal-disease/ [accessed 29/01/2019]

91 WHO (2014). Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. World Health Organization. URL: https://apps.who.int/iris/bitstream/handle/10665/134014/9789241507691_eng.pdf?sequence=1&isAllowed=y

92 Miri, A., Ahmadi, H., Ekhtesasi, M., Panjehkeh, N. & Ghanbari, A. (2009). Environmental and socio-economic impacts of dust storms in Sistan Region, Iran, International Journal of Environmental Studies, 66: 3, 343–355. URL: https://www.tandfonline.com/doi/abs/10.1080/00207230902720170

93 Middleton, N. (2019). Variability and Trends in Dust Storm Frequency on Decadal Timescales: Climatic Drivers and Human Impacts. Geosciences, 9(6), 261. URL: https://www.mdpi.com/2076-3263/9/6/261

94 Wu, X., Lu, Y., Zhou, S., Chen, L., & Xu, B. (2016). Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. Environment International, 86, 14–23. URL: https://www.ncbi.nlm.nih.gov/pubmed/26479830

National Adaptation Policies and Strategies

TABLE 6. Key national adaptation policies, strategies, and plans

Policy/Strategy/Plan	Status	Document Access
Nationally Determined Contribution (NDC) to Paris Climate Agreement	Submitted	November, 2016
Disaster Management Strategy (2014–2017)	Enacted	2014
National Communications to the UNFCCC	Two Submitted	March, 2013; May, 2019
Initial Biennial Update Report	Submitted	July, 2019
National Adaptation Program of Action for Climate Change (NAPA)	Enacted	February, 2009
Poverty Reduction Strategy Paper (PRSP)	Submitted	May, 2008
Technology Needs Assessment	Under Development (Phase III)	

Climate Change Priorities of ADB and the WBG

ADB Country Partnership Strategy

The Asian Development Bank agreed a Country Partnership Strategy (CPS) with the Government of Afghanistan covering the period 2017–2021. Climate change and issues of environmental sustainability form the third strategic pillar of engagement, which is comprised of two themes.[95]

Priority Areas	Interventions
Protecting, restoring, and promoting the sustainable use of the environment	• Protect, restore and support management of natural resources • Strengthen resilience to climate change and natural hazards through • Improve watershed management and precipitation infiltration and recharge as well as flood mitigation • Reduce impacts of soil erosion and landslides by restoring original forestry and rangeland vegetation around watersheds • Prepare and implement natural resource management plans for watersheds and/or restoration and protection of rangeland sites
Strengthening resilience to climate change and natural hazards	• Support design enhancements for construction standards and technology for climate-proofed infrastructure for transport, energy and infrastructure sectors • Improve infrastructure for hazard-prone and flood risk areas • Improve irrigation systems to protect against flooding and improve drought mitigation measures • Develop capacities for disaster-resilient design, risk-sensitive land use planning, and disaster risk management

[95] Asian Development Bank (2017). Afghanistan, 2017–2021 —Achieving Inclusive Growth in a Fragile and Conflict-Affected Situation. URL: https://www.adb.org/sites/default/files/institutional-document/371531/cps-afg-2017-2021.pdf

WBG Country Partnership Framework

The World Bank agreed a Country Partnership Framework (CPF) with the Government of Afghanistan covering the period 2017–2020. Climate change is identified as a cross-cutting theme of the CPF and is integrated across key areas in order to:

- Build strong and accountable institutions
- Enhance inclusive economic growth
- Improve social inclusion
- Increase the collection, analysis, and use of information on disaster risk and climate change for evidence-based decision making
- Investigate climate change impacts on hydrology and agriculture[96]
- Increase resilience to climate variability and change through increasing use of sustainable renewables
- Develop capacities for early warning and response to natural disasters

[96] World Bank (2016). Country Partnership Framework for Islamic Republic of Afghanistan for the Period FY 17 to FY 20. URL: http://documents.worldbank.org/curated/en/163401481660770129/pdf/108727-REVISED-PUBLIC-Afghanistan-CPF-27-Oct-final-12082016.pdf

CLIMATE RISK COUNTRY PROFILE

AFGHANISTAN

WORLD BANK GROUP

ADB ASIAN DEVELOPMENT BANK