A STORY OF SADNESS
THE LIKELY EFFECTS OF CLIMATE CHANGE

A desk study of current predictions for a number of selected countries // 2019
A story of Sadness – projected effects of climate change

A desk study of current scientific predictions for selected countries

Acknowledgements

This paper has been written by Iris Secher Kristensen, Anne-Sofie Schow-Poulsen and Mattias Söderberg, based on recent science and research.

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Foreword

A father of six loses the majority of his crops in a flash flood in Bangladesh and decides to migrate with his family to an uncertain future. A young girl in Zimbabwe is infected with malaria after surviving the severe flooding of her rural village. In Kenya, farmers are cultivating drought-resistant crops instead of the primary staple crops. A young woman working at a ski-resort in Lebanon loses her job as winter-outdoor tourism diminishes.

Climate change is a reality and, as a global development NGO, we experience and witness the dramatic consequences it has for the World’s poorest and most vulnerable people at first hand. Business-as-usual pathways and upscaling current practices are not options if we want to fulfil our aspirations for the global population in the future. We are moving towards the crossing of negative tipping points, which would lead to dramatic changes in the conditions of the Earth system in ways that are irreversible on time scales meaningful for society. Science is very clear. As the Global Sustainable Development Report from 2019 bluntly states, “Just over 10 years remain to achieve the achieve the 2030 Agenda 1, but no country is yet convincingly able to meet a set of basic human needs at a globally sustainable level of resource use.”

Therefore, we must take action and rethink our approach to development. That is the reason for this paper. DanChurchAid is engaged in more than twenty countries around the world, and we are following developments on the ground. However, to be agile, and prepared, we must also look ahead, and learn from the science.

This report compiles research about the countries where DCA is engaged, and it is sad to read. Actually, when you consider that there are people, communities, and livelihoods behind the dry figures about temperature and rain, you realise that millions of people in the coming decade will face huge challenges, not only to live, but to survive.

While the content of this report is both scary and sad, we do not lose faith. We still believe that something can be done, and we are committed to take action. More than a third of DanChurchAid projects are already related to climate change, and in the coming years we aim at mainstreaming climate change into all of our programs. We will increase our efforts to help local communities to adapt to the effects of climate change, and we will support a development which is sustainable and based on low carbon solutions. And with this paper, we will know more about what is needed.

However, this report is not only encouraging us to develop our programmes, it also gives us new arguments in our call for climate action. What the future will look like depends on how governments, companies, organisations and people act in the coming years. We have presented two scenarios, one which is possible if we all, together, manage to reduce emissions rapidly and one, which is more likely, if we let go and continue as we are doing now. When reading, it becomes very clear that the first scenario is the only option and we must therefore do everything possible to make it a reality.

Birgitte Qvist-Sørensen
Generalsekretær
Folkekirken Nødhjælp

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Introduction

This Report will guide you through a short summary of the projected effects of climate change in 24 developing countries where DanChurchAid is engaged. The summaries are based on recent scientific research and they are presented with clear references to the sources. The report does not add any analysis or assessment, but it gives a good overview of what we can expect.

It should of course be noted that the future is still uncertain. How much global temperature will increase depends on how much emissions of greenhouse gasses are reduced in the coming years. Many of the effects of climate change will also depend on policies and action, or inaction, by national governments. As an example, many of the countries in this report experience conflicts, which of course have a big effect on development, growth, agriculture and the effort to adapt to climate change. However, the climate research is still relevant and important to consider, as it includes conclusions which may have a significant effect on the development of a country. In the reports of the Intergovernmental Panel on climate change (IPCC), different scenarios are presented. We have chosen two of these scenarios - the best-case scenario and the worst-case scenario - to get an overview of possible developments.

The first scenario (A), refers to the IPCC scenario called “2.6”. That is a scenario based on an assumption of ambitious climate action, where the increase of global temperatures still could be kept under 1.5°C. This scenario still includes climate change-related effects, but it is still a scenario we could live with.

The second scenario (B), refers to the IPCC scenario called “8.5”. This is a scenario which is likely if very little action is taken, and if emissions are allowed to continue to increase. With this scenario, the world will look very different. Sea level rise will change the coastline of countries, and heath waves may make selected areas impossible to live in. This is a scenario where hunger, displacements and conflicts are more likely, and it is a future we should do everything to avoid.

For each country, there is a short paragraph about expected changes in monthly temperature and precipitation in 2040-2059 compared to the reference period, 1986-2005. Climate change can be monitored in different ways, but we have chosen these two categories, as they are relevant parameters for all countries. For each country we have additionally added selected parameters which can be relevant for the country.

The graphs show the 10th to 90th percentile range with a light blue colour. The change in temperature or precipitation is very likely to fall within this width. The graphs also have plotted points showing the median expected monthly change.

Vulnerability

The country summaries in this report focus on the direct effects of climate change, such as changes in temperature and rain. However, some research results related to the effects on communities and production are also included. Such research is of course dependent on vulnerability of the people. The effect of flooding will be very different in a community with prepared flood response, such as pumps, channels and walls, compared to communities with no, or only limited, preparations. The actual risk related to climate change will thus depend on three factors:

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• Hazard – The climate change-related effect such as heat wave, drought or flooding.
• Exposure – The degree of exposure may differ, and the risk related to flooding is, for example, dependent on where you are.
• Vulnerability – The extent to which people have adapted to the effects of climate change, which will affect the actual risk. With good preparations, damages may be small.

When we look at scenarios for the second half of the 21st century, it is difficult to foresee the full risk. People may, because of their own decisions, or because of government interventions, have relocated from hazard-prone spots. And big investments in adaptation may change the vulnerability. However, when expected effects on communities have been included in this report, it has been based on available research, based on the existing context.

**Climate change, human rights and sustainable development**

Climate change is a reality which can’t be ignored anymore, and it is closely interlinked with growth and development, human rights, gender justice and all the Global Goals. The developed, rich countries have the best capacity to deal with, and adapt to, the consequences of climate change. At the same time these countries have a big responsibility for the current emissions. 3.5 billion people living in poverty around the world are only responsible for 10% of global CO2 emissions while 50% of the emissions are coming from the richest 10%3. An estimate from the world bank states that if we do not act on climate changes now 120 million more people will live in poverty by 20304. This is indicating that global inequality will raise even more in the coming years.

To make a comprehensive assessment of future impacts of climate change, all of these aspects should have been considered. We should have looked at effects on human rights, equality, poverty and a lot more. However, the scope was limited, and in this report, you will only find assessments of the direct effects on climate conditions in the countries where DanChurchAid is active.

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South and Southeast Asia

South and Southeast Asia experience many challenges due to climate change. We can expect a negative impact on rice production and effects on food prices, which can exacerbate poverty in rural areas. Climate change is also expected to have widespread impact on health issues. There is high confidence that more frequent and intense heat waves will increase mortality and morbidity in vulnerable groups in urban areas. Warmer air and water temperatures, as well as altered rain patterns and water flows, are projected to increase the likelihood of the transmission of infectious diseases. It is expected that there will be change in the geographical distribution of vector-borne diseases, as vector species that carry and transmit diseases because of climate change migrate to more hospitable environments. Whether we look at a high- or low-emission scenario, warming of all land areas in South and Southeast Asia are very likely in the mid- and late 21st century. In a high-emission scenario, the annual mean temperature will be greater than 3°C above the late-20th-century baseline over South and Southeast Asia by the mid-21st century; comparatively, the annual mean temperature changes are less than 2°C above the late-20th-century baseline in both the mid- and late-21st century under a low-emission scenario. In the low-emission scenario, increased precipitation is likely to take place late-21st-century. In a high-emission scenario, the increase is even more likely. The increase in precipitation can be problematic in different ways. The water can create a lot of damage when it falls during extreme weather events. The trend in South Asia is that the frequency of heavy precipitation events is increasing, while the frequency of light rain events is decreasing. In Southeast Asia, rainfall from extreme weather has increased 10 mm per decade. The precipitation will also increase the likelihood of rainfall-induced landslides. In some parts of Asia, settlements on landslide-prone areas are common. The people facing the biggest risk due the impacts of climate change in South and Southeast Asia are the people living in low-lying coastal zones and flood plains. People in these areas face a magnified impact when tropical cyclones hit, even if the severity and frequency of the cyclones stay the same, because of the rising sea level. But there is high confidence that there will be an increase in extreme precipitation near the centres of the tropical cyclones, which will also increase the effects of the storms. Half of the Asia’s urban population lives in these low-lying coastal zones and flood plains areas, and 90% of the global population exposed to tropical cyclones lives in Asia. Countries in South Asia that are covered in this paper are Bangladesh, Pakistan and Nepal. Countries in Southeast Asia that are covered in this paper are Lao People’s Democratic Republic, Myanmar, People’s Republic of Cambodia and Thailand.

Bangladesh

Bangladesh consists of about 80% low and flat land (floodplains), 12% tertiary hills, and 8% mid-way terraces in the north eastern and south eastern parts. Bangladesh has a monsoonal tropical climate. There is one main rainy season which begins in June and ends in September. Bangladesh is very dependent on summer monsoons, since up to 80% of the annual rain in Bangladesh falls during this

1 https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-PartB_FINAL.pdf
2 Ibid
3 Ibid
4 https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5_all_final.pdf
5 https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-PartB_FINAL.pdf
6 http://unfccc.int/resource/docs/napa/ban01.pdf
period\textsuperscript{11}. High interannual variability in the precipitation causes both droughts and flooding\textsuperscript{12}. Bangladesh has one of the highest population densities in the world; in 2015, its population was 163 million and the population is still growing rapidly\textsuperscript{13}.

**Expected changes in temperature**

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
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<tbody>
<tr>
<td>Projected Change in Monthly Temperature for Bangladesh for 2040-2059</td>
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</table>

Temperatures in Bangladesh are rising. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the monthly temperatures are expected to rise between 0.5 and 1°C, while the monthly temperatures in Scenario B are predicted to rise between 1.5 and 2°C. As the graphs show, the monthly changes are generally 1°C higher in Scenario B than in Scenario A\textsuperscript{14}.

**Expected changes in precipitation**

<table>
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Bangladesh is expected to experience bigger amounts of precipitation. This means that water availability in Bangladesh is projected to increase slightly. Scenario A shows a moderate change in rainfall whereas Scenario B shows a substantial change - in both scenarios the changes in precipitation are concentrated on the summer monsoon season. Part of the increase in precipitation is due to an

\textsuperscript{11}Ibid
\textsuperscript{12}C:\Users\iskr\Downloads\WBG_ClimateChange_Final.pdf
\textsuperscript{13}Ibid
\textsuperscript{14}https://climateknowledgeportal.worldbank.org/country/bangladesh
increased rainfall from tropical cyclones\textsuperscript{15}. Shifts and variability in the timing and intensity of monsoon rain is expected\textsuperscript{16}.

**Hazards**

Bangladesh is very disaster-prone and frequently experiences seasonal floods and flash floods as well as periodic cyclones, droughts, and earthquakes. These events cause loss of life and large-scale damage to crops and infrastructure\textsuperscript{17}. Bangladesh ranked as the 7\textsuperscript{th} most affected country on the Climate Risk Index for the period 1998-2017\textsuperscript{18} and the circumstances are expected to worsen. Exposure is particularly notable to growing risks of river flooding, and increasingly intense tropical cyclones\textsuperscript{19}. If the global temperature rise is limited to 1.5°C or even 2°C, the total global number of tropical cyclones could decrease. But because of warmer oceans, the intensity of the storms and amount of extreme precipitation are expected to increase. Therefore, an increase in the most intense and damaging cyclones is expected, with landfall, along the coasts of Bay of Bengal\textsuperscript{20,21}.

**Agriculture**

Agriculture is one of the key sectors in Bangladesh and 47\% of the population depends on it. Toward the end of the century, crop productivity is likely to trend downward. In Scenario B, widespread declines of 50 to 80\% are projected\textsuperscript{22}. Overall, climate change is expected to decrease agricultural GDP by 3.1\% each year\textsuperscript{23}.

**Sea level rise**

Because Bangladesh is a low-lying country with sizable areas just above sea level near the Bay of Bengal, it is highly exposed to storm surge and sea level rise. The estimated sea level rise differs from 27 cm\textsuperscript{24} to 50 cm by 2050\textsuperscript{25}, with significant consequences and loss of land. With increased sea level, coastal areas will also be more exposed to flooding during the monsoon, with increased risks for salinization of farmland.

**Displaced people**

Bangladesh is densely populated and will continue to experience population increases throughout 2050\textsuperscript{26}. Climate change is an increasing driver of migration. The Association for Climate Refugees estimates that 6 million people have so far been displaced by climate hazards in Bangladesh and the number of climate-displaced people is projected to increase\textsuperscript{27}. The number of climate-displaced people in Bangladesh could be up to 13.3 million in 2050\textsuperscript{28}. Dhaka, the river delta south of the city, and the eastern coast near Chittagong are expected to become out-migration hotspots, as they are

\textsuperscript{15}https://climateknowledgeportal.worldbank.org/country/bangladesh/climate-data-projections?variable=pr
\textsuperscript{16}C:\Users\iskr\Downloads\WB_G_ClimatChange_Final.pdf
\textsuperscript{17}https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_BGD.pdf
\textsuperscript{18}https://www.germanwatch.org/sites/germanwatch.org/files/GLOBAL%20Climate%20Risk%20Index%202019_2.pdf
\textsuperscript{19}C:\Users\iskr\Downloads\WBG_ClimatChange_Final.pdf.
\textsuperscript{21}https://www.germanwatch.org/sites/germanwatch.org/files/GLOBAL%20Climate%20Risk%20Index%202019_2.pdf
\textsuperscript{22}C:\Users\iskr\Downloads\WB_G_ClimatChange_Final.pdf
\textsuperscript{23}https://climateknowledgeportal.worldbank.org/country/bangladesh
\textsuperscript{24}https://openknowledge.worldbank.org/handle/10986/29461 (Groundswell: Preparing for Internal Climate Migration)
\textsuperscript{26}https://openknowledge.worldbank.org/handle/10986/29461 (Groundswell: Preparing for Internal Climate Migration)
placed in deltaic and coastal areas, which are particularly vulnerable to climate change because of rising seas, combined with storm surges. Also, rice-production areas in the northeast are expected to be out-migration hotspots. This is due to changes in water availability. The main in-migration hotspot is projected in the Ganges River basin in the west, which is a rainfed agriculture livelihood zone.

Cambodia
Cambodia is a low-lying country with rich water resources. Two of the main water sources in Cambodia are the Mekong River, which supplies surface water to the eastern part of the country, and the Tonle Sap River Basin that supplies the central and western parts with water. Like most other countries in the Asian region, the climate and the water resources in Cambodia are largely dominated by the two annual monsoons. The monsoons are the primary sources of water for the Cambodian agriculture sector, which supports around 80% of the population.

Expected changes in temperature

<table>
<thead>
<tr>
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<tr>
<td>Projected Change in Monthly Temperature for Cambodia for 2040-2059</td>
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<tr>
<td>Temperature</td>
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<tr>
<td>January</td>
<td>December</td>
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</table>

Temperatures in Cambodia are rising. Mean annual temperatures have increased by 0.8°C since 1960 at a rate of 0.18 °C per decade. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, monthly temperatures are expected to rise between 0.99°C (in May) and 0.77°C (in July). In Scenario B, the rise is significantly higher, varying from 1.4°C (in September and November) to 1.68°C (in April and May).
Expected changes in precipitation

There are still large uncertainties about precipitation trends in Cambodia, but there seem to be differing regional trends: an increase in seasonal rainfall between June and August in the northwest, and a decrease in the northeast of the country. The projections indicate, as the graphs show, a general increase in precipitation during the monsoon season in both Scenario A and B. The change in monthly precipitation in the monsoon season is bigger in Scenario B than in Scenario A. The biggest expected change is in Scenario B, where an increase of 24mm is expected in August.

Floods and droughts

Cambodia experiences floods and droughts on a seasonal basis, which cause considerable economic losses and damage to people’s livelihoods. Floods and droughts are recognized by the government as one of the main drivers of poverty. Due to the expected increase in seasonal precipitation, climate-related flooding is projected to increase in frequency and intensity, especially on the main plains. Due to rising temperatures and changes in precipitation, increased drought in Cambodia is also expected.

Coastal areas

Marine coastal areas near the 435 km long coastline in Cambodia already suffer from storm surges, high tides, beach erosion and seawater. Sea level rise will cause flooding and more severe damage in relation to storms, and could therefore pose a significant threat to settlements, coastal fisheries and mangrove forests in these areas. Cambodia is at high risk of cyclones. If the global temperature rise is limited to 1.5°C or even 2°C, the total global number of tropical cyclones could decrease; however, because of warmer oceans, the intensity of the storms and amounts of extreme precipitation are expected to increase instead. Therefore, an increase in the most intense and damaging cyclones is expected.

35 [https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gdp_climate_change_country_profile_for_KHM.pdf](https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gdp_climate_change_country_profile_for_KHM.pdf)
41 [https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf](https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf)
Key sectors
Cambodia’s key sectors are agriculture, water resources, forestry, fisheries, and tourism. They are all climate sensitive. Retaining a robust growth under climate change will therefore be a challenge. Cambodia’s Ministry of Economy and Finance says that climate change could have a significant impact on the country’s economy, mainly by reducing productivity of workers, due to temperature increase and all extreme weather events that impact infrastructure and loss of crops. Both types of impact will affect all key sectors in the country. As a result, Cambodia’s GDP could be reduced in 2050 by almost 10%. Climate change is also expected to have a negative effect on equality in the country, as it Expected that 42.

Lao People’s Democratic Republic (Laos)
Laos has a tropical climate dominated by monsoon variability. There are two seasons: a rainy season from May to September and dry season from late October to April. More than 70% of precipitation falls during the wet season. Laos is particularly rich with water resources, including the Mekong’s tributaries and countless smaller water bodies, but this also makes the country prone to severe flooding43. The country experiences interannual rainfall variability associated with large-scale climate drivers such the El Nino-Southern Oscillation (ENSO), resulting in frequent floods, mostly in the south, and droughts in the north.44 Laos is highly dependent on climate-sensitive natural resources; therefore, the majority of the population is highly vulnerable to climate hazards, especially to floods and droughts, and the country has low adaptive capacity. Combined, this makes the country particularly vulnerable to climate change45.

Expected changes in temperature

Temperatures in Laos are rising. Temperatures increased on average between 0.1 to 0.3°C per decade between 1951 and 200046. The period 2040-2059 is projected be substantially warmer than the reference period (1986-2005). In Scenario A the monthly increase in temperature varies from 0.76 to

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42 Summary Report, Modelling of Climate Change Impacts on Growth—En (2018)
43 https://unfccc.int/sites/default/files/resource/Laonc2.pdf
44 Ibid
45 https://www.greenclimate.fund/documents/20182/1688867/Lao_People_s_Democratic_Republic_Country_Programme.pdf/9362f3bd-dda9-390c-80c0-439f64b02b9a
1.34°C. Whereas the monthly increase varies from 1.5 to 2.1°C in Scenario B. Some studies indicate similar warming across all regions, while others indicate that the Southern parts of the country will experience less warming than the rest of the country.

**Expected changes in precipitation**

<table>
<thead>
<tr>
<th>Scenario A</th>
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<tbody>
<tr>
<td>Projected Change in Monthly Precipitation for Laos at Location (102.25,19.85) for 2040-2059</td>
<td>Projected Change in Monthly Precipitation for Laos for 2040-2059</td>
</tr>
<tr>
<td><img src="https://example.com/graphA.png" alt="Graph A" /></td>
<td><img src="https://example.com/graphB.png" alt="Graph B" /></td>
</tr>
</tbody>
</table>

Annual precipitation is expected to increase. The increase is, as shown at the graphs, expected to fall during the wet season. The increase is substantially higher in Scenario B than in Scenario A. The largest monthly projected increase in Scenario B is 32 mm in August. The increase in precipitation is expected to be largest in the eastern and southern parts of the country.

**Extreme events**

The frequency of the extreme weather events in Laos increased from about once every two years before 1992 to every year or even twice a year after 1992. Particularly, frequency and intensity of floods have increased. Floods normally occur during the rainy season as a result of heavy monsoon rain in the upper Mekong river basin. The plain areas along the Mekong River in the central and southern parts of Laos are most vulnerable to flooding, but the areas affected by floods has grown at an accelerated pace. Although not as frequent and devastating as floods, droughts have also been more frequent and more intense in recent decades. Droughts typically occur during the dry season.

**Agriculture**

Agriculture is gradually declining in its contribution to GDP. But agriculture continues to play a major role in Laos’ economy, and is responsible for 29.9% of GDP, and approximately 70% of the population is dependent on the sector for livelihoods. Most of the country’s farming systems are susceptible to flooding, drought, and the late onset of the rainy seasons. With a high dependency on

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51 [https://unfccc.int/sites/default/files/resource/Laonc2.pdf](https://unfccc.int/sites/default/files/resource/Laonc2.pdf)
traditional agricultural systems and a predominance of smallholder farms, the impacts of such natural disasters can be devastating\textsuperscript{56}.

**Myanmar**

The climate in Myanmar is primarily dominated by the tropical southwest and northeast monsoons (the summer and winter monsoons). Myanmar has three distinct seasons: rainy, winter, and summer. During the rainy season, the weather is humid, wet and warm, typical of the tropics. During most of the year, rain-showers only occur occasionally, and are hardly as intense as those brought on by the monsoons that the country experiences twice a year, especially in the summer. The monsoon is of great importance, especially for the rural and poor population in Myanmar, since these population groups highly depend on agriculture\textsuperscript{57}.

**Expected changes in temperature**

<table>
<thead>
<tr>
<th>Scenario A</th>
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Temperatures in Myanmar are rising. The mean annual temperature has increased by 0.3-0.8°C between 1971-2000. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the change in monthly temperature is expected to be between 0.7°C and 1.3°C. In Scenario B, monthly temperature is expected to be between 1.5°C and 2.0°C. The highest increase in temperature is expected in the Rakhine Costal and Yangon Deltaic regions\textsuperscript{58}.

\textsuperscript{57} http://www.fao.org/fileadmin/templates/rap/files/epublications/MyanmarecordFINAL.pdf
\textsuperscript{58} https://climateknowledgeportal.worldbank.org/country/myanmar-burma/climate-data-projections?variable=pr
Expected changes in precipitation

Scenario A

Myanmar is expected to have an increase in annual precipitation. In Scenario A, an increase in precipitation is expected in June to September. The change varies from an increase of 15mm in June to 16.7mm in July and 13.2mm in August. From October to May, no substantial change is expected. In Scenario B, the change pattern is somewhat the same, but the precipitation increases in the period (June to September) are expected to be higher. In August it is expected that, on average, 32.2mm more precipitation will fall compared to the reference period. The biggest increase in precipitation is expected in the Rakhine Coastal region, where an increase of 1582mm per year is projected. The smallest increase is expected in the Eastern Hilly region, where an increase of 209mm per year is projected. The increase in precipitation could have critical impact on wet season flooding in some regions.

Scenario B

Extreme temperatures and drought

An increase in extreme heat in Myanmar is also projected. Myanmar is already challenged with extreme high temperatures and has recently seen an increase in the intensity and frequency of heat. During the summer of 2010, 1482 heat-related disorders and 260 heat-related deaths were reported. There is a dramatic increase in very hot days (warmer than 35°C) in both Scenario A and B, yet there is a large difference in scale. In Scenario A, an increase of 12 days per year with temperatures higher than 35°C is projected in 2040-2059, compared to the reference period (1986-2005). The change in Scenario B is 26 days. At the end of the century, the difference between Scenario A and B becomes larger. In 2080-2099 the projected increase in Scenario A is only 13 days but in Scenario B, the expected increase will amount to 68 days.

The increase in temperatures can cause severe damage to crop productivity, human health and infrastructure. The extreme increase in heat, especially in Scenario B, will have significant impact on these sectors in Myanmar. The frequency in very hot days, in combination with the high humidity, can cause death and severe health complications amongst the young, the elderly, and outdoor workers. Myanmar has also experienced an increase in droughts. Because of rising temperatures, droughts

60 Ibid
64 https://climateknowledgeportal.worldbank.org/country/myanmar-burma/vulnerability
are likely to increase in the future. This will affect agriculture, particularly in vulnerable communities that already struggle with declining water availability.\textsuperscript{65}

### Tropical Cyclones

Myanmar is high risk of damaging cyclones.\textsuperscript{66} Since 1990, the total number of tropical cyclones reaching Myanmar has increased.\textsuperscript{67} The Climate Risk Index ranked Myanmar as the 3\textsuperscript{rd} most affected country by climate hazards from 1998-2017. This rank is mainly due to Cyclone Nargis in 2008, which was responsible for an estimated loss of 140,000 lives and 2.4 million properties.\textsuperscript{68} If the global temperature rise is limited to 1.5°C or even 2°C, the total number of tropical cyclones could decrease. But because of warmer oceans, the intensity of the storms and amounts of extreme precipitation are expected to increase. Therefore, an increase in the most intense and damaging cyclones is expected.\textsuperscript{69}

### Agriculture

Agriculture is the largest employer in Myanmar and the economy is very dependent on it.\textsuperscript{70} The sector is highly vulnerable to climate change, specifically the potentially detrimental changes in rainfall patterns as well as higher night temperatures, heat waves, and loss of coastal agricultural land to sea level rise.\textsuperscript{71}

### Sea level rise

Myanmar is experiencing sea level rise. By 2050-2059, the sea level may rise by 20 to 41cm above the 2000-2004 baseline. By 2080-2089, the middle-range of projections estimates sea levels to be between 37 and 83cm above the baseline, but the rise could potentially rise to 122cm above the baseline.\textsuperscript{72} Given that Myanmar’s coastline consists of large, low-lying areas and a populated coastline, these rising sea level projections would mean increases in permanently flooded areas and the frequency and magnitude of flooding for those coastal areas not permanently inundated.\textsuperscript{73} The Ayeyawady Delta is at particular risk, and even a small rise will lead to a large portion of the Delta being inundated.\textsuperscript{74}

### Nepal

Nepal’s terrain is generally mountainous, but there are also low-lying areas with elevations less than 100m.\textsuperscript{75} The country is divided into five geographic regions, where the climate varies significantly, ranging from alpine and arctic in the north, to tropical in the south.\textsuperscript{76} Like many other countries in Asia, Nepal is very dependent on both summer and winter monsoons.\textsuperscript{77} About 80% of the annual

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\textsuperscript{66} http://thinkhazard.org/en/report/171-myanmar/CY
\textsuperscript{68} https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf
\textsuperscript{69} Ibid
\textsuperscript{71} Ibid
\textsuperscript{72} Ibid
\textsuperscript{73} Ibid
\textsuperscript{74} https://unfccc.int/resource/docs/napa/mmr01.pdf#page=97&zoom=100,0,97
\textsuperscript{76} https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_NPL_2011.pdf
\textsuperscript{77} http://unfccc.int/resource/docs/natc/nepnc1.pdf
precipitation in Nepal falls during the summer monsoon, and the monsoon is thereby the single most important source of water for drinking and agriculture in Nepal. However, the monsoon also causes frequent landslides and flooding, resulting in the loss of human life, farmlands, and infrastructure. The Himalayan glaciers are also a very important water source, which feeds the country’s rivers. While there is more than enough water during the monsoon period, in the periods outside the monsoons, Nepal quite often experiences severe drought, which damages crop production and strains the supply of fresh drinking water. Both the country’s topography and social vulnerability makes Nepal susceptible to climate-related disasters.

**Expected changes in temperature**

### Scenario A

*Projected Change in Monthly Temperature for Nepal for 2040-2059*

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>Ensembles Median and Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>1°C</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>2°C</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>3°C</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>4°C</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>5°C</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>6°C</td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td>7°C</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>8°C</td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td>9°C</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>10°C</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>11°C</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>12°C</td>
<td></td>
</tr>
</tbody>
</table>

### Scenario B

*Projected Change in Monthly Temperature for Nepal for 2040-2059*

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>Ensembles Median and Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>1.5°C</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>2.5°C</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>3.5°C</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>4.5°C</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>5.5°C</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>6.5°C</td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td>7.5°C</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>8.5°C</td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td>9.5°C</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>10.5°C</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>11.5°C</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>12.5°C</td>
<td></td>
</tr>
</tbody>
</table>

Temperatures are rising in Nepal. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). The increase in temperature is expected to occur more rapidly during the dry period, which is from December to March. In Scenario A, the biggest change is expected in April, where the monthly temperature is expected to rise by 1.6°C. The smallest change expected is 0.99°C in August. In Scenario B, the changes in monthly temperatures are expected to be higher. The biggest change is expected in April, where a 2.6°C rise is expected. The smallest expected change is a 1.5°C rise, is in August.

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79 [https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_NPL.pdf](https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_NPL.pdf)
81 [https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_NPL.pdf](https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_NPL.pdf)
Expected changes in precipitation

**Scenario A**
Projected Change in Monthly Precipitation for Nepal for 2040-2059

Mean precipitation will significantly decrease by an average of 3.7mm per month, per decade, and this decrease is particularly significant during the monsoon period between June-September83. Nepal is expected to experience an increase in precipitation. As mentioned, 80% of Nepal’s precipitation falls in the summer monsoon period and the extra precipitation is also expected to fall within these months. In Scenario A, there is an expected increase by 10.6mm in August, 3.8mm in September, and 7.1mm in October. In Scenario B, the extra precipitation is expected from June to October, with an increase between 6-16.4mm per month84.

**Hazards**

Nepal is exposed to a range of water-related climate hazards, including floods and landslides, which are often triggered by the rapid melting of snow and ice in the mountains and extreme, torrential rainfall episodes in the foothills during the monsoon season85. Nepal has experienced an increase in these types of events, as well as soil erosion. This has placed Nepal 11th on the Climate Risk Index for 1998-201786. In 2017, Nepal even placed 4th due to massive rainfalls, which led to flash floods and landslides amounting to 600 million USD in damages87. Nepal also experiences high seismic activity, which recently led to large-magnitude earthquakes88.

Climate change projections suggest that Nepal will be more exposed to risks of climate-related disasters in the future, as changes in the flow and quality of water derived from glaciers, snowmelt and rainfall could lead to excess water at certain times of the year and prolonged dry periods and extreme drought in others89. The damage from extreme weather events is expected to be concentrated on urban settlements, water resources and energy infrastructure90.

**Agriculture**

Nepal is experiencing urbanization, yet 83% of Nepal’s population lives in rural areas and agriculture provides livelihood for almost two thirds of the population and accounts for 33% of Nepal’s GDP ($21 billion)91. Because of Nepal’s topography, only 17% of total land area is suitable for agriculture. 75%

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84 https://climateknowledgeportal.worldbank.org/country/nepal
86 Ibid
87 https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf
of the agricultural area is rainfed and thus affected by droughts, floods and monsoon rainfall; these reduce production and are expected to have increased impacts due to climate change. The most productive agricultural areas are in the floodplains of the Terai, which are vulnerable to floods and riverbank cutting. Droughts are becoming more frequent during the winter months in the western Terai plains. Rice yields are particularly sensitive to climatic conditions and may decline in this region, which threatens food security\textsuperscript{92}.

Pakistan

The climate in Pakistan is characterized by mild, moist winters and hot, dry summers in the north, and semi-arid and arid zones in the west and parts of the south. Pakistan is very dependent on the summer monsoon (June-September), which is the source of more than 60% of annual precipitation\textsuperscript{93}. Pakistan is at high risk for many climate-related hazards, including flooding, landslides, tropical cyclones, water scarcity, extreme heat, and wildfires. This is also reflected by The Climate Risk Index ranking Pakistan as the 8th most affected country by climate hazards from 1998 to 2017\textsuperscript{94}.

Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Change in Monthly Temperature for Pakistan for 2040-2059</td>
<td>Projected Change in Monthly Temperature for Pakistan for 2040-2059</td>
</tr>
</tbody>
</table>

Temperatures in Pakistan are rising. Temperatures increased 0.47°C between 1961 and 2007\textsuperscript{95}. The period 2040-2059 is also projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the monthly temperature is expected to rise between 1.2 and 1.5°C, varying between the months. In Scenario B, temperature changes are bigger: between 2.1 and 2.6°C, varying from month to month\textsuperscript{96}. Snow-covered areas of Pakistan in the north are expected to have a larger increase in mean temperature compared to central and southern regions in both scenarios\textsuperscript{97}.

\textsuperscript{93}https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf
\textsuperscript{94}https://www.germanwatch.org/sites/germanwatch.org/files/Global\%20Climate\%20Risk\%20Index\%202019_2.pdf
\textsuperscript{95}https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-historical
\textsuperscript{96}https://climateknowledgeportal.worldbank.org/country/pakistan
\textsuperscript{97}https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf
Expected changes in precipitation

Mean rainfall in the arid plains of Pakistan and the coastal belt has decreased by 10-15% since 1960. Most other regions have experienced a slight increase\(^98\). Projections of future precipitation in Pakistan are uncertain. The graphs show a small increase in precipitation in the fall in both scenarios\(^99\). The variability is expected to increase, which can lead to more frequent and intensive droughts and floods.

Drought and floods
Pakistan has high exposure to droughts and floods, which has major impacts. The possibility of severe droughts is projected to increase in both Scenario A and B, but with a very large increases in Scenario B\(^100\). Pakistan’s average annual losses to floods are around 1 billion USD\(^101\). Climate change is also predicted to increase the likelihood of both coastal and inland flooding, initiating a demand for storm water management in both rural and urban centres of the country\(^102\).

Tropical Cyclones
Pakistan is at high risk of damaging cyclones\(^103\). Climate change has an impact on trends of tropical cyclones. If the global temperature rise is limited to 1.5°C or even 2°C, the total number of tropical cyclones could decrease. But because of warmer oceans, the intensity of the storms and amount of extreme precipitation is expected to increase. Therefore, an increase in the most intense and damaging cyclones is expected\(^104\).

Extreme heat
Pakistan regularly experiences some of the highest maximum temperatures in the world, with many regions experiencing temperatures of 38°C and above on an annual basis. Such temperatures have serious impacts on health. During the 2015 heatwave in Pakistan, over 65,000 people were hospitalized with heat stroke\(^105\). Pakistan has seen an increase in days with extreme temperatures in the period from 1980 to 2007, and this increase is very likely to continue as the global temperature rises\(^106\).

\(^99\) [https://climateknowledgeportal.worldbank.org/country/pakistan](https://climateknowledgeportal.worldbank.org/country/pakistan)
\(^100\) [https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability](https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability)
\(^101\) [Ibid](http://www.mocc.gov.pk/moclc/userfiles1/file/Pak%20TNA%20Adaptation%20Final%20March%202016%20(29-3-17).pdf)
\(^103\) [https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf](https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf)
\(^104\) [https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability](https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability)

19
Sea level rise

Pakistan’s 1046km-long coastline stretches along the border of the Arabian Sea. In the past century, the average mean sea level rose by 1.1mm/year for Pakistan, and so Pakistan is already experiencing adverse effects of sea level rise, including the degradation of mangrove forests, declining drinking water quality, a high rate of coastal erosion, and a decrease in fish and shrimp productivity. It is difficult to project the future sea level rise for Pakistan, since data is limited. Sea level rise at Pakistan’s coast is expected to be at a faster rate than the global rise by the end of 2100, and Pakistan is very vulnerable. As millions of people live in the coastal areas, sea level rise is expected to have a large impact on Pakistan. The Sindh coastal area in the south of Pakistan is the most vulnerable to sea level rise due to its tidal flat topography and high population density with marked industrial activities along coastal areas.\(^\text{107}\)

Agriculture and water security

The agriculture and water sectors are the two most vulnerable to climate change. Pakistan has grown from a primarily agricultural-based economy to a mostly service-based economy, but agriculture is still the largest employer in the country. In 2017, 42.3% of the workforce was employed with agriculture.\(^\text{108}\) Crop productivity is expected to feel a direct impact from rising temperatures, changes in water balance, and extreme events.\(^\text{109}\) Pakistan has the world’s largest integrated Indus Basin irrigation system, which is fed by the glaciers in Hindukush-Karakoram range in the northern part of the country and seasonal rainfalls. Climate change poses threats to water security. This threat is, amongst other things, due to higher temperatures that increase water demands and reduce water availability through higher evaporation as well as loss of natural reservoirs in the form of glaciers.\(^\text{110}\)

Thailand

Thailand is in the tropical region. The climate is relatively warm throughout the year and is influenced by seasonal monsoon winds. Climate change is expected to have a negative impact on the country, particularly through increased exposure to rising temperatures, extreme weather events and sea level rise.

Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Change in Monthly Temperature for Thailand at Location (101.83,16.77) for 2040-2059</td>
<td>Projected Change in Monthly Temperature for Thailand for 2040-2059</td>
</tr>
</tbody>
</table>

\(^\text{108}\) https://climateknowledgeportal.worldbank.org/country/pakistan  
\(^\text{109}\) http://www.mocc.gov.pk/moclc/userfiles1/file/Pak%20TNA%20Adaptation%20Final%20March%202016%20%29-3-171.pdf  
\(^\text{110}\) http://www.mocc.gov.pk/moclc/userfiles1/file/Pak%20TNA%20Adaptation%20Final%20March%202016%20%29-3-171.pdf
The temperature is rising in Thailand. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, monthly temperature change varies from an expected increase of 0.7°C in January and July to an expected increase of 1.2°C in March. In Scenario B, the monthly change varies from 1.4°C in August to 1.8°C in April. The temperature is expected to continue rising throughout the century in both scenarios, but the increase is much higher and more rapid in Scenario B. The projected warming is expected to be more rapid in the northern interior regions of Thailand than in the southern coastal regions.

Expected changes in precipitation

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Projected Change in Monthly Precipitation for Thailand for 2040-2059</strong></td>
<td></td>
</tr>
<tr>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
</tbody>
</table>

Annual precipitation in Thailand is expected to increase. The extra precipitation is expected to fall during the wet months from May to October. As the graphs show, the increase will be substantially higher in Scenario B, as the expected change of precipitation in August amounts to 30mm.

Agriculture

More than half of the population in Thailand is engaged in agriculture and agriculture is one of the key sectors in Thailand’s economy. At the same time, agriculture is the most vulnerable sector to climate change as rainfed agriculture is sensitive to variability in precipitation and could be affected negatively in the future. Additional heat stress due to rising temperatures is also expected to reduce the production of crops such as lowland rice.

Droughts and floods

Drought and floods pose a great threat to Thailand and variability in precipitation is a key driver of these hazards. Thailand ranked 10th the Climate Risk Index for 2017, which measures the impact of weather-related loss events. This rank was due to massive amounts of extreme rainfall that caused heavy floods in southern Thailand, which affected about 1.6 million people. Under Scenario B, and without large investments in adaptation, 2.4 million people on average are projected to be affected by flooding every year in the end of the century, mainly due to sea level rise.

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112 Ibid
114 https://www.iucn.org/sites/dev/files/content/documents/thailand_country_profile_june2014_press.pdf
115 https://climateknowledgeportal.worldbank.org/country/thailand/vulnerability
116 https://www.germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf
117 http://www.searo.who.int/thailand/areas/phe-country-profile-thailand.pdf
1990) to 58 per 100,000 in 2080. By 2070, around 71 million people are projected to be at risk of malaria under Scenario B.\footnote{http://www.searo.who.int/thailand/areas/phe-country-profile-thailand.pdf}
Middle East and North Africa (MENA)

The countries in the MENA region that are covered in this paper are Jordan, Lebanon, Palestine, Syria and Libya. The MENA region consists of an arid, mountainous terrain and as much as 92% of the population inhabits only 3% of the region’s surface, concentrated around coastal strips, mountain valleys and along rivers. The most frequent natural disasters in the region are floods, earthquakes, storms and droughts. Even though the flood mortality risk is decreasing on a global level, this region is one of the few where the number is still increasing. Urbanization is expected to increase in the coming decades and the population will be exposed to the effects of climate change hazards such as sea level rise, which could cause millions of displaced people in the region. Furthermore, water scarcity will increase and in 2050 the population in MENA could lack up to 50% of fresh water supplies. Together with climate change, the rapid urbanization and water scarcity is and will be a great challenge for policy and planning as well as for good development planning, and specialists both from the United Nations and climatologists have projected that MENA will be the second most affected region by climate change.

Jordan

Jordan mainly consists of arid deserts, highlands, plains and the Great Rift Valley. The climate is characterized by hot and dry weather conditions. More than 80% of the country is unpopulated due to desert conditions, where annual precipitation falls under 50mm. The water scarcity is said to be the greatest challenge of economic growth and development in Jordan, and it makes the country very sensitive to climate change.

Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Projected Change in Monthly Temperature for Jordan for 2040-2059" /></td>
<td><img src="image2" alt="Projected Change in Monthly Temperature for Jordan for 2040-2059" /></td>
</tr>
</tbody>
</table>

Jordan faces increasing temperatures. The mean annual temperature has increased by 0.89°C since 1900. The period 2040-2059 is also projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the change in monthly temperature is between 1.01 and 1.81°C. In Scenario B, the change rises dramatically in monthly temperature to a high of 2.85°C in September.

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118 World Bank, Poor Places, Thriving People/Natural disasters in Middle East and North Africa: A regional overview
119 Natural disasters in Middle East and North Africa: A regional overview
121 Natural disasters in Middle East and North Africa: A regional overview
122 World Bank, Adaptation to a Changing Climate in the Arab Countries.
123 https://climateknowledgeportal.worldbank.org/country/jordan
and a low of 1.85°C in February. February is also the only month in Scenario B with a temperature change under 2°C while the change in scenario A never exceeds 1.8°C. The warming is expected to be more rapid in the northern, interior regions of the country than in the southern, coastal regions. In both scenarios, a rapid increase in the number of very hot days with temperatures over 35°C is projected, but there is a large difference in the scale of increase in Scenario A and B, especially looking at a longer timeframe. In Scenario A, the increase in the number of very hot days is expected to be 21 days in the late-21st-century compared to the reference period (1986-2005) in contrast to 64 days in Scenario B\textsuperscript{127}.

**Expected changes in precipitation**

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation in Jordan has been decreasing since 1900 and is expected to decrease further in both scenarios. The largest decrease is expected in Scenario B, where only August and September will have a modest increase of 0.36 and 0.07mm. Even though precipitation is expected to decrease, the rainfall intensity is expected to increase. Rainfall trends in Jordan are characterized by high variability from one year to another and the variability is expected to increase\textsuperscript{128} 129.</td>
<td></td>
</tr>
</tbody>
</table>

**Water availability**

The standard water poverty threshold is 500 m\textsuperscript{3} per capita per year. Water availability levels in Jordan are now less than 100 m\textsuperscript{3} per person, per year. The water sector is by far the most affected by climate change, and so water availability is expected to decrease even further. This is caused by the decrease in precipitation as well as higher evaporation due to higher temperatures. At the same time, water availability levels are also decreasing because of population growth, which is driven by large inflows of refugees\textsuperscript{130}.

**Extreme weather events**

Rainfall events in Jordan are often followed by flooding, especially in the winter. Heavy rains often cause serious flooding and landslides. Landslides and erosion problems are concentrated on the steep slopes of mountains and wadis in Amman, especially on Mounts Amman, Akhdar, Ashrafiyah, Nuzha, Weibdeh and Hussein and the Amman-Irbid main road\textsuperscript{131}. Climate change is expected to increase the

\textsuperscript{127} https://climateknowledgeportal.worldbank.org/country-profiles
\textsuperscript{128} http://thinkhazard.org/en/report/130-jordan/f1
\textsuperscript{129} https://climateknowledgeportal.worldbank.org/country/jordan/climate-data-projections
\textsuperscript{130} https://reliefweb.int/sites/reliefweb.int/files/resources/Jordan_2.pdf
\textsuperscript{131} https://climateknowledgeportal.worldbank.org/country/jordan/vulnerability
frequency of extreme events like heavy rain and flooding as well as snowstorms and droughts\textsuperscript{132}. Today, development in rural areas often lacks planning and zoning, which leads to a higher concentration of people and infrastructure in areas at risk along rivers and valleys, and within flood plains\textsuperscript{133}.

Agriculture
The rising temperatures and lower precipitation are likely to have a critical influence on the patterns of future agricultural production in Jordan as it will increase crop water requirements, but at the same time decrease available water. The growth season will be shortened and losses of crops in relation to droughts and floods will increase\textsuperscript{134} \textsuperscript{135}.

Lebanon
Lebanon is characterised by a ‘typical’ Mediterranean climate with hot and dry summers and cool and rainy winters, and 70% of the precipitation falls between November and March\textsuperscript{136}. Generally, the rainfall in Lebanon has very poor chances of being stored due to lack of infrastructure for water storage, and low absorbance of the natural habitat - with one exception. This exception is the snow coverage in the Lebanese mountains, which serves as a water reservoir that melts in the dry summer months when the need for water is present\textsuperscript{137}. Lebanon is experiencing a high population growth due to large inflows of refugees from Syria. In 2018, registered Syrian refugees accounted for 20% of the population in Lebanon. This puts great pressure on the natural resources and the economy\textsuperscript{138}. Climate change is also expected to have a large impact on the economy. Climate change could result in a 14% decline in GDP in 2040, and 32% in 2080\textsuperscript{139}.

Expected changes in temperature

Temperatures in Lebanon are rising. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the expected change in monthly temperature

\begin{itemize}
  \item \textbf{Scenario A}
  \item \textbf{Scenario B}
\end{itemize}

\textsuperscript{132} \url{https://www.undp.org/content/dam/jordan/docs/Publications/Climate%20change%20policy_JO.pdf}
\textsuperscript{133} \url{https://climateknowledgeportal.worldbank.org/country/jordan/vulnerability}
\textsuperscript{134} \url{https://www.undp.org/content/dam/jordan/docs/Publications/Climate%20change%20policy_JO.pdf}
\textsuperscript{135} \url{https://reliefweb.int/report/jordan/climate-change-profile-jordan}
\textsuperscript{136} \url{https://unfccc.int/resource/docs/natc/lebanon_snc.pdf}
\textsuperscript{137} \url{https://reliefweb.int/sites/reliefweb.int/files/resources/Lebanon_4.pdf}
\textsuperscript{138} \url{http://climatechange.moe.gov.lb/viewfile.aspx?id=228}
varies from 0.89°C in January to 1.51°C in August. In Scenario B, the expected change in monthly temperature varies from 1.5°C (February) to 2.2°C (June)\[^{140}\].

**Expected changes in precipitation**

**Scenario A**

![Projected Change in Monthly Precipitation for Lebanon for 2040-2059](image)

**Scenario B**

![Projected Change in Monthly Precipitation for Lebanon for 2040-2059](image)

Precipitation in Lebanon has decreased by 11mm per month, per century since 1950\[^{141}\]. The precipitation is expected to continue decreasing. Decreasing precipitation is visible on the graphs for both Scenario A and B. The decrease in Scenario B is substantial with an expected decrease in rainfall of -7.28mm in December and -8.53mm in January, while the biggest expected monthly change in Scenario A is -3.77mm in January. In both scenarios, the decreasing trend continues throughout the century\[^{142}\].

**Water availability**

The decrease in precipitation, together with the increase in temperature, will impact Lebanon’s water supply negatively, particularly by decreasing the snow level that is a vital water source for the country\[^{143}\]. If the global temperature rises by 1°C, the total volume of water resources in Lebanon are projected to decrease by 6% to 8%. If the global temperature rises by 2°C, the total volume of water resources is projected to decrease by 12% to 16%\[^{144}\].

**Droughts and floods**

Flooding in Lebanon is mainly caused by irregularities in rainfall patterns. The country experiences 1 to 2 cases of flooding annually, a number that is likely to rise with climate change. About 10% of the Lebanese population is susceptible to drought and the severity and frequency of droughts is expected to rise\[^{145}\]\[^{146}\].

**Sea level rise**

The Mediterranean Sea has risen roughly 20mm per year since 1960. The rising could reach up to 30-60cm between 2020 and 2050 if the recent rate of rise continues\[^{147}\]. The higher sea level will have an impact on the sand beaches in the south, and on the coastal natural reserves such as the Palm Islands.

\[^{143}\] https://reliefweb.int/sites/reliefweb.int/files/resources/Lebanon_4.pdf
\[^{146}\] https://climatechange.moe.gov.lb/viewfile.aspx?id=228
and the Tyre nature reserves. It will lead to seawater intrusion into aquifers which will affect not only urban areas but also coastal irrigated agriculture. The potential impact of climate change on the coastal zone also includes coastal flooding and inundation during storms, coastal erosion and a loss of sand beaches, degradation of coastal ecosystems and nature reserves, and economic losses in coastal and marine activities such as tourism, agriculture, fisheries and transportation148.

Key sectors
Agriculture is the sector in Lebanon most vulnerable to climate change as higher temperatures, changes in precipitation, and extreme weather events are expected to reduce crop production149. As opposed to many of the other countries described, agriculture, forestry and fishing are the sectors with lowest contributing share to the GDP (4%) in Lebanon. However, agriculture employs 20-30% of the active workforce and constitutes 17% of the total exports. In rural areas, agriculture is reported to contribute up to 80% of the local GDP150. The tourism industry is one of the most important economic sectors in Lebanon. It contributes with 7.6% (20 % when indirect investments are considered) to the country’s GDP and employs 38% of the country’s workforce. Lebanon’s popular attractions of both sun and snow (e.g. ski resorts) are highly weather-dependent and vulnerable to climate change151. Winter outdoor tourism will diminish as warmer temperatures and reduced precipitation shorten the skiing season. Other impacts on tourism will occur in response to changes in ecosystems, loss of natural attractions, such as sandy public beaches, and structural damage to the nation’s archaeological heritage152.

Palestine
Palestine has a Mediterranean climate with hot and dry summers and rainy winters. However, even though Palestine is a somewhat small area, there is great diversity of the climate within the area: The West Bank ranges from extremely arid to humid, with annual rainfall ranging from up to 700mm in the north to as low as 45mm in the southeast. In the Gaza Strip, the rainfall is also diverse. Gaza receives up to 525mm rain in the north and 225mm in the south, making the weather conditions in the Gaza Strip somewhat better than in the West Bank153. Temperatures have been rising and are projected to continue to rise in Palestine. The extent of the temperature rise is, as for the other countries, dependent on how large global emission will be in the future154. According to projections, precipitation in Palestine might not change substantially if global temperature rise is kept under 2°C. But if global temperatures rise by 3°C, precipitation in Palestine could decrease by 15% in 2055 and 20% in 2090. In that case, the frequency of droughts would very likely increase155.

Unfortunately, climate projections for Palestine were not available at the World Bank Group’s Climate Knowledge Portal. Therefore, graphs showing changes in temperature and precipitation for Scenario A and B in this chapter show the changes in Israel. As the geographical territory is the same for the

148 Ibid
150 https://reliefweb.int/sites/reliefweb.int/files/resources/Lebanon_4.pdf
151 Ibid
155 http://www.climasouth.eu/sites/default/files/Technical%20Paper%20h.2%20Palestine%20%282.0%29_amend%20RT%20040717.pdf
two countries, we have chosen to show these graphs in order to visually underline the text about changes in temperature and precipitation in Palestine.

**Expected changes in temperature**

### Scenario A

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature in Scenario A</th>
<th>Temperature in Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>1.57°C</td>
<td>2.52°C</td>
</tr>
<tr>
<td>February</td>
<td>0.95°C</td>
<td>1.64°C</td>
</tr>
</tbody>
</table>

In Scenario A, the temperature is 1.57°C in August and 0.95°C in February, whereas Scenario B is projected to be substantially warmer with temperatures varying from 2.52°C in July and 1.64°C in February.

### Scenario B

**Expected changes in precipitation**

<table>
<thead>
<tr>
<th>Month</th>
<th>Precipitation in Scenario A</th>
<th>Precipitation in Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>-1.77mm</td>
<td>-4.18mm</td>
</tr>
<tr>
<td>April</td>
<td>-1.64mm</td>
<td>-3.83mm</td>
</tr>
<tr>
<td>August</td>
<td>Very small increase</td>
<td>Very small decrease</td>
</tr>
<tr>
<td>September</td>
<td>0.22mm</td>
<td>0.10mm</td>
</tr>
</tbody>
</table>

Scenario A shows a moderate decrease in precipitation with -1.77mm in January and -1.64mm in April, while Scenario B shows a much worse picture with a decrease in precipitation varying from -4.18mm in December and -3.83mm in January to a very small increase in precipitation of 0.10mm in August and 0.22mm September\(^\text{156}\).

**Sea level rise**

There is high confidence that sea level has increased in general over recent decades, but there are large uncertainties about the magnitude of increase\(^\text{157}\). Sea level in the eastern Mediterranean Sea, including Gaza, is expected to rise by 10cm every decade, which is consistent with global estimates of

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a 0.6-1.6m increase by the end of this century\textsuperscript{158}. Coastal aquifers will be affected by a rise in sea level, which contributes to saltwater intrusion. Sea level rise will accelerate coastal erosion and increase saltwater intrusion. Agricultural land makes up a part of the coastal area and sea level rise will affect farms, particularly in low-lying areas\textsuperscript{159}.

**Water availability**

The water sector is particularly vulnerable to the effects of climate change as Palestine has one of the lowest availabilities of water per capita in the world. The standard water poverty threshold is 500m\textsuperscript{3} per capita, per year. But the annual water share of Palestinians is less than 200m\textsuperscript{3} per capita, per year. The water situation is particularly acute in Gaza, where it is estimated that 26% of all diseases observed in the area are water-related. Studies suggest that over 90% of the Gaza Strip’s water resources are already undrinkable. This already alarming percentage is projected to rise because of further overexploitation and climate change, which will have adverse effects due to higher temperatures, changes in precipitation, increased seawater intrusion and salinization of freshwater resources\textsuperscript{160}. However, it should be noted that water access, to a large extent, depends on policy decisions linked to the conflict and occupation, and it is therefore difficult to attribute the availability of water to climate change.

**Agriculture**

Groundwater represents the main source of water for Palestinians and about half of the water extracted from groundwater wells is used for agriculture. The economic contribution of the agricultural sector to the country’s GDP has been declining for long period, and in 2014 the sector only contributed with 3.8% of the GDP. But domestic agricultural production is vital to the country’s food security, as it provides about 78% of the food consumed locally. Changes in temperature, precipitation, water availability and extreme climate events will have direct effects on agricultural production. Sea level rise is expected to affect coastal agriculture, which represents 31% of the Gaza Strip’s total agricultural production\textsuperscript{161}.

**Syrian Arab Republic (Syria)**

Syria is located in an arid to semi-arid region and has four geographic zones: the Mediterranean coast in the west, the mountainous scenery east of the coast, the steppe east of the mountains and along the northern border, and desert in the southeast of the country\textsuperscript{162}. Syria is affected by several of the impacts of climate change, and at the same time Syria is in a particularly vulnerable position because of the civil war that has been raging in Syria since 2011\textsuperscript{163}. The agricultural sector, which historically has been very robust, is declining and has been ever since the drought of 2006-2011. Industry and oil production have traditionally been the two main drivers of Syria’s economy\textsuperscript{164}. Several natural hazards are a reality for the Syrian population, and global warming is an exacerbating factor\textsuperscript{165}. Due to heavy use for irrigation in agriculture and an uneven distribution of the available water resources, Syria is

\textsuperscript{158} \url{file:///C:/Users/iskr/Downloads/Palestinian+Territories.pdf#page=18&zoom=100.0,181}

\textsuperscript{159} \url{http://www.climasouth.eu/sites/default/files/Technical%20Paper%20N.2%20Palestine%20%282.0%29 Amend%20RT%20040717.pdf}

\textsuperscript{160} \url{file:///C:/Users/iskr/Downloads/Palestinian+Territories.pdf#page=18&zoom=100.0,181}

\textsuperscript{161} \url{http://www.climasouth.eu/sites/default/files/Technical%20Paper%20N.2%20Palestine%20%282.0%29 Amend%20RT%20040717.pdf}

\textsuperscript{162} \url{https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_GEMS_Climate%20Change%20Risk%20Profile_Syria.pdf}

\textsuperscript{163} \url{https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Syrian%20Arab%20Republic%20FirstNDC%20Eng_Syrian%20Arab%20Republic.pdf}

\textsuperscript{164} Ibid and \url{https://climateknowledgeportal.worldbank.org/country/syria}

\textsuperscript{165} \url{https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_GEMS_Climate%20Change%20Risk%20Profile_Syria.pdf}
facing water scarcity even though the country has available water resources from Yarmouk and Orontes and several other basins. The mean annual temperature is expected to increase by 2°C by 2050 with a more rapid warming in the interior regions than in areas close to the coast. By the same year, a decrease in mean annual precipitation by 11% is projected.

**Expected changes in temperature**

**Scenario A**

Temperatures are rising in Syria. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 0.97 to 1.78°C. In Scenario B, the changes in monthly temperature vary from 1.8 to 3.0°C. The warming is expected to be highest in the northwest and southeast.

**Scenario B**

**Expected changes in precipitation**

The annual precipitation in Syria is projected to decrease in both Scenario A and B. The decrease in Scenario B is substantially larger than in Scenario A. The decrease in Scenario B is considerable, with the most dramatic expected change at -7.28mm in December and -8.53 in January. This is greater than the compared decrease of precipitation in Scenario A, where the monthly expected change will be -3.77mm in January.

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167 Ibid
168 https://climateknowledgeportal.worldbank.org/country/syria
Extreme weather events
Syria is exposed to extreme rainfall, heat waves and cold waves which cause severe damage to humans, livestock and agriculture169.

Droughts and floods
Syria is very vulnerable to drought because of the agricultural sector’s reliance on rain and groundwater170. Droughts have ranked among the worst of Syria’s natural disasters since 1900 by number of people affected. For example, the 2008 drought affected over 1.3 million people, and the 2009 Global Assessment Report estimated that about 10% of the Syrian population is exposed to droughts171. Devastating droughts, which can last for several years, such as the one in years up to the civil war, are predicted to be two to three times more likely due to climate change172.

Water availability
Syria is experiencing a water resource crisis due to climate change and poor agricultural policies. The country has, over a long period, over-withdrawn from its internal renewable water resources and it is estimated that a big part of the groundwater use, most of which was used for agriculture, has been deemed unsustainable in recent years. Because of the excessive withdrawal of groundwater, the country’s Khabur River has dried out and Syria is now even more reliant on groundwater173. Negative trends, with regard to water scarcity in Syria and driven by climate change, will lead to less precipitation, lower groundwater levels, and a decline in levels of vegetation. The fields and the groundwater will be salinized and make local wells unfit for drinking, and the agricultural productivity will decrease. Furthermore, the increase in both precipitation and snow in the mountains is expected to further increase the Syrian dependence on ground- and rainwater

Libya
Libya is a very arid country and is influenced both by the Mediterranean Sea to the North and the Sahara Desert to the South. Therefore, the country experiences very abrupt transitions in weather conditions174. Many areas in the country do not get any precipitation at all while other areas closer to The Mediterranean Sea get a little but far from enough to support the needs of the country175. More than 90% of Libya is desert with poor soil, and around 97% of the territory receives an average of less than 100mm of rain per year. These conditions mean that agriculture has very tough conditions and thus only can provide 25% of the country with food176. It is estimated that one third of the population lives below the poverty line and has limited resources to adapt to increasing temperatures and extreme weather events177. The winter period brings the most precipitation, whereas the summer months are very dry178. The mean annual temperature in Libya is projected to increase by 2°C by 2050, mainly due to heat waves and fewer frost days. Mean annual precipitation is expected to decrease by

169 https://climateknowledgeportal.worldbank.org/country/syria
171 https://climateknowledgeportal.worldbank.org/country/syria
172 https://climateknowledgeportal.worldbank.org/country/syria
173 Ibid
175 Ibid
176 https://climateknowledgeportal.worldbank.org/country/libya
7% with an intensity in rainfall but with fewer rainy days. Models disagree on whether Libya will get wetter or drier in the future.\textsuperscript{179}

**Expected changes in temperature**

**Scenario A**

Temperatures are rising in Libya. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In both scenarios, the monthly temperature is expected to rise the most from June to September. In Scenario A, the highest monthly increase is 1.65°C in August. In Scenario B, the highest monthly increase is 3.0°C in August. The warming is projected to cause more frequent heat waves.\textsuperscript{180}

**Scenario B**

**Expected changes in precipitation**

**Scenario A**

There is no significant change in precipitation in either of the two Scenarios. However, as noted above, other research predicts a decrease in precipitation, which would have a negative effect on the already very-dry country.

**Scenario B**

**Droughts and floods**

Libya often experiences droughts and flash floods, which lead to loss of crops, soil erosion and damage in the infrastructure. Droughts can extend to several years and major floods cause losses and damage

\textsuperscript{179} https://climateknowledgeportal.worldbank.org/country/libya/climate-data-projections

\textsuperscript{180} https://climateknowledgeportal.worldbank.org/country/libya/climate-data-projections
to infrastructure. Intensity and frequency in floods and drought are projected to increase from climate change and will lead to even worse losses of crops and soil, which will be a serious problem as almost 65% of Libya’s population depends on this. The variability of the rainfall – even to a lesser degree – will change the cropping patterns and reduce the yield

Sea level rise
Sea level rise will not have a very big effect on Libya in the short term, even in the coastal low-lying areas by the Mediterranean. Long-term though - by 2150-2200 – it is predicted that there will be a one-meter sea level rise, which will have a severe effect and will damage around 16% of the Libyan wetland with unpredictable consequences to agriculture and wildlife. This combined with higher temperatures and less rainfall will lead to urban areas increasing substantially in the future.

Challenges
The main challenges in Libya will be to adapt to the rising temperatures and the more frequent and severe droughts and floods. Damages to crops and soil will be a reality as well as losses and damage of wetlands and livelihoods. Sea level rise will also, in time, lead to displacements of large parts of the population.

\[^{181}\text{Grist and Speranza 2012}\]
\[^{182}\text{https://darsint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/country-profile/?country=Libya}\]
\[^{183}\text{Dasgupta et.al. (2008)}\]
Africa

In general, many African countries are vulnerable to climate change, not only because of their exposure, but also because of their high dependence on rainfed agriculture and low adaptation capacity. Climate change poses a major threat to sustainable development and growth in Africa\textsuperscript{184}. Temperatures on the continent are projected to increase faster than the global average during the 21\textsuperscript{st} century. A change in mean temperature is very likely over all land areas, no matter which scenario becomes reality. In the high-emission scenario (Scenario B), the change in mean annual temperature exceeds 2°C above the late-20th-century baseline over most land areas of the continent in the mid-21st century. In the late-21st century, the change in mean temperature will exceed 4°C in most land areas\textsuperscript{185}. Most of the countries in Africa still lack sufficient precipitation data, which means the projected precipitation for Africa is more uncertain than projected temperatures. A high-emission scenario (Scenario B) projects a very-likely decrease in mean annual precipitation over Southern Africa in the mid-21\textsuperscript{st} century and a further decrease in the late-21\textsuperscript{st} century. This scenario also projects a likely decrease in mean annual precipitation over central and eastern Africa in the mid-21\textsuperscript{st} century. In a low-emission scenario (Scenario A), the changes in mean annual precipitation over most areas in Africa are too small and uncertain to conclude that there will be any change in either the mid- or late-21\textsuperscript{st} century\textsuperscript{186}. African countries covered in this section are Democratic Republic of the Congo, Malawi, Zambia, Zimbabwe, Mali, Burundi, Kenya, Uganda and Ethiopia and the Central African Republic. Libya is covered above, in the MENA section.

Burundi

Annual rainfall and average temperatures vary for different parts of Burundi. There are four distinguished seasons, which have recently experienced change in Burundi. The long rainy season would normally occur from February – May, but now often ends in April. The long dry season would normally occur from June – August but can now be considered from May to September. The dry season is followed by a short and wet season lasting until December, again followed by a shorter dry period from mid-January to mid-February\textsuperscript{187}. As you can read bellow, further changes in the precipitation is projected. Burundi is the second-most densely populated country in Sub-Saharan-Africa but is experiencing very high population growth. Poverty is a big challenge for the country as 90-95\% of the population is living on less than 2 USD per day. The country is highly dependent on agriculture and is, therefore, very vulnerable to climate change\textsuperscript{188}.

\textsuperscript{185}https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartB_FINAL.pdf
\textsuperscript{186}https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartB_FINAL.pdf
\textsuperscript{187}https://climateknowledgeportal.worldbank.org/country/burundi/climate-data-historical
\textsuperscript{188}https://reliefweb.int/sites/reliefweb.int/files/resources/Burundi_1.pdf
Expected changes in temperature

Scenario A

Temperatures in Burundi are rising. Mean temperatures have increased by 0.7-0.9°C since the 1930s. The period between 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the change in monthly temperature varies from 1°C (December) to 1.3°C (September). In Scenario B, the change in monthly temperature varies from 1.7°C in (December-January) to 2.2°C (June).

Scenario B

Expected changes in precipitation

Scenario A

An increase in annual precipitation in Burundi is expected in both scenarios. The extra precipitation is expected to fall in the rain season. Scenario A projects an increase in January (11.63mm) and February (8.2mm) and a decrease in precipitation is projected in March (10.49mm) and October (15.99mm), which is the end and beginning of the rain season. The same pattern is projected in Scenario B, with a decrease in precipitation in the beginning and end of the rain season (March and November) and increasing rain in December and January. The variation in rainfall in Scenario B is substantial compared to Scenario A. The decrease in the beginning and end of the rainy season means that the

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dry season is getting longer. Combined the high increase in temperature during the dry period, this will have negative effects on water availability and affect crop and livestock productivity negatively\(^{192}\). By 2050, rainfall patterns are likely to be altered to the extent that Burundi will experience two six-month seasons, one rainy season lasting from November to April and a dry season covering May to October\(^{193}\).

**Extreme events**

Burundi is plagued with climate-related hazards like floods and droughts, which result in losses in GDP. Floods damage crops, soil and infrastructure, while they can also increase the presence of pests or diseases that affect food crops and livestock. Whereas drought lowers water levels and results in low crop and livestock production, floods are expected to increase in frequency and magnitude in the low-lying area\(^{194}\). Due to increased temperatures and change in precipitation trends, the frequency and intensity of droughts is also expected to increase, especially in northern parts of Burundi, which will cause a decrease in water levels in lakes\(^{195}\).

**Agriculture**

Agriculture is the primary economic sector in Burundi as it contributes 39.2\% to the country’s GDP and it employs 90 \% of inhabitants\(^{196}\). Today, food security is extremely fragile, and 61\% of households risk food security at least one time during the year. The expected challenges with higher temperatures, changes in rain seasons, and increased frequency of extreme events calls for agricultural adaptation\(^{197}\).

**Democratic Republic of Congo (DRC)**

The climate in The Democratic Republic of Congo (DRC) varies; it is hot and humid around the Equator, cooler and drier in the south, and cooler and wetter in the east\(^{198}\). North of Equator, it is possible to divide the climate into two seasons: the wet season ranges from April to October and the dry season ranges from December to February. South of Equator, the climate season is also divided into two main seasons: the wet season is from November to March and the dry season from April to October\(^{199}\). DRC is home to the second-largest rainforest in the world, and the Congo River Basin, a network derived from the Congo river with numerous tributaries which cover the entire country. The central plain is bordered by grasslands and mountain ranges to the north and west, savannahs along the south, and glacial peaks in the eastern highlands\(^{200}\). Even though DRC has an abundance of resources, this has not translated into stability or wealth for the majority of people because the country is currently characterized by significant social vulnerability, political instability, food insecurity and high poverty rates\(^{201}\). While there will be significant biophysical impact, particularly in the northeast, DRC’s high vulnerability is primarily related to socioeconomic factors\(^{202}\).

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\(^{192}\) https://reliefweb.int/sites/reliefweb.int/files/resources/Burundi_1.pdf

\(^{193}\) Ibid

\(^{194}\) Ibid

\(^{195}\) Ibid

\(^{196}\) Ibid

\(^{197}\) Ibid


\(^{199}\) http://geography.about.com/library/cia/blcldrcongo.htm

\(^{200}\) https://assets.publishing.service.gov.uk/media/57a08b02408065526d00a36/02-Democratic-Republic-of-Congo-Talks-Climate.pdf

\(^{201}\) https://www.climatelinks.org/sites/default/files/asset/document/20180716_USAID-ATLAS_Climate-Risk-Profile_DRC.pdf

\(^{202}\) https://reliefweb.int/sites/reliefweb.int/files/resources/DRC%28east%29.pdf
**Expected changes in temperature and precipitation**

Unfortunately, detailed climate projections for DRC were not available at the World Bank Group’s Climate Knowledge Portal. Therefore, graphs showing changes in temperature and precipitation for Scenario A and B are absent for this section.

Temperatures have been and are increasing in DRC. Projections indicate that a mean annual temperature increase may range between 1.72°C and 2.08°C by the 2060s, and between 2.69 and 3.22°C by the 2090s. Mean annual precipitation across the DRC has been consistently declining since 1951, but projections show an increase in future mean annual precipitation. The highest increase is projected in the northeast, with up to 16% more precipitation during March, April and May. In the northeast, a 3% decrease is projected for June, July and August. In the central parts of the country, projections indicate a maximum increase of 8% during June, July and August and a reduction by 4% during September and November.

**Extreme events**

Floods frequently happen within the River Congo Basin during equatorial heavy rain events. Several areas along the River Congo are therefore highly exposed to flooding, landslides, and erosion. Drought events are also common in DRC and can affect several thousand people. Climate change is likely to result in an increased frequency of extreme events, primarily floods (resulting in erosion, landslides, and crop failure) but, in some cases, also droughts. Whereas problems due to excess of rainfall are mainly expected in central DRC, droughts are forecasted primarily for the south.

**Health**

In DRC, malaria is a leading cause of morbidity and mortality. Given the impact of temperature on the lifecycle and habitat of malaria-carrying mosquito and parasite species, warmer temperatures may open up new locations suitable for transmission across the Congo Basin. A study predicts that, by 2030, an additional 65,000–80,000 people in DRC will be at risk from endemic malaria in areas previously unsuitable for malaria transmission, mainly in the south and pockets of Maiko-Tayna Kahuzi-Biéga and Greater Virunga Landscapes. However, in other areas of DRC (central and northwest within the Lac Télé-Lac Tumba Landscape), the season for malaria transmission is likely to become shorter. Increases in temperature and episodes of more intense rainfall are likely to impact the spread of waterborne diseases and emerging infectious diseases. Although DRC is one of the wettest places of the world, the majority of its people do not have access to safe drinking water and sanitation, so diarrheal diseases already represent a significant public health burden.

**Agriculture**

DRC is very dependent on agriculture as it accounts for 40% of the country’s GDP and employs around 70% of the population. The sector is very vulnerable to climate change as the agricultural activities are mainly rainfed and subsistence in nature. Increased rainfall intensity will damage crops and erode fertile soil. Prolonged dry spells and rising temperatures stress plants and reduce yields, putting

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205 https://climateknowledgeportal.worldbank.org/country/congo-democratic-republic/vulnerability
206 https://reliefweb.int/sites/reliefweb.int/files/resources/DRC%2B%28east%29.pdf
208 Ibid
209 Ibid
pressure on farmers to expand their cropland into forests. Climate variability and change may displace key activity seasons, affecting productivity and altering farmers’ crop selection, production, and processing practices.\textsuperscript{210}

**Ethiopia**

Ethiopia has a diverse climate and landscape, which ranges from equatorial rainforest with high rainfall and humidity in the south and southwest, to the Afro-Alpine on the summits of the Semen and Bale mountains, to desert-like conditions in the northeast, east and southeast lowland\textsuperscript{211}. The year can be divided into three overall seasons: a dry period from October to January, a short rain period from February to May and a long rain period from June to September\textsuperscript{212}. Ethiopia has rich water resources, and the country is very dependent on rainfed agriculture, which makes up 85% of the national labour force employment and more than 50% of the country’s GDP\textsuperscript{213}. Ethiopia is one of the most vulnerable countries in Africa to climate change, but because of the differences across the country in climate and topography as well social, cultural and economic characteristics, the degree of vulnerability to climate change varies across localities\textsuperscript{214} \textsuperscript{215}.

**Expected changes in temperature**

### Scenario A

<table>
<thead>
<tr>
<th>Month</th>
<th>Projected Change in Monthly Temperature for Ethiopia for 2040-2059</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.8°C (0.94°C in December to 1.22°C in May)</td>
</tr>
<tr>
<td>Feb</td>
<td>1.0°C</td>
</tr>
<tr>
<td>Mar</td>
<td>1.1°C</td>
</tr>
<tr>
<td>Apr</td>
<td>1.2°C</td>
</tr>
<tr>
<td>May</td>
<td>1.3°C</td>
</tr>
<tr>
<td>Jun</td>
<td>1.4°C</td>
</tr>
<tr>
<td>Jul</td>
<td>1.5°C</td>
</tr>
<tr>
<td>Aug</td>
<td>1.6°C</td>
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<td>Sep</td>
<td>1.7°C</td>
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<tr>
<td>Oct</td>
<td>1.8°C</td>
</tr>
<tr>
<td>Nov</td>
<td>1.9°C</td>
</tr>
<tr>
<td>Dec</td>
<td>2.0°C</td>
</tr>
</tbody>
</table>

### Scenario B

<table>
<thead>
<tr>
<th>Month</th>
<th>Projected Change in Monthly Temperature for Ethiopia for 2040-2059</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.8°C (1.7°C in October and November to 2.0°C in April)</td>
</tr>
<tr>
<td>Feb</td>
<td>1.0°C</td>
</tr>
<tr>
<td>Mar</td>
<td>1.2°C</td>
</tr>
<tr>
<td>Apr</td>
<td>1.4°C</td>
</tr>
<tr>
<td>May</td>
<td>1.6°C</td>
</tr>
<tr>
<td>Jun</td>
<td>1.8°C</td>
</tr>
<tr>
<td>Jul</td>
<td>2.0°C</td>
</tr>
<tr>
<td>Aug</td>
<td>2.2°C</td>
</tr>
<tr>
<td>Sep</td>
<td>2.4°C</td>
</tr>
<tr>
<td>Oct</td>
<td>2.6°C</td>
</tr>
<tr>
<td>Nov</td>
<td>2.8°C</td>
</tr>
<tr>
<td>Dec</td>
<td>3.0°C</td>
</tr>
</tbody>
</table>

The temperature is rising in Ethiopia. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, monthly temperature change varies from an expected increase of 0.94°C in December to an expected increase of 1.22°C in May. In Scenario B, monthly temperature change varies from an expected increase 1.7°C in October and November to an expected increase of 2.0°C in April\textsuperscript{216}.

\textsuperscript{210} \url{https://www.climatelinks.org/sites/default/files/asset/document/20180716_USAID-ATLAS_Climate-Risk-Profile_DRC.pdf}
\textsuperscript{211} \url{https://climateknowledgeportal.worldbank.org/country/ethiopia}
\textsuperscript{212} \url{https://unfccc.int/resource/docs/2018/10/web_gfrd_publication_climate_change_country_profile_for_ETH.pdf}
\textsuperscript{213} \url{https://climateknowledgeportal.worldbank.org/country/ethiopia/climate-data-projections}
Expected changes in precipitation

**Scenario A**

Projections of changes in Ethiopia’s precipitation are still very uncertain. The graphs show a general increase in the precipitation in October, November and December in both Scenarios. But the expected change differs between areas in Ethiopia. For central and southern areas in Ethiopia, rainfall could decrease, while an increase is expected in southwest and southeast areas. Northern areas are near-uniformly expected to experience a general decrease in rainfall. An increase in rainfall variability is predicted for the whole country, making rainfall less predictable\(^{217}\). Moreover, the proportion of total annual rainfall occurring in ‘heavy’ events are expected increase with up to 18%\(^{218}\).

**Drought and floods**

Ethiopia is one of the world’s most drought-prone countries, and warming has exacerbated droughts and expanded desertification in the lowlands. Between 1900 and 2010, 12 extreme droughts were recorded, killing over 400,000 people and affecting over 54 million. Such severe drought often results in famines. Ethiopia also experienced dozens of local droughts with equally devastating effects\(^{219}\). Especially the north, northeast, and east of Ethiopia tend to experience more frequent and severe droughts than the rest of the country\(^{220}\). Due to changes in precipitation, increased incidence of severe droughts is expected in the future. Heavy flooding with erosion and landslides is another climate hazard which Ethiopia is familiar with. Flash floods occur regularly throughout the country, particularly after a long dry spell. Vulnerable communities in the northwest have been especially affected\(^{221}\).

**Agriculture**

Agriculture in Ethiopia is largely subsistence smallholders with low levels of mechanization. Ethiopia is very reliant on rainfed agriculture, making the country particularly vulnerable to the effects of climate change. In 2017, 73% of the population in Ethiopia depended on agriculture, and agriculture accounted for 37% of GDP\(^{222}\). Climate change will have significant economic effects on the agricultural sector due to factors such as the loss of arable land due to shifting agroecological zones, altered growing cycles that delay planting, the increased frequency and intensity of extreme weather events

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217 https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Ethiopia)
219 https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Ethiopia)
220 https://openknowledge.worldbank.org/handle/10986/29461 (Groundswell: Preparing for Internal Climate Migration)
221 https://openknowledge.worldbank.org/handle/10986/29461 (Groundswell: Preparing for Internal Climate Migration)
222 file:///C:/Users/iskr/Downloads/WBG_ClimateChange_Final.pdf
and increased incidence of pests and disease\textsuperscript{223}. Overall, poor smallholder farmers are the most vulnerable groups to climate change. Afar, Somali, Oromia, and Tigray, which all are heavily dependent on agriculture, are expected to be the state’s most vulnerable to climate change\textsuperscript{224}.

**Displaced people**

In 2018, a report funded by the World Bank Group was published, which examined how many people climate change in the future will displace. The report examined Ethiopia as a case. The report found that, due to water availability and crop production, 0.4 to 1.2% of Ethiopia’s population is expected to be internally displaced due to climate change. The northern highlands with desiccated rainfed cropland areas are expected to be climate out-migration hotspots as lower crop production will force people to move away. The Capital, Addis Ababa, is also projected to be a climate out-migration hotspot because of its location in the heart of the rainfed agricultural region, which is projected to be hit by crop productivity declines. Climate in-migration hotspots will occur in the pastoral areas, rangelands, and semi-natural and wild areas (mostly semi-arid to arid areas) of the southern highlands and Ahmar Mountains in the east, where better water availability and crop productivity are projected\textsuperscript{225}.

**Kenya**

Kenya can be classified overall as arid and semi-arid as 85% of land falls into these two categories\textsuperscript{226}. But there are large climatic variations within the country; Kenya has a hot and humid tropical coast, temperate inland, and very dry north and northeast. Four seasons can be identified: a long, wet season from April to June, a cool dry season from July to September, a short and wet season from October to December and a warm dry season from January to March. Significant rainfall also occurs during the cool dry season in the Western Highlands and along the coast. Rainfall in Kenya is variable, especially in the Arid and Semi-Arid lands (ASALs). Annual variations follow El Niño and La Niña episodes\textsuperscript{227}. Glacial melt at Mount Kenya is a big concern for the country. The mountain had 18 glaciers in 1900, but in 2008 only seven of them still existed. Since these glaciers supply water to the Tana and Nzoia rivers, there has been a serious decrease in water availability\textsuperscript{228}.

\textsuperscript{223} https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Ethiopia)
\textsuperscript{224} Ibid
\textsuperscript{225} https://openknowledge.worldbank.org/handle/10986/29461 (Groundswell: Preparing for Internal Climate Migration)
\textsuperscript{227} https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Kenya)
\textsuperscript{228} Ibid
Expected changes in temperature

**Scenario A**
Projected Change in Monthly Temperature for Kenya for 2040-2059

**Scenario B**
Projected Change in Monthly Temperature for Kenya for 2040-2059

Temperatures are rising in Kenya. Since 1960, Kenya’s mean annual temperature has increased by 1.0°C, at an average rate of 0.21°C per decade\(^2\). The period 2040-2059 is also projected to be substantially warmer than the reference period (1986-2005). As the graphs show, in Scenario A the changes in monthly temperature vary from 0.83 to 1.04°C. In Scenario B, the changes in monthly temperature vary from 1.5 to 1.8°C\(^2\).

Expected changes in precipitation

**Scenario A**
Projected Change in Monthly Precipitation for Kenya for 2040-2059

**Scenario B**
Projected Change in Monthly Precipitation for Kenya for 2040-2059

There have not been any observed precipitation trends in either direction in Kenya since 1960, but there is an expected increase in annual precipitation in both scenarios. The projections indicate, as shown in the graphs, that the extra precipitation will fall in the wet season from October to December. The increase is dramatically higher in Scenario B where monthly precipitation is expected to increase by 18.4mm in December, compared to only 7.94mm in Scenario A\(^3\).

Floods and droughts
Kenya is one of the most disaster-prone countries in the world, affected by floods and droughts. Drought is the prime recurrent natural disaster in Kenya. Droughts have big economic impacts,


accounting for losses for around 8% of GDP every five years. Droughts are often nation-wide, but normally have the most severe effects in the ASALs. Increased temperatures in the future are likely to exacerbate the drought conditions and may have a significant impact on water availability. While droughts affect most people, floods have caused greater loss of human life. Due to increasing rainfall intensity, more frequent and heavier floods, accompanied by landslides, are also expected. Floods in Kenya are linked to EL Niño or La Niña episodes. Floods are more localized than droughts. Especially the areas around Lake Victoria basin, the Tana River drainage basin, and coastal settlements have been affected by floods. ASALs periodically experience flash floods.

Coastal areas
Coastal economies, communities and ecosystems in Kenya are likely to be adversely affected by climate change due to increases in sea surface temperature, sea level rise and coastal erosion. Sea level rise, in combination with extreme weather events, is likely to intensify flooding as most of the coastal land is low-lying. The coastal city of Mombasa is particularly exposed.

Agriculture and food security
The economic importance of the agricultural sector is declining but still generates 25% of annual GDP and employs 80% of Kenya’s population. Kenya is one of the water-scarcest areas in Africa, yet nearly all of Kenya’s crop production is rainfed. The projected increase in evaporation, altered rainfall patterns, sea level rise, and accelerated loss of glaciers will further decrease available water for agriculture. Frequent droughts, floods, endemic crop and livestock diseases, and frequent pests are some of the other big challenges farmers in Kenya face today, which will cause even larger challenges under climate change.

Climate change is expected to affect the food security in Kenya, which is already a problem as over ten million Kenyans suffer from chronic food insecurity and nearly 30% of children are undernourished.

Challenges
The adaptive capacity to climate change is low in Kenya’s agricultural sector due to various factors. Adaptation requires information and resources and, as there are high levels of poverty among smallholders, their adaptive capacity is low. Maize is Kenya’s primary staple crop, grown throughout the country, but because it is sensitive to drought, it is vulnerable to climate change. Climate change has already encouraged some farmers to start cultivating drought-resistant crops such as cassava, millet and cowpeas. But the fact that these are traditionally considered ‘poor men’s crops’ means that some farmers are discouraged to cultivate them.
Malawi

The climate of Malawi can be divided into three seasons: a warm and wet season from November to April (where 95% of the annual precipitation falls), a cool and dry winter season from May to August, and finally a hot and dry season ranging from September to October\(^{241}\). Overall rainfall exhibits high interannual variability and is highly influenced by the El Niño Southern Oscillation\(^{242}\). High population growth, dependence on rainfed agriculture, high rates of malnutrition and HIV/AIDS, and inadequate power supply combine to make Malawi particularly vulnerable to climate change\(^{243}\). In Malawi’s National Climate Change Management Policy, the Government states that economic models predict that, if Malawi does not act now, the direct overall costs due to climate change will be equivalent to losing at least 5% of the Gross Domestic Product (GDP) each year \(^{244}\).

Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Projected Change in Monthly Temperature for Malawi for 2040-2059</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Temperature</td>
</tr>
<tr>
<td>Jan</td>
<td>Feb</td>
</tr>
<tr>
<td>0°C</td>
<td>1°C</td>
</tr>
</tbody>
</table>

Temperatures are rising in Malawi. Mean annual temperature has increased by 0.9°C between 1960 and 2006. The increase has been most rapid in the rainy months from December to February, and lowest in in the hot season from September to November\(^{245}\). The period 2040-2059 is also projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 0.88 to 1.4°C. In scenario B, the changes in monthly temperature vary from 1.8 to 2.6°C\(^{246}\).

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\(^{243}\) [Ibid](https://reliefweb.int/sites/reliefweb.int/files/resources/NCCM-Policy-Final-06-11-2016.pdf)

\(^{244}\) [https://reliefweb.int/sites/reliefweb.int/files/resources/NCCM-Policy-Final-06-11-2016.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/NCCM-Policy-Final-06-11-2016.pdf)

\(^{245}\) [https://climateknowledgeportal.worldbank.org/country/malawi климатические данные поисторическим](https://climateknowledgeportal.worldbank.org/country/malawi климатические данные поисторическим)

\(^{246}\) [https://climateknowledgeportal.worldbank.org/country/malawi климатические данные по проектированным](https://climateknowledgeportal.worldbank.org/country/malawi климатические данные по проектированным)
Expected changes in precipitation

**Scenario A**

Projected Change in Monthly Precipitation for Malawi for 2040-2059

**Scenario B**

Projected Change in Monthly Precipitation for Malawi for 2040-2059

The very high year-to-year variability in rainfall in Malawi has made it difficult to identify long-term trends and changes in precipitation. There is no change projected in monthly precipitation between June and October in either Scenario A or B. There are projected changes in precipitation in the period from September to May, but some models predict an increase, while others predict a decrease, which means there is no conclusion on the direction of the changes. An increase in the proportion of rainfall in heavy events are expected in both scenarios247.

**Health**

Temperature increases are expected to heighten the incidence of malaria as the mosquito populations will spread into higher altitudes. Increasing flooding in the south will increase risks of cholera and other diarrheal diseases. Climate change is also expected to worsen already high malnutrition in the country as agriculture will be affected. Disease outbreaks and food shortages will disproportionately affect Malawi’s vulnerable HIV/AIDS population248.

**Droughts and floods**

Droughts and floods are the major climatic hazards in Malawi, and the direct cost of droughts and floods is about 1.7% of Malawi’s GDP every year. There has been an increase in frequency, intensity and magnitude of prolonged dry spells, seasonal droughts, intense rainfall, riverine floods and flash floods249. These hazards affect the agricultural sector as well as the fisheries sector and have been responsible for the decline, or even drying up, of water bodies. Droughts and floods have adversely affected food, water, and energy security250.

**Agriculture**

Rainfed agriculture is the foundation of Malawi’s economy. The crop production is already constrained by limited landholdings, declining soil fertility. Rainfall variability and future climate change will constrain production further251. Most of the agriculture production is focused on maize. Maize production accounts for 52% of total agricultural crop area, 34% of the country’s gross domestic

249 https://reliefweb.int/sites/reliefweb.int/files/resources/NCCM-Policy-Final-06-11-2016.pdf
251 https://reliefweb.int/sites/reliefweb.int/files/resources/NCCM-Policy-Final-06-11-2016.pdf
product (GDP), and 85% of employment\textsuperscript{252}. However, maize is sensitive to changes in temperatures and rainfall as well as extreme events\textsuperscript{253}. Other types of crops such as soy and pigeon peas are emerging as these are more resilient to higher temperature. But these crops are still of course vulnerable to extreme events\textsuperscript{254}. If the reliance on maize continues, it will restrict livelihood options for millions and exacerbate food insecurity over the long term\textsuperscript{255}.

### Mali

Mali spans four different eco-climatic zones: Sahara, Sahelian, Sudanian and Sudanian-Guinean. The northern areas of Mali extend into the Sahara and Sahel. The southern region experiences a wetter, more tropical climate and is where most of the country’s economic activity is concentrated. Even though there are variations over the zones (for example the rainy season is significantly longer in the south than the north), there are three distinguished seasons in Mali: a cool and dry season occurring between October and January, a hot and dry season occurring between February to May, and a rainy season where humidity increases, and lower temperatures are experienced between June and September\textsuperscript{256}. Variations in the movements of the low-pressure belt intertropical convergence zone from one year to another cause large inter-annual variability in wet-season rainfall, which means that Mali suffers from recurring drought\textsuperscript{257}.

### Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="chart" alt="Projected Change in Monthly Temperature for Mali for 2040-2059" /></td>
<td><img src="chart" alt="Projected Change in Monthly Temperature for Mali for 2040-2059" /></td>
</tr>
</tbody>
</table>

Temperatures are rising in Mali. The mean annual temperature in Mali has increased by 0.7°C since 1960, an average rate of 0.15°C per decade\textsuperscript{258}. The period 2040-2059 is also projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 1.2 to 1.4°C. In Scenario B, the changes in monthly temperature vary from 2.1 to 2.6°C.

\textsuperscript{252} https://climateknowledgeportal.worldbank.org/country/malawi/impacts-agriculture  
\textsuperscript{255} https://climateknowledgeportal.worldbank.org/country/malawi/impacts-agriculture  
\textsuperscript{256} https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdr_climate_change_country_profile_for_MLI.pdf  
\textsuperscript{257} https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Mali)  
\textsuperscript{258} Ibid
Expected changes in precipitation

Because rainfall in Mali is characterised by high variability on inter-annual and inter-decadal timescales, it has been difficult to identify long-term trends.\(^{259}\) There is only a small change between the scenarios in 2040-2059. According to the National Direction of Meteorology in Mali in 2008, the rainfall had been decreasing since 2001\(^{260}\), but is not yet possible to get a clear picture of future changes in precipitation in Mali, as some models predict a drying trend while others predict a more humid future\(^{261}\). Climate change is expected to increase the variability though\(^{262}\).

Drought and floods

Mali is prone to extreme climatic events, especially droughts. Their incidence is increasing due to rising temperatures and increasing variability in precipitation\(^{263}\). The north of the country is experiencing desertification where the borderline gradually shifts to lower latitudes. Under climate change, this situation is likely to worsen, with accelerated desertification and limited water availability in the north\(^{264}\). More frequent torrential rains and flooding are expected in the south during rainy seasons, where many people are exposed to floods along the two great rivers Niger and Senegal and their tributaries\(^{265}\).

Health

Malaria is the leading cause of death in Mali. The rising temperatures will shorten the transmission season, and so deaths caused by malaria could decrease in many zones. But rising temperatures will cause more frequent heat waves, resulting in a negative effect on human health. Mali also has high rates of diarrheal diseases, and higher temperatures and increased flood risk may increase transmission of pathogens\(^{266}\).

Agriculture

Agriculture employs about 75% of Mali’s population and accounts for approximately 50% of its gross domestic product (GDP)\(^{267}\). Despite this heavy reliance on agriculture, only 14% of the country’s land

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259\) Ibid
260\) Ibid
262\) https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Mali)
263\) Ibid
264\) Ibid
265\) Ibid
266\) https://www.climatelinks.org/sites/default/files/asset/document/Mali_CRP_Final.pdf
267\) https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Mali)
area is considered suitable for agriculture. While spatial patterns of vulnerability vary significantly within Mali, the northern parts of Mali are among the most vulnerable. This means that the intensively cultivated south is endangered by increasing pressure on natural resources. 95% of agriculture is rainfed, and rainfall is already a major constraint for crop production.

Challenges
Most Malians already live in a situation of chronic food insecurity. To date, 2.7 million people (25%) of the rural population are food insecure, and 3.5 million people (32%) living in rural households are in a vulnerable position. Cotton and Gold production are some of the biggest sectors. They are both highly water-demanding though and may compete with food security, especially if climate change limits water availability further. But effects of climate change may also lead to new areas being gained for the production of specific crops. However, that shift requires adaptation of farmers’ crop selection, which is not automatically done and requires good information and resources. The fact that Mali has low adaptive capacity is one of its biggest challenges.

The Central African Republic (CAR)
CAR is located north of the Equator and is a landlocked country with tropical savannah, dominated by two mountain ranges - one eastern and one in the western end of the country. The country has two central drainages: the Chari-Longue basin in the north and the Congo basin in the south. The population is estimated to be around 5 million. Poverty is widespread in the population and, even though the country has a multitude of natural resources, it is under-exploited because of political instability and lack of infrastructure. CAR is fragile and in a vulnerable position, which will be further exacerbated by climate change. The climate in CAR is hot and humid and characterised by two seasons: a dry season from December to March and a rainy season from April to November. Rising temperatures and changes in precipitation patterns have direct effects on crop productivity as well as indirect effects due to changes in water availability for irrigation. Temperatures and rainfall in CAR vary considerably. In northern parts, temperatures are the highest.

265 https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles (Climate change profile: Mali)
267 ibid
268 https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Central%20African%20Republic/1/CPDN_R%C3%A9publique%20Centrafricaine_EN.pdf
270 https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Central%20African%20Republic/1/CPDN_R%C3%A9publique%20Centrafricaine_EN.pdf
271 https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Central%20African%20Republic/1/CPDN_R%C3%A9publique%20Centrafricaine_EN.pdf
Temperatures are rising in CAR. Mean annual temperature has increased at a rate of 0.3°C per decade since 1978, with faster increases in north eastern parts of the country. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from to 0.96 to 1.4°C. In scenario B, the changes in monthly temperature vary from 1.7 to 2.1°C.

Expected changes in precipitation

There has been a decrease in precipitation in CAR over the period 1978–2009 with more inter-annual variability. Projections regarding changes in precipitation in the CAR are not very clear and quite uncertain. Some forecasts predict a slight increase in annual precipitation while others project irregular variations in precipitation. In Scenario A, the graph shows that the projected annual changes in precipitation are very small whereas in Scenario B, larger changes are shown, and an annual increase is expected.

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279 https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Central%20African%20Republic/1/CPDN_R%C3%A9publiq ue%20Centrafricaine_EN.pdf
Droughts and floods
Torrential rains followed by floods and droughts are the most important climate hazards which are expected to increase with climate change. The massive rainfall and floods are projected to affect the southern parts, while the drought will mainly affect the northern parts of the country. More rain will, at first sight, seem positive but combined with the rising temperatures, it can lead to higher evaporation and therefore, reduce water for agricultural use. Instead, intensity of the rainfall can lead to more severe floods and landslides in the future, having negative effects in agriculture that will affect more than 70% of the population's livelihood in CAR.

Agriculture
75% of the workforce in CAR earns livelihood through agriculture and it is the main economic sector in the country and accounts for around 55% of GDP. At the same time, the poor part of the population is the most dependent on subsistence agriculture, which will be most affected by climate change. Rainfall is clearly the most important factor for rainfed agriculture and livestock productivity, and it is important to determine the annual mean precipitation, as either more or less precipitation will be an important factor in determining the future adaptation to climate change, such as whether certain crops or farm practices are still viable or if reduced water availability should shift to more drought resistant crops or maybe even if farmers should shift investments into irrigation.

Challenges
CAR is characterized by significant social vulnerability, political instability and poverty. In this sense, CAR is not well equipped to adapt to the adverse impacts of climate change. The rural populations are the poorest as well as the most exposed to the effects of climate change. Therefore, in order to mitigate climate change and adapt agriculture and natural resource management to long-term trends in climate variability, capacity within government institutions, local communities and non-governmental organizations that work with those communities, needs to be strengthened. Building an adaptive capacity to climate change can bring about other positive changes regarding the process of reconstruction, reconciliation and peacebuilding in the country.

South Sudan
South Sudan is a recently independent state and a landlocked country with a tropical climate and one of the richest agricultural areas in Africa. The country has two peaks of rainy seasons. Almost 87% of the population works in agriculture (including livestock and forestry). This is not reflected very well in the country's economy as up to 98% of the country's budget revenue is from oil. South Sudan has an estimated population of 12.2 million and has a very high poverty rate. The country is relatively new and has been through a considerable amount of conflict, making it very vulnerable and less able to adapt to climate change. Among the natural hazards the country faces are floods and drought. The

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281 Ibid
286 https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Central%20African%20Republic/1/CPDIN_RNC3%20public.pdf
Implications of climate change lead to a variability in the climate and an intensity in rainfall, which will affect both agriculture and increase the risk of floods and spread of disease.

Expected changes in temperature and precipitation
As one of the world’s newest countries, there is not a lot of historical data for South Sudan and unfortunately, detailed climate projections for South Sudan were not available at the World Bank Group’s Climate Knowledge Portal. Therefore, graphs showing changes in temperature and precipitation for Scenario A and B are missing in this section. It can be said about the temperatures in South Sudan that they have been rising and are projected to continue to rise. This graph was available, and it shows a substantial difference in temperature between the two scenarios.

According to these projections, mean annual temperatures are projected to rise to between 1-2.1°C by mid-century. Annual mean precipitation is expected to increase by 4% by 2050 and the country is expected to become wetter with increased intensity in rainfall. The increased torrential rainfall will have especially grave effects.

Droughts, floods, and the spread of epidemic diseases
Both droughts and floods are a known phenomenon in South Sudan. Between July and September, when heavy rains fall in most parts of the country, the Nile River tributaries are often flooded, and many parts of the country are left under water. Due to the hot and dry conditions in the dry season (January to April) droughts also occur very often in South Sudan. A disadvantage to the South Sudanese otherwise benefitting from the Nile River ecosystem is the spreading of diseases such as malaria and bilharzias. Furthermore, the humid environment in the southwestern agricultural belt makes tsetse flies very common, and in the Eastern Flood Plains, sand fly infestations are very prevalent. These natural hazards will be further exacerbated by climate change, which will lead to more severe drought and increase variability in weather events. Climate change will bring grave consequences, especially for the agricultural sector, which is the livelihood for the vast majority of the population.

Agriculture
Agriculture is, as noted earlier, the livelihood of more than 85% of the South Sudanese population. As most of the agricultural production is rainfed and depends on the seasonal rain for optimal crop performance, it is very vulnerable to climate variability, which is predicted. South Sudan is home to a

289 https://climateknowledgeportal.worldbank.org/country/south-sudan/vulnerability
variety of production systems which are all raising livestock (for example, pastoralism), which is
dependent on access to grazing land and watering points, and therefore might change migration
patterns as those in search for water and fodder end up in agricultural or other pastoral lands. Already
existing tensions between farmers and pastoralists, competing over land use and increasingly scarce
resources, may be worsened as the effects of climate change develop290.

Challenges
South Sudan faces a number of challenges regarding development due to its status as the youngest
and one of the least developed countries in the world. Political instability (with ongoing internal
conflict), poverty (about 50% of the population lives below the national poverty line) and persistent
food insecurity are exacerbated by climate change and South Sudan ranks among the most fragile
states in the world. Frequent flooding, droughts, ongoing conflict and the displacement of millions
of people has drastically reduced food production, and more than 50% of the population is considered
food insecure291.

Sudan
Sudan is one of the largest countries in Africa and has a highly variable climate with arid savannah in
the east, west and south, and desert in the north. Mean annual temperatures vary between 26ºC and
32ºC across the country. And Although most of the country is desert, Sudan also has fertile land,
mountains and livestock. Agriculture and livestock are an important part of the country’s economy,
besides oil292. The most extreme temperatures are found in the far north, where summer
temperatures can often exceed 43ºC and sandstorms blow across the Sahara Desert from April to
September. The main rainy season is from March to October, with precipitation ranging between less
than 50mm in the extreme north to more than 1500mm in the extreme south293. Temperatures are
projected to rise to between 0.5ºC-3ºC by mid-century, with extreme temperature increases in the
north. These increases in temperature will intensify the impacts of drought through increased
evapotranspiration and reduced soil moisture. Precipitation is projected to increase by 4% per decade
and the variability in rainfall will also increase. Rainfall is already unpredictable and varies substantially
from the northern to the southern parts of the country294. This variance, combined with the intensity
of short growing seasons, threatens rainfed agriculture in Sudan. The rainfall patterns will further the
advancement of the Sahara Desert towards the South, continuing the already existing advancement
of an estimated 1.5km per year. Depending on the increase in temperature, the Red Sea could rise 30-
50cm by 2050295.

291 https://www.climatelinks.org/resources/climate-change-risk-profile-south-sudan
294 https://www.adaptation-undp.org/explore/northern-africa/sudan
Expected changes in temperature

Scenario A

Projected Change in Monthly Temperature for Sudan for 2040-2059

Temperatures are rising in Sudan. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 1.14 to 1.35°C. In Scenario B, the changes in monthly temperature vary from 2.0 to 2.3°C. The increase in temperatures in Sudan is forecasted to be more extreme in northern regions of the country. The increase in temperatures is expected to intensify the impacts of drought through increased evapotranspiration and reduced available soil moisture.296

Expected changes in precipitation

Scenario A

Projected Change in Monthly Precipitation for Sudan for 2040-2059

Changes in precipitation for Sudan are more uncertain than temperature predictions. With forecast results showing both wetter and drier conditions in the future, it is difficult to obtain a clear picture of changing precipitation. Model projections for northern Sudan are uncertain, while there is a more reliable forecast about an increase in intense precipitation southern Sudan. In general, the variability and unpredictability in seasonal rainfall is expected to be higher and increased frequency and intensity of droughts will follow.297

Drought and floods

The main challenges in Sudan are due to the temperature increases and the variability in precipitation is expected to exacerbate the impacts of drought\textsuperscript{298}. The projections, with regards to the changes in drought, are not consistent in northern Sudan, while an increase in droughts in the southern part of the country is expected. Droughts are expected to occur on average every 5 years. 15% of natural disasters in Sudan in the last three decades have been droughts and they are expected to increase in frequency. In the same period, between 1990-2014, 73% of disasters recorded in the country have been floods, which makes this the most frequent natural disaster in the country and floods are also expected to increase in frequency as an impact of climate change. River floods are projected to occur, at minimum, once in Sudan within the next decade and the risk-level is high across all regions in the country. In the same period, the risk of coastal flooding in the eastern coastal regions is also classified as high, which means that waves are expected to flood the coast with potentially damaging impacts\textsuperscript{299}.

Agriculture

Sudan suffers from poor soil conditions and the agricultural sector is not performing very well. Increasing drought and variability in rainfall will further constrain rainfed agriculture in the country. Areas in the north are expected to be increasingly unsuitable for agriculture as the more humid climate is projected to shift southward. Consecutive years of drought with consequential reduced yield, crop failure and high livestock mortality, have already created recurring food emergencies and famine across the country; furthermore, drought and reduced rainfall have reduced available productive lands and put a strain on rural livelihoods. These problems within the agricultural sector increase rural migration to the urban parts of the country, expanding slums and exacerbating health and sanitation concerns. Evidence also suggests that pastoralist communities have been stressed by prolonged droughts leading to regional conflict\textsuperscript{300}.

Challenges

Water-related conflicts are some of the challenges which will be exacerbated with the effects of climate change. In northern Sudan, where desert landscape is prevalent and water scarcity a reality, an increased water consumption by agriculture and population growth could contribute to a water crisis for Sudan. With half of Sudan’s population living on only 15% of the country’s land area, all near the Nile River, water resources are extremely important to the country’s continued economic development and social cohesion. 67% of Sudan’s population is dependent on the Nile as the main source of water supply. As 94% of water demand is used for irrigation, a projected increase in agricultural development, even without climate change, will cause demand to far outpace supply by 2030 and climate change impacts are only expected to exacerbate this issue\textsuperscript{301}. Water rights are a continuing source of tension between Sudan and neighbouring countries (particularly South Sudan). Across the region, access to water from the Nile has sparked conflict between states and there is concern that climate change may adversely impact the stability of Sudan. Increased discussions over rights and access to water at the local, national and regional levels will continue to be a source of conflict and is expected to worsen as water scarcity increases\textsuperscript{302}.

\textsuperscript{298} https://climateknowledgeportal.worldbank.org/country/sudan/vulnerability
\textsuperscript{300} Ibid
\textsuperscript{301} Ibid
\textsuperscript{302} Ibid
Uganda

Uganda’s climate can generally be divided into three types: the highland climate (cool with moderate rainfall), the savannah climate (medium temperatures with large amounts of rainfall) and the semi-arid climate (high temperatures with low amounts of rainfall). The climate in Uganda is generally stable and moderate throughout the year, and with its location across the Equator, the country has two yearly rain seasons, which merge into one long rain season as one moves away from the Equator. The first rain season ranges from March to June, while the second ranges from August to October. Around 80% of the population in Uganda relies on agriculture, making this sector the single most important in the country\textsuperscript{103}.

Expected changes in temperature

\textbf{Scenario A}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{scenario_a}
\caption{Projected Change in Monthly Temperature for Uganda for 2040-2059}
\end{figure}

Temperatures are rising in Uganda. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 0.9 to 1.2 °C. In scenario B, the changes in monthly temperature vary from 1.6 to 2.0 °C\textsuperscript{104}. The increasing temperatures are likely to accelerate the rate of evaporation and thereby reduce the immediate benefits of increasing rainfall and increase the severity and frequency of droughts and heats waves\textsuperscript{105}.

\textbf{Scenario B}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{scenario_b}
\caption{Projected Change in Monthly Temperature for Uganda for 2040-2059}
\end{figure}

Expected changes in precipitation

\textbf{Scenario A}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{scenario_a_precipitation}
\caption{Projected Change in Monthly Precipitation for Uganda for 2040-2059}
\end{figure}

\textbf{Scenario B}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{scenario_b_precipitation}
\caption{Projected Change in Monthly Precipitation for Uganda for 2040-2059}
\end{figure}

\begin{itemize}
\item \textsuperscript{103} \url{http://unfccc.int/resource/docs/natc/uganc1.pdf}
\item \textsuperscript{104} \url{http://climateknowledgeportal.worldbank.org/country/uganda/climate-data-projections}
\item \textsuperscript{105} \url{https://unfccc.int/resource/docs/natc/uganc2.pdf}
\end{itemize}
The annual precipitation in Uganda is expected to increase both in Scenario A and B. An increase in monthly precipitation is expected from November to February. The increase in these months varies from 0.15 to 6.54mm per month in Scenario A and from 5 to 19mm in Scenario B\(^{306}\).

**Drought and floods**

Temperature rise and an increase in the frequency and intensity of extreme droughts and floods can reduce crop yields and cause a loss in livestock, which will have important implications for food security. Water resources are also likely to be strained in the future climate of Uganda. With more frequent and severe droughts, the region will likely experience negative impacts on water supply, biodiversity, and hydropower generation. A potential simultaneous increase in floods poses a serious water pollution threat. Climate changes may also affect the health of wetland and forest ecosystems, which provide critical ecosystem services for communities in Uganda\(^{307}\). The most drought-prone areas in Uganda are the districts in the cattle corridor stretching from Western and Central to mid-northern and eastern Uganda. Additionally, the likelihood of increased aridity and drought stress is expected to lead to water scarcity in some areas, resulting in increased demand for water and raising and the potential for conflict and biodiversity loss. Higher temperatures with increased aridity may also lead to livestock stress and reduced crop yields. Flooding, particularly in low-lying areas of the country, presents the largest risk. Floods impact nearly 50,000 people per year. Uganda experiences both flash floods and slow-onset floods, which are common in urban areas, low-lying areas, areas along riverbanks and swamplands. The northern and eastern areas of the country and the capital city, Kampala, are the most prone to floods. Increased intense rainfall events, with the possibility of higher rainfall for some areas, will lead to a heightened risk of flooding, loss of life, and damage to property and infrastructure. Torrential rainfall and flooding may also result in soil erosion, decreasing yields and increasing food insecurity. Climate change is expected to increase the risk and intensity of flooding as well as increase likelihood for water scarcity for certain areas of the country\(^{308}\).

**Agriculture**

Agriculture is the main economic sector in Uganda, accounting for over 20% of the country’s GDP and employing over 70% of the labour force\(^{309}\). High dependence on rainfed agriculture makes Uganda vulnerable to climate change and remains a downside risk to growth, the income of poor people, as well as export earnings\(^{310}\). The agricultural sector in Uganda is currently being affected by climate-related threats such as increasing temperatures, droughts, flooding, prolonged dry spells, hailstorms, landslides, pests, disease epidemics for livestock and crops, and a shift in rainy seasons. Some of the crops most widely grown in Uganda (coffee, maize and bananas) are vulnerable to the projected increasing temperatures and increasing variability in rainfall, among other things, because of increased risk of disease\(^{311}\).


\(^{308}\) [https://climateknowledgeportal.worldbank.org/country/uganda](https://climateknowledgeportal.worldbank.org/country/uganda)


\(^{311}\) [https://unfccc.int/resource/docs/natc/uganc2.pdf](https://unfccc.int/resource/docs/natc/uganc2.pdf)
Challenges
Uganda is ranked as one of the countries least ready to cope with climate impacts. Climate change is affecting all key sectors in Uganda. According to the Economic Assessment of the Impacts of Climate Change 2015, Climate change damage estimates in the agriculture, water, infrastructure and energy sectors could collectively amount to 2-4% of the GDP between 2010 and 2050. Challenges from climate change are interlinked with other social economic factors, such as the influx of refugees and displaced people. Overall, increasing variability in precipitation and increasing temperatures will present an additional stress on development in Uganda.

Zambia
Zambia’s climate is tropical. Temperatures remain relatively cool throughout the year due to the high altitudes of the East African Plateau. There are three seasons in Zambia: a hot and dry season from August to November, a wet season from November to April, and a cool and dry season from May to August. Rainfall in Zambia is strongly influenced by the El Niño Southern Oscillation (ENSO), which causes further inter-annual variability and makes the wet period drier than average in the south, while the northern areas experience wetter conditions during El Niño years. The opposite occurs during La Niña years. Zambia is one of the most urbanised countries in sub-Saharan Africa. About 40% of its inhabitants live in urban areas. Even though Zambia is a middle-income country and has a robust economic growth, poverty levels remain high. As with many other countries in the region, many Zambians rely on rainfed agriculture, which makes the country vulnerable to climate change.

Expected changes in temperature

Temperatures are rising in Zambia. Zambia’s mean annual temperature increased by 1.3°C between 1960 and 2003. The period 2040-2059 is also projected to be substantially warmer than the

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318 Ibid
319 Ibid
320 Ibid
reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 1.09 to 1.5 °C. In Scenario B, the changes in monthly temperature vary from 1.9 to 2.6 °C.

**Expected changes in precipitation**

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
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<tbody>
<tr>
<td><strong>Projected Change in Monthly Precipitation for Zambia for</strong></td>
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<td>2040-2059</td>
<td>2040-2059</td>
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</tbody>
</table>

The mean annual rainfall over Zambia has decreased by an average rate of 1.9mm per month and 2.3% per decade since 1960. This annual decrease is largely due to a decrease by 7.1mm per month in December, January and February. Projections do not indicate substantial changes in annual precipitation. But as the graphs show, further decreases in rainfall are expected in the wet season in both Scenario A and B.\(^{321}\)

**Drought and floods**

Floods are common in Zambia and affect many sectors. Zambia also experiences droughts, which can have devastating consequences. Studies show that there has been an increase in the frequency and severity of both hazards over the past decades. Further, the studies show that the rainy season is becoming shorter.\(^{322, 323}\) Vulnerable sectors like agriculture, forestry, water and health have been adversely impacted by climate-induced changes.\(^{324}\)

**Water**

The water resources in Zambia represent about 40% of the water resources in the Southern African region.\(^{325}\) However, surface water in Zambia is unevenly distributed, and the southern region often experiences water shortages. During drought periods and following declines in precipitation, there have been reductions in the flow and volume of rivers, streams, and lakes, which have affected the accessibility and availability of water.\(^{326}\)

**Health**

Climate change is expected to bring heat stress caused by the rising temperatures, increases in waterborne diseases, and malnutrition due to insufficient food, which will affect the health of vulnerable populations.\(^{327}\) Malaria is a killer disease in Zambia. Increased flooding is expected to, cause favourable environments for mosquitoes, which will in turn transmit more diseases.\(^{328}\)


\(^{324}\) [Ibid](https://www.climatelearningplatform.org/sites/default/files/resources/zambia_climate_risk_screening_report_-_final.pdf)


Agriculture
The agriculture in Zambia is highly dependent on rainfall and thereby very sensitive to climate change. The agriculture sector is the fourth largest contributor to GDP and 70% of the workforce depends on agriculture. The majority of farmers, almost 98%, can be classified as small-scale farmers, whose agricultural activities are almost 100% dependent on rainfall. Zambia’s poorest population falls under this category. Climate Change, especially changes in precipitation, is expected to cause a reduction in agricultural productivity. Zambia is fairly stable in terms of national food security, particularly in reference to availability and access to grains such as maize. However, as maize is produced mostly by smallholders under rainfed conditions, households and national food security are vulnerable to weather variability and climate change.

Zimbabwe
The Zimbabwean climate can be divided into four seasons: a hot season from mid-August to mid-November (with day temperatures between 26°C and 36°C); a main rainy season from mid-November to mid-March (interrupted by 4 to 5 dry spells); a cool season from mid-May to mid-August (with day temperatures between 20°C and 29°C); and a post-rainy season from mid-March to mid-May (with day temperatures between 23°C and 31°C). Generally, Zimbabwe can be said to lay in a semi-arid region with limited and unreliable rainfall patterns and temperature variations. By mid-century, the mean annual temperature in Zimbabwe is projected to rise to between 1.2 and 2.2°C, depending on future emissions, and it is expected that the duration of heat waves and warm dry spells will increase in the near future.

Expected changes in temperature

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
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<tbody>
<tr>
<td>Projected Change in Monthly Temperature for Zimbabwe for 2040-2059</td>
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<tr>
<td>Temperatures are rising in Zimbabwe. The period 2040-2059 is projected to be substantially warmer than the reference period (1986-2005). In Scenario A, the changes in monthly temperature vary from 0.9 to 1.4°C. In Scenario B, the changes in monthly temperature vary from 2.0 to 2.7°C. The increase in temperature is, in both Scenarios, highest from September to December. Temperatures are</td>
<td></td>
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232 https://www.kas.de/c/document_library/get_file?uuid=6d0fe27f-66d1-4f7b-72e7-65c1ae2b955&groupId=2520238
expected to increase relatively homogeneously across Zimbabwe, though with a slightly higher warming in southern and western parts of the country.

Expected changes in precipitation

The annual precipitation in Zimbabwe is expected to decrease in both scenarios, but the decrease is largest in Scenario B. The decrease in precipitation is mainly in the wet season from October to March. Northern and eastern parts of Zimbabwe will experience more precipitation than the country average, while western and southern parts of the country will receive less than average precipitation.

Droughts and floods

Zimbabwe is currently prone to extreme weather events such as droughts, very heavy rainfall events and tropical cyclones. Climate change will intensify the precipitation variability of Zimbabwe. Heavy rains and flash floods threaten human lives directly in low-lying areas. Floods also create breeding grounds for mosquitoes, which are associated with the spread of malaria. Floods damage buildings and infrastructure and cause significant material losses. The combination of torrential rainfall and severe droughts leads to floods and landslides with severe impact on the livelihoods of the poor and rural populations. This increase of natural disasters related to the rising temperature and variability in precipitation has led to the agricultural sector’s insufficiency to cover Zimbabwean consumption.

Agriculture

The agricultural sector is the most vulnerable sector when it comes to impacts of climate change. The rising temperatures, combined with unpredictable and decreasing rainfall, will lead to increasing intensity and frequency in floods and droughts, which will have a severe impact on the agricultural sector in Zimbabwe. These conditions are expected to render land increasingly marginal for agriculture. This is a major threat to the economy and the livelihoods of the poor and rural population, which are dependent on rainfed agriculture and other climate sensitive resources. 62% of the Zimbabwean population is farmers and the majority of them are projected to bear disproportionate impacts due to their limited adaptive capacity.