CLIMATE RISK COUNTRY PROFILE

LESOTHO

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This profile is part of a series of Climate Risk Country Profiles developed by the World Bank Group (WBG). The country profile synthesizes most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The country profile series are designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is managed and led by Veronique Morin (Senior Climate Change Specialist, WBG) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

This profile was written by MacKenzie Dove (Senior Climate Change Consultant, WBG). Additional support was provided by Jason Johnston (Operations Analyst, WBG), Yunziyi Lang (Climate Change Analyst, WBG) and Megumi Sato (Junior Professional Officer, WBG).

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

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FOREWORD

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

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

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

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

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

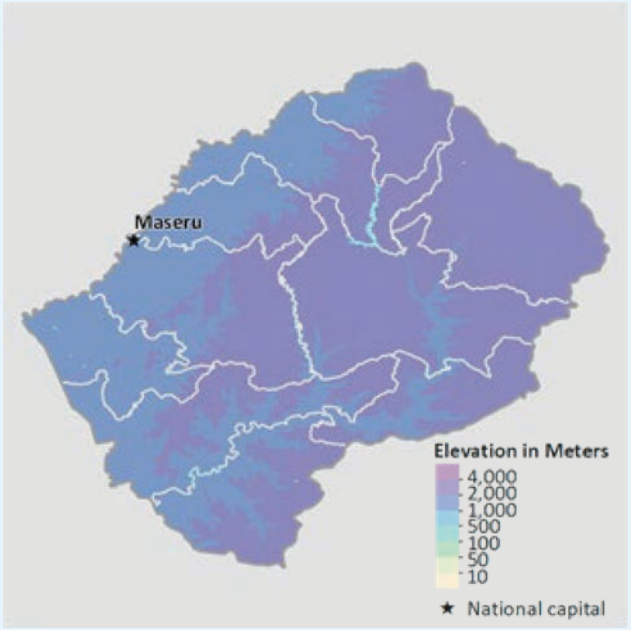
It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

COUNTRY OVERVIEW

Lesotho is a small landlocked country in Southern Africa, surrounded by the Republic of South Africa, located between latitudes 28° and 31°S, and longitudes 27° and 30°E. The country's 30,355 square kilometers (km^2) land area has a topography characterized by a rugged terrain with elevations ranging from 1,388 meters (m) to 3,482 m. Only 10% of the land area is considered arable.[1] The geography and location of Lesotho exposes it to climatological patterns from both the Indian and Atlantic Oceans, resulting in significant variability in temperatures. Topographical variability and the microclimatological influences define the ecological zones of the country: the Lowlands (17%), Foothills (15%), Mountains (59%) and Senqu River Valley (9%) (**Figure1**). These zones are characterized by distinct climatic and ecological differences. The majority of socio-economic activity for Lesotho is restricted to the Lowlands, the Foothills and the Senqu River Valley, leaving the mostly barren and rugged mountain region used primarily as grazing grounds.

FIGURE 1. Elevation of Lesotho[2]



Lesotho is a lower-middle-income country with a constitutional monarchy, ruled by a King as Head of State and governed by a 33-member Senate and a 120-member National Assembly.[3] The country's population of 2.14 million people (2020) has an annual growth rate of 0.8% (2020), and is projected to reach 2.3 million people by 2030 and 2.6 million people by 2050 (**Table 1**). An estimated 28% of the current population resides in urban areas, which is expected to increase to just 34% and 46% by 2030 and 2050, respectively.[4] The country has a Gross Domestic Product (GDP) of $1.844 billion (2020), and experiences volatile growth rates, with a current annual growth rate of –0.4% in 2019 and –11.1% in 2020.[5] The economy has been negatively affected due to political instability and a prolonged period of slow growth in South Africa. While unemployment remains high at 24% to 28%, the national poverty rate declined from 56% in 2002 to 49% in 2017 and food poverty rates declined from 34% to 24% and poverty gap declined

[1] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[2] World Bank (2019). Internal Climate Migration Profile – Lesotho.

[3] World Bank (2021). Lesotho – Overview. URL: https://www.worldbank.org/en/country/lesotho/overview

[4] World Bank Open Data, Data Retrieved October 2020. Data Bank: Population Estimates and Projections, Lesotho. URL: https://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections

[5] World Bank Open Data, Data Retrieved March 2021. Data Bank: World Development Indicators, Lesotho. URL: https://databank.worldbank.org/data/reports.aspx?source=2&country

from 29% to 21%, over the same period. Lesotho's economy and water availability are expected to benefit from the second phase of the Lesotho Highlands Water Project, which increases bi-lateral funding and expands mineral mining. Lesotho's geographical characteristics and socio-economic conditions, particularly for its rural population make it one of the most vulnerable countries to the impacts of climate change. The country is additionally vulnerable due to its high dependence on rain-fed agriculture and reliance on regional, imported energy supplies.[6]

TABLE 1. Data Snapshot: Key Development Indicators[7]

Indicator	
Life Expectancy at Birth, Total (Years) (2019)	54.3
Population Density (People per sq. km Land Area) (2018)	69.4
% of Population with Access to Electricity (2019)	44.6%
GDP per Capita (Current US$) (2020)	$861.00

The ND-GAIN Index[8] ranks 181 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. This Index aims to help businesses and the public sector better identify vulnerability and readiness in order to better prioritize investment for more efficient responses to global challenges. Due to a combination of political, geographic, and social factors, Lesotho is recognized as highly vulnerable to climate change impacts, ranked 127 out of 181 countries in the 2020 ND-GAIN Index. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 2** is a time-series plot of the ND-GAIN Index showing Lesotho's progress through 2018.

Lesotho's topography and location influences its temperate climate, characterized with alpine characteristics. This increases the country's vulnerability to climate variability and long-term climate change.[9] Lesotho is already experiencing the negative effects of climate changes, including increased frequency of extreme events, inter alia droughts, increased rates of soil erosion and desertification, and reduced soil fertility.[10] The country is likely to become generally hotter and drier across projected future climates. Likewise, Lesotho will also continue to experience extreme events like droughts and floods and other climate-related hazards, in addition to continued rainfall variability and increasing temperatures. This will likely result in adverse environmental impacts for soil erosion, deforestation, recurrent droughts, desertification, land degradation, and the loss of biodiversity including wildlife. Key sectors such as, agriculture and livestock, health, water resources, and tourism are increasingly vulnerable.

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6 World Bank (2020). Lesotho – Overview. URL: https://www.worldbank.org/en/country/lesotho/overview

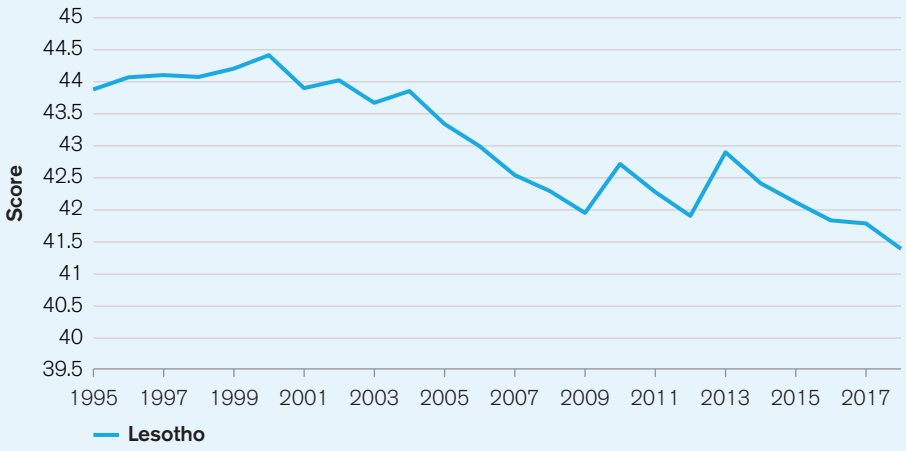
7 World Bank (2021). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators

8 University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/

9 Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

10 UNDP (2015): Lesotho Project Document: *Reducing vulnerability from climate change in the Foothills, Lowlands and the Lower Senqu River Basin*. URL: https://www.adaptation-undp.org/resources/prodocs/project-document-lesotho-pims-4630

FIGURE 2. ND-GAIN Index for Lesotho



Lesotho submitted its Second National Communication in 2013 and its Nationally Determined Contribution (NDC) in 2017. The NDC outlines the country's efforts to realize its development goals and increase its adaptive capacity to climate change. Lesotho is focused on implementing adaption mechanisms to improve and diversify livelihoods in view of current and future climate risks. The country is particularly vulnerable to the negative impacts from climate variability and change on water and food security, as well as to adverse conditions to health, human settlements, and the energy sector. Climate change strategies are integrated in the country's development strategies in support of plans to eliminate poverty and eradicate inequality. The NDC for Lesotho is consistent with the country's overall goals of achieving medium-term economic development, poverty reduction, and longer-term sustainable development. Key areas of focus include the sustainability of the environment, water resources, sustainable land management, agriculture, energy, and health sectors.[11]

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

[11] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

Climate Baseline

Overview

Lesotho's climate is generally classified as temperate with alpine characteristics. The country experiences hot summers and relatively very cold winters. Temperatures tend to be lower than in other countries at similar latitudes mainly due to the higher elevations. Four distinct seasons are recognized, with large fluctuations in temperature and very erratic rainfall.[12] Its location exposes the country to the influences of both the Indian and the Atlantic Oceans, with wide differences in temperature. Annual precipitation is highly variable both temporally and spatially, ranging from 500 millimeters (mm) to 760 mm. Temperatures are highly variable on diurnal, monthly, and annual time scales, generally ranging between 10°C and 30°C. High winds of up to 20 meters per second can sometimes be received during summer thunderstorms.[13]

Lesotho has fragile ecosystems because of its topography, type and pattern of rainfall, erodibility of soils, land use patterns and other habitats such as bogs and sponges. The topography is mountainous with sharp terrains ranging in elevation from 1,460 m above sea level in the west to 3,400 m above sea level in the northeast. The rainfall pattern is very erratic and unpredictable. The rainy season starts in early spring, mostly with heavy short-duration downpours and hailstorms all of which can cause soil movement. This lasts until late autumn (November to March). Winters are mostly dry with no active vegetative growth, and therefore favorable conditions for erosive early spring rains. Soils are derived from the underlying sandstone and basalt parent materials in the lowlands and mountains, respectively. The sandstone-derived soils are highly erodible. Land use patterns are communal in the rangelands and semi-private in cultivated lands. The country has world-renowned special high-altitude wetland habitats with rare plant and animal species. These wetlands are a main source of southern Africa's regional water and Lesotho's forage resources for livestock.[14]

In Lesotho, high aridity and periods of intense drought exacerbate the loss of biological diversity, deterioration of rangelands and reduced crop and animal productivity via desertification, making the country increasingly vulnerable. The productivity of major crops and animals has declined significantly in recent years due to poor land and rangeland conditions.[15] The high evaporation rate and the virtual absence of permanent surface water over large parts of the country combine to make water a scarce resource, with some projections indicating that even without climate change impacts, water resources will be reduced significantly. Primary challenges are centered around water resource

[12] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[13] IFPRI (2013). Lesotho. In: Southern African agriculture and climate change – A comprehensive analysis. URL: http://www.ifpri.org/publication/lesotho

[14] Lesotho (2015). National action Program in natural resource management, combating desertification and mitigating the effects of drought. URL: http://extwprlegs1.fao.org/docs/pdf/les149664.pdf

[15] Lesotho (2015). National Action Program in natural resource management, combating desertification and mitigating the effects of drought. URL: http://extwprlegs1.fao.org/docs/pdf/les149664.pdf

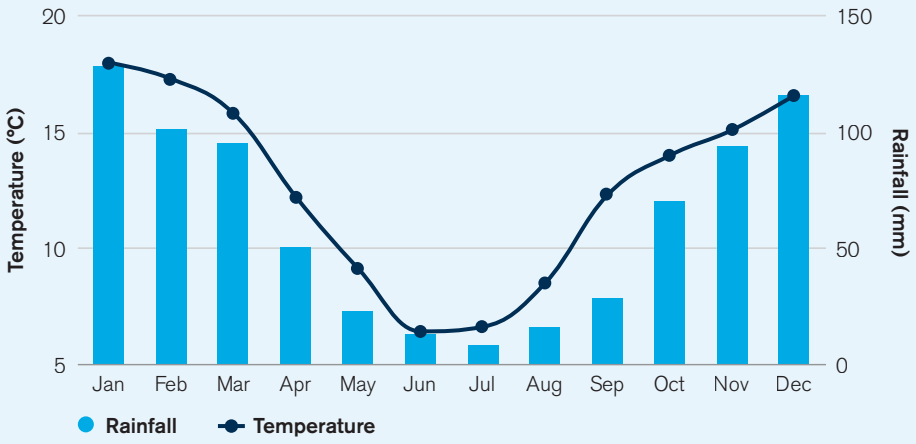
availability, changing precipitation patterns and increasing population demands.[16] Climatic and socio-economic environments in semi-arid areas in Lesotho make communities vulnerable to food insecurity and unstable livelihoods and lead to unsustainable agroecological systems, crop failure, and unproductive rangelands.[17]

An analysis of data from the World Bank Group's Climate Change Knowledge Portal (CCKP) (**Table 2**) shows information for the latest climatology, 1991–2020. Mean annual temperature for Lesotho is 12.7°C, with average monthly temperatures ranging between 15°C (November to March) and 6°C (June, July). Mean annual precipitation is 748 mm, with highest rainfall occurring October to April, with extremely low levels of precipitation occurring between May to September (**Figure 3**), shown across the latest climatology, 1991–2020.[18] **Figure 4** shows the spatial variation of observed average annual precipitation and temperature across Lesotho.

TABLE 2. Data Snapshot: Summary Statistics

Climate Variables	1991–2020
Mean Annual Temperature (°C)	**12.7°C**
Mean Annual Precipitation (mm)	**748.3 mm**
Mean Maximum Annual Temperature (°C)	**19.6°C**
Mean Minimum Annual Temperature (°C)	**5.7°C**

FIGURE 3. Average Monthly Temperature and Rainfall for Lesotho, 1991–2020[19]



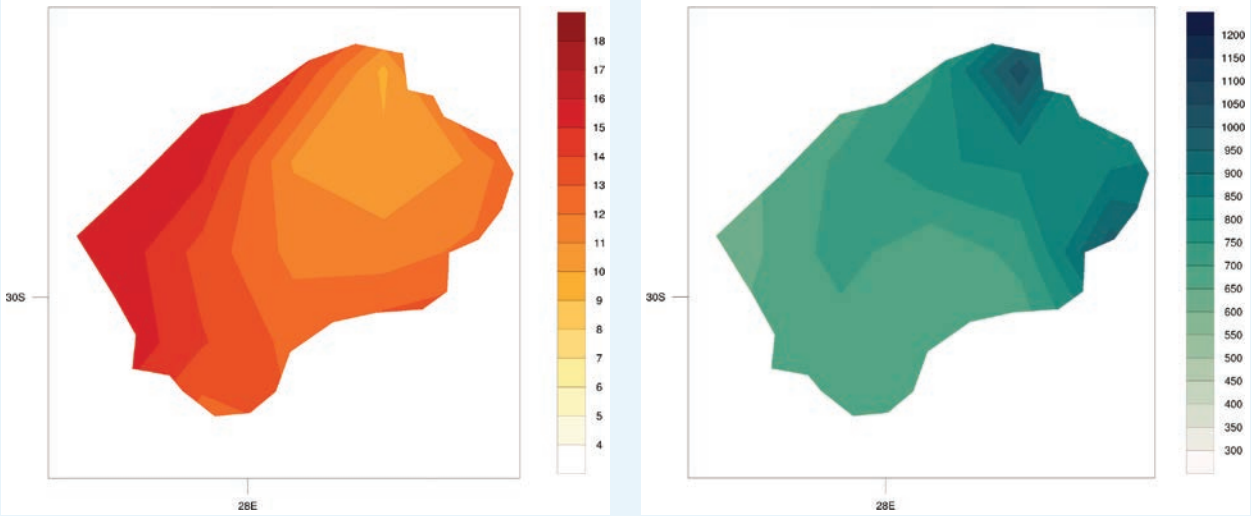
[16] Adaptation Partnership (2011). Review of Current and Planned Adaptation Action. Lesotho. URL: https://www.preventionweb.net/files/25785_southafrica.pdf

[17] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[18] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-historical

[19] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-historical

FIGURE 4. Mean Annual Temperature (°C) (left); Annual Precipitation (mm) (right) of Lesotho, 1991–2020[20]



Key Trends

Temperature

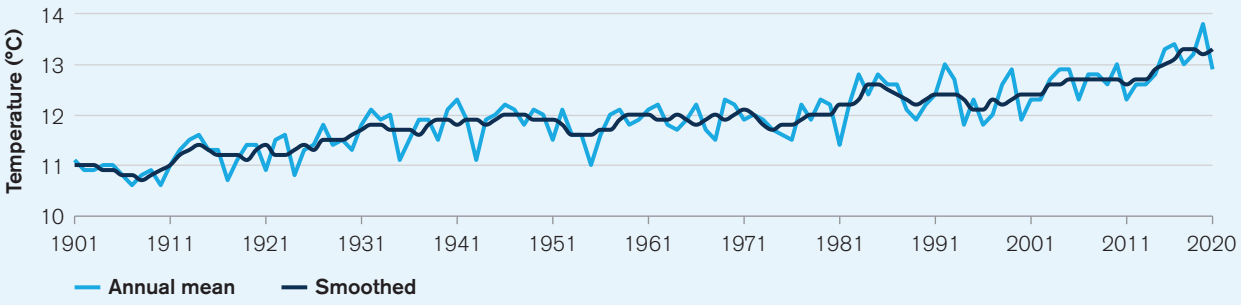
Temperatures in Lesotho vary year on year; however, an overall trend of temperature increase has been observed since the 1960s (**Figure 5**). Since 1960, Lesotho's mean annual temperature increased by 0.76°C, with an average rate of increase of 0.20°C per decade. Increases in both annual maximum and minimum temperatures between 1970 and 2005 with minimum temperatures warming more than the maximum temperatures and the most rapid warming occurring in the early 1980s.[21] Lesotho experiences frost, snow, and hailstorms in the highland areas, which is known to cut off the rural highland population from critical services and necessities.[22]

[20] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-historical

[21] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

[22] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

FIGURE 5. Observed Temperature for Lesotho, 1901–2020[23]



Precipitation

Precipitation trends have a high degree of interannual variability across southern Africa. While annual rainfall trends are weak overall, observations indicate a decrease in annual precipitation for Lesotho. Changes in seasonal rainfall patterns have revealed progressive increases in winter season precipitation (June to August) accompanied by an opposite trend in the summer season, in some regions. This has led to drying out of traditionally perennial springs; and reduced flows on major rivers. Furthermore, many dams currently are dry for most of the year.[24] The water sector has already been significantly impacted from reduced precipitation and altered rainfall patterns as perennial springs have run dry, previously robust rivers have been greatly diminished and many dams remain dry for a majority of the year. Additionally, subsistence farming, a major source of living in rural areas, is in steady decline due to recurring droughts, which has led to a steep decline in production of key staples such as maize and livestock farming.[25]

Climate Future

Overview

The main data source for the World Bank Group's CCKP is the CMIP5 (Coupled Model Inter-Comparison Project Phase5) data ensemble, which builds the database for the global climate change projections used in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For more information, please refer to the RCP Database. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 3** provides CMIP5 projections for essential climate variables under high emission scenario (RCP 8.5) over 4 different time horizons. **Figure 6** presents the multi-model (CMIP5) ensemble of 32 Global Circulation Models (GCMs) showing the projected changes in annual precipitation and temperature for the periods 2040–2059 and 2080–2099.

[23] WB Climate Change Knowledge Portal (CCKP, 2021). Lesotho URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-historical

[24] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

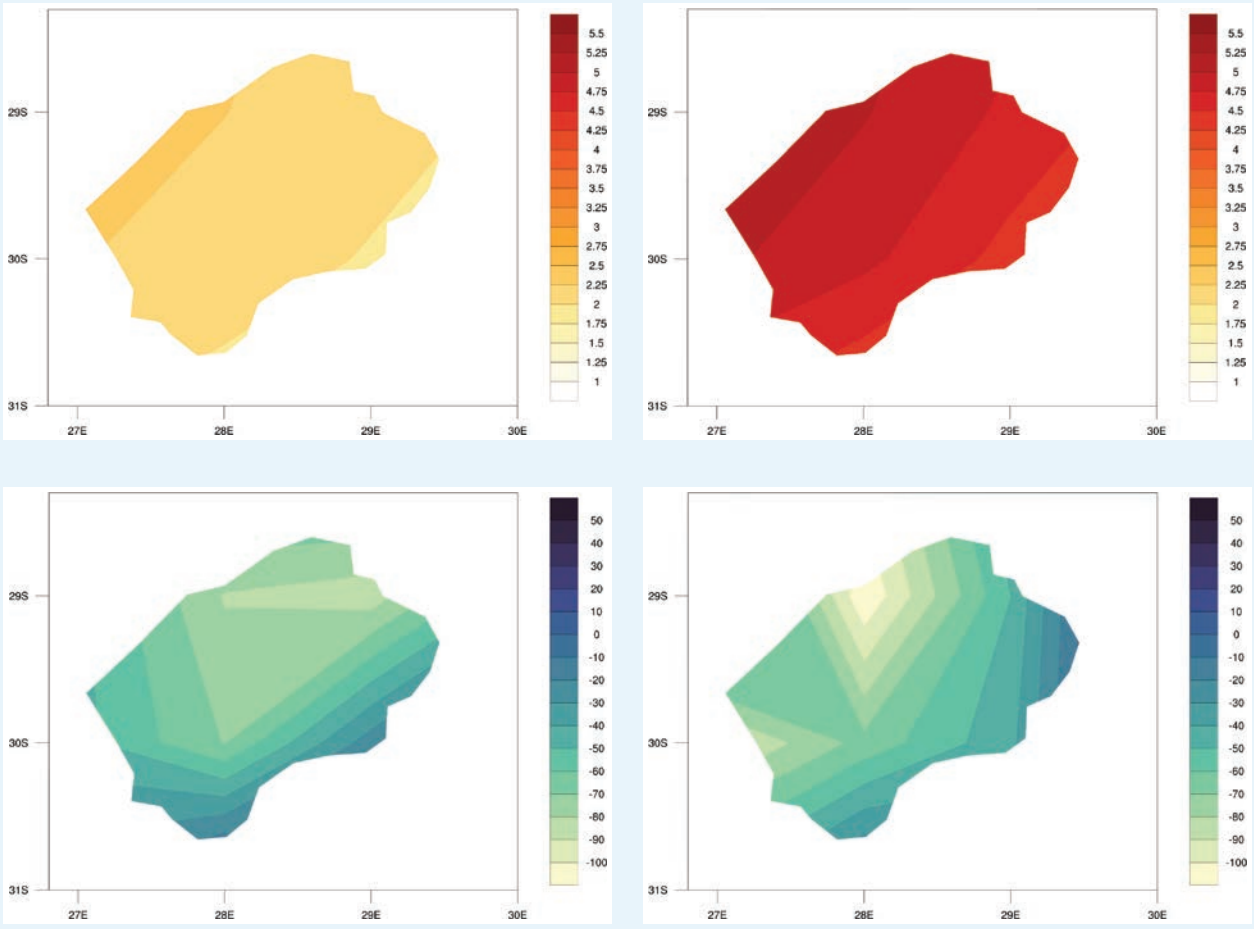
[25] Irish Aid (2015). Lesotho Climate Action Report. URL: https://www.irishaid.ie/media/irishaidpublications/Country-Climate-Action-Reports-Lesotho-FINAL.pdf

TABLE 3. Data Snapshot: CMIP5 Ensemble Projection

CMIP5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.6 to +1.7** (+1.6°C)	**+1.5 to +3.0** (+2.1°C)	**+2.4 to +4.5** (+3.3°C)	**+3.4 to +6.2** (+4.4°C)
Annual Precipitation Anomaly (mm)	**–21.6 to +20.1** (–0.5 mm)	**–27.3 to +21.0** (–1.9 mm)	**–26.5 to +26.7** (–1.6 mm)	**–30.2 to +28.2** (–2.9 mm)

Note: The table shows CMIP5 ensemble projection under RCP8.5. Bold value is the range (10th–90th Percentile) and values in parentheses show the median (or 50th Percentile).

FIGURE 6. CMIP5 Ensemble Projected Change (32 GCMs) in Mean Annual Temperature (top) and Precipitation (bottom) by 2040–2059 (left) and by 2080–2099 (right), Relative to 1986–2005 Baseline under RCP8.5[26]



[26] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-projections

Key Trends

Temperature

Increased temperatures are expected for the region, mean monthly temperature changes expected to increase by more than 2.0°C for the 2050s and by 4.4°C by end of the century, under a high-emission scenario. Temperature increases are expected throughout the country, although slightly lower degrees of temperature increases are expected to occur in the mountain zones.[27] Increased incidence of heat waves and higher rates of evapotranspiration are expected, which will affect multiple aspects of local economic development and agricultural productivity.[28] One of the most serious consequences of increased heat for Lesotho is the projected increases in the number of days with temperatures over 25°C. Impacts will be most pronounced from August to May.[29]

Across all emission scenarios, temperatures increases are projected for Lesotho throughout the century. As seen in **Figure 7**, under a high-emission scenario, average temperatures are expected to increase rapidly throughout the century. Across the seasonal cycle, temperature is expected to increase throughout the year. Increased heat and extreme heat conditions will negatively impact human and animal health, agriculture, and ecosystems. **Figure 8**, shows the change in the number of days with temperatures over 25°C, with the greatest increase projected for August to April.

FIGURE 7. Projected Average Temperature for Lesotho (Reference Period, 1986–2005)[30]

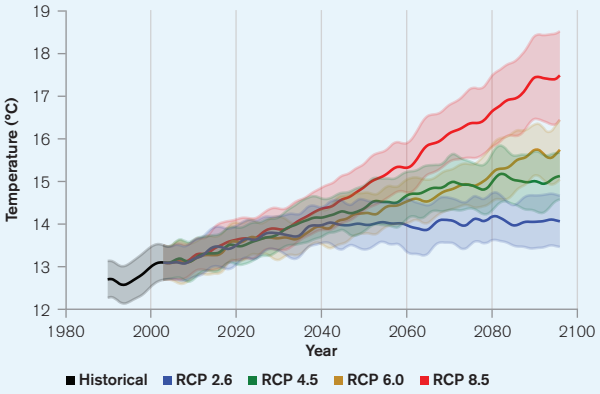
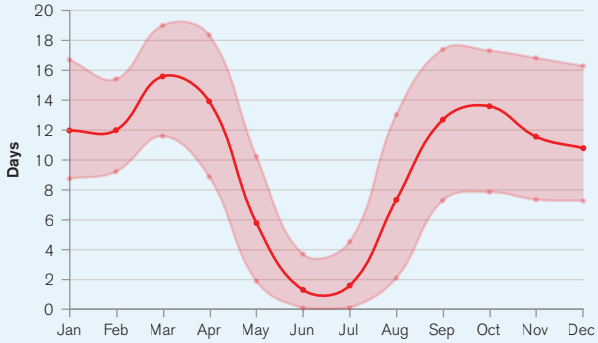


FIGURE 8. Projected Change in Summer Days (Tmax >25°C) (RCP8.5, Reference Period, 1986–2005)[31]



[27] Morris, C. (2017). Historical vegetation-environment patterns for assessing the impact of climatic change in the mountains of Lesotho. *African Journal of Range and Forage Science*. 34(1). DOI: https://doi.org/10.2989/10220119.2017.1333150

[28] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[29] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-projections

[30] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard – Agriculture. Lesotho. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=LSO&period=2080-2099

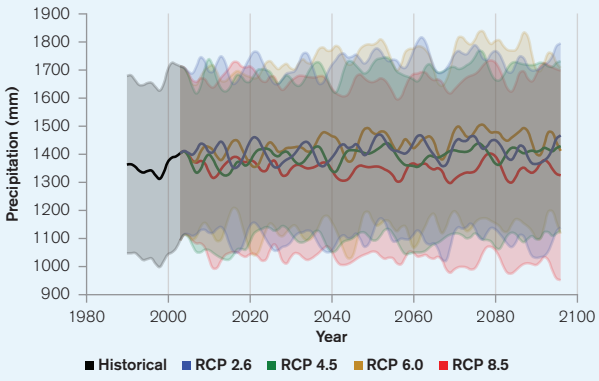
[31] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data – Projections, Lesotho. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-projections

Precipitation

Water resources are likely to be increasingly strained across Lesotho as well as across southern Africa; warmer temperatures are expected to accelerate the rate of evapotranspiration for the country. With more frequent and severe droughts, the region will likely experience negative impacts on water supply and agriculture. A potentially simultaneous increase in flooding events poses a serious water pollution threat, affecting health of wetland ecosystems and agriculture and livestock communities. Rainfall in Lesotho is highly variable. Northern areas of the country are expected to experience below normal precipitation through mid-century, with slightly above normal rainfall through the end of the century. Southern areas of Lesotho are expected to have below normal rainfall through the end of the century of between 50 and 100 mm per annum in the Lowland, Foothill, and southern Senqu Valley zones.[32] Significant changes in precipitation and temperature could have severe impacts on people's livelihoods, particularly in the Lowlands, the Foothills, and the Senqu Valley, where increasing temperatures and decreasing precipitation might lead to a substantial decrease in crop harvests.[33]

Figure 9 presents the change in projected annual average precipitation for Lesotho. Water routing, storage and other management options, are often very different if the precipitation occurs as multiple, lite rainfall events or a series of heavy rainfall events.[34] Lesotho's projected precipitation regime, aggregated across a national scale, will only slightly reduce against observed historical trends, under the highest emissions scenario, RCP8.5. However, changes in precipitation patterns for Lesotho are projected to experience an increase in extreme precipitation events, indicating potential for prolonged dry periods in between events. The country's drought areas may be further exacerbated by these trends.[35]

FIGURE 9. Projected Annual Average Precipitation in Lesotho (Reference Period, 1986–2005)[36]



[32] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[33] IFPRI (2013). Lesotho. In: Southern African agriculture and climate change- A comprehensive analysis. URL: http://www.ifpri.org/publication/lesotho

[34] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Water Dashboard. Data Description. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-sector-water

[35] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[36] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data-Projections. Lesotho. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-sector-water

Overview

Lesotho has a high degree of risk to natural hazards, including floods, drought, frost, strong winds, and heavy snowfall. Drought is a recurring hazard, which results in disasters for communities and the wider economy.[37] Key impacted sectors include agriculture and livestock, water, tourism, and health. Impacts of extreme rainfall events on public and private infrastructure has resulted in costly repairs, road closures, limited or no access to electricity, and complete failures of sewage and storm water systems. Temperature increases are affecting infrastructure sensitive to temperature extremes, such as roads. Rainfall and temperature changes are impacting agriculture and food security and extreme weather events are affecting tourism and livelihoods that depend on the sector and have caused human and livestock deaths, property damage, and loss of crops. Natural hazards are exacerbated in many mountain areas in Lesotho and the country is particularly vulnerable as more than 70% of the population live in remote and ecologically fragile mountainous terrain.[38] The country is also severely impacted by drought. While drought conditions are generally a common phenomenon of the climate in southern Africa, Lesotho has experienced increasingly frequent occurrences of drought in recent years. The country's worst dry spells were experienced in 2002/3, when 760,000 people were affected, as well as in 2006/7 when rainfall levels for the critical months of January to March in which 45% of the expected precipitation.[39] For the months of December 2010 and January 2011, Lesotho saw unprecedented rains, floods and rock slides that destroyed crops, livestock and property. These events resulted in significant impact upon key economic sectors including agriculture, transport, health, and education, with total losses and damages estimated at 3.2% of the GDP. Heaviest damages were sustained by the roads sector, livestock, education, and housing. Heaviest losses in production were sustained by crops, road transport, and commerce sectors. Extreme rainfall has resulted in soil erosion, land degradation, loss of ecosystems and ecosystem services, alien species invasion, salinization of groundwater, and flood trails containing pesticides and fertilizer.[40] More than 90% of disasters in Lesotho are related to climate variability and change, specifically, drought, snowfall, hailstorms, strong wind, localized floods, and early frost and pest infestations. Recent hailstorms, heavy rains, and flash floods in Lesotho have resulted in significant damage to houses, vehicles, roads, schools, and health centers as well as key crops, maize, beans, and sorghum.[41]

Data from the Emergency Event Database: EM-Dat, presented **Table 4**, shows the country has endured various natural hazards, including floods, landslides, epidemic diseases, and storms.

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[37] Kamara, J., Agho, K. and Renzaho, A. (2019). Understanding disaster resilience in communities affected by recurrent drought in Lesotho and Swaziland – a qualitative study. PLOS ONE. DOI: https://doi.org/10.1371/journal.pone.0212994

[38] IFPRI (2013). Lesotho. In: Southern African agriculture and climate change – A comprehensive analysis. URL: http://www.ifpri.org/publication/lesotho

[39] Kamara, J., Agho, K. and Renzaho, A. (2019). Understanding disaster resilience in communities affected by recurrent drought in Lesotho and Swaziland – a qualitative study. PLOS ONE. DOI: https://doi.org/10.1371/journal.pone.0212994

[40] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[41] World Bank (2011). Post Disaster Needs Assessment Heavy Rains 2010/2011. URL: https://www.recoveryplatform.org/assets/publication/PDNA/CountryPDNAs/Lesotho_Heavy%20Rain_2010_PDNA.pdf

TABLE 4. Natural Disasters in Lesotho, 1900–2020[42]

Natural Hazard 1900–2020	Subtype	Events Count	Total Deaths	Total Affected	Total Damage ('000 USD)
Drought	Drought	8	0	4,148,015	1,000
Epidemic	Bacterial Disease	2	28	2,334	0
Flood	Riverine Flood	4	48	85,000	0
Storm	Convective Storm	2	0	7,100	0

Climate Change Impacts

Water, agriculture, forestry, human health, and livestock are the country's most vulnerable sectors with respect to climate variability and change. The increased frequency of intense precipitation events will lead to a heightened risk of flooding, river bank over flow, and flash flooding. This may also result in soil erosion and water logging of crops, thus decreasing yields with the potential to increase food insecurity; particularly for subsistence-scale farmers. Higher temperatures increase aridity and can lead to livestock stress and reduced crop yields, with impacts to economic and food security. Furthermore, land degradation and soil erosion, exacerbated by recurrent flood and drought adversely impacts agricultural production, further affecting the livelihoods of the rural poor. Small rural farmers, are more sensitive to impacts of disasters (floods, dry periods) because they have limited resources with which to influence and increase adaptive capacity.[43] Most recently, the country suffered from a severe drought from 2015 to 2017, due largely to El Niño events that affected Southern Africa. This had dramatic impacts to the country's food security situation and required international food assistance from international donors.[44]

Disaster risk from increased temperatures is expected to (i) exacerbate existing tensions between agricultural and livestock needs as well as human population needs for water, especially during the dry season, (ii) alter the quality of available water from surface water and groundwater, and (iii) increase pressure on urban zones due to increased urbanization. Changing rainfall patterns are expected to play a significant role in agricultural production and harvest seasons, with later onsets expected to impact crop productivity as well as livestock health. Droughts have remained one of the key drivers of food insecurity for the country, with increased aridity and drought resulting in crop damage, loss of pasture and water sources, loss of animals, hunger, disease outbreaks, asset depletions, malnutrition, and migration.[45] Increased temperatures and degraded agricultural conditions are expected to adversely affect 'working days', impacting livelihoods and economic resilience of vulnerable groups. Increased temperatures and increased aridity will also heighten the country's risk for wildfires. **Figure 10** presents the risk of river flooding and wild fires for Lesotho.

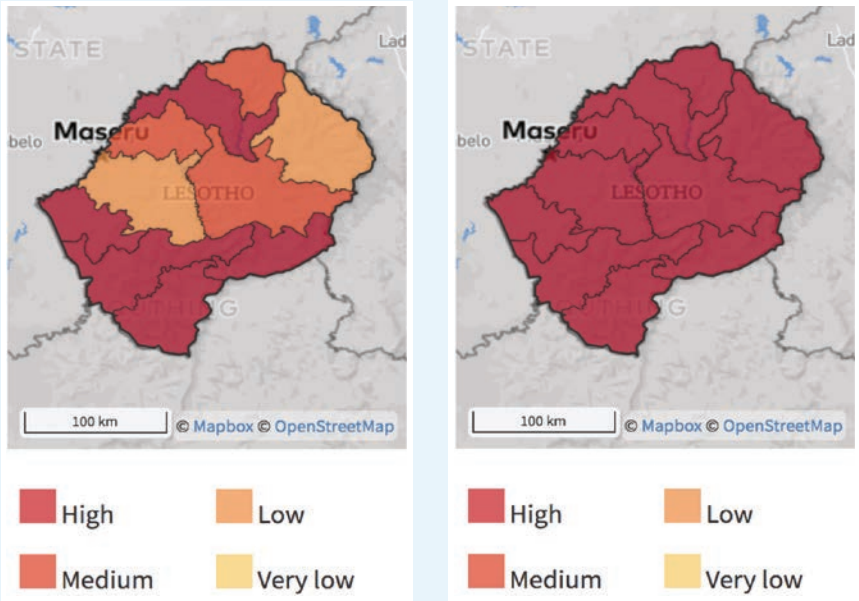
[42] EM-DAT: The Emergency Events Database – Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium. URL: http://emdat.be/emdat_db/

[43] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[44] WBG (2018). Building the role of social protection in disaster response and resilience in Lesotho. GFDRR. URL: https://www.gfdrr.org/sites/default/files/publication/Lesotho%20%281%29.pdf

[45] UNHCR (2018). Lesotho Flash Update 01 – Hailstorms and Flash floods (period: March 1 2018–March 31 2018). URL: https://reliefweb.int/sites/reliefweb.int/files/resources/Lesotho%20Flash%20Update%20No.%201%20-%20Hailstorm%20and%20flash%20floods%20%28as%20of%204%20April%202018%29.pdf

FIGURE 10. Risk of River Flood (left)[46]; Risks of Wildfires (right)[47]



Implications for DRM

The Government of Lesotho aims to protect the country's population and economic sectors and preserve its natural environment. Lesotho is in the process of mainstreaming its disaster risk reduction, adaptation, and management into development activities, which are important policy goals for responding to climate change and disaster risk. This requires a shift in thinking towards more pro-active risk reduction and adaptation planning from its current reactive system.[48] The country is in the process of developing and implementing a Disaster Risk Management Act and a corresponding Disaster Policy in order to strengthen institutional linkages between disaster risk management and climate change adaptation. This will be overseen by the Ministry of Finance and Development Planning. Outcomes and key strategies will be integrated with key sectors, such as land use planning, energy, and agriculture, as well as public works safety codes and regulations. The Lesotho Meteorological Services play a critical role in providing meteorological forecasts and extreme event information to the country's Disaster Management Agency (DMA) and other ministries in support of preparatory and response efforts to climate related natural disasters.[49]

As Lesotho's water resources are particularly vulnerable to climate change and natural hazards in the country, the country's DMA has undertaken systematic risk assessments specifically in regards to the country's water resources sector (including on flooding and drought potential) and water management systems. Lesotho's DMA received technical support from the World Bank as well as the World Food Program in order to build out its Early Warning

[46] ThinkHazard! (2020). Lesotho – River Flooding. URL http://thinkhazard.org/en/report/142-lesotho/FL
[47] ThinkHazard! (2020). Lesotho – Wild Fires. URL: http://thinkhazard.org/en/report/142-lesotho/WF
[48] World Bank (2011). Post Disaster Needs Assessment Heavy Rains 2010/2011. URL: https://www.recoveryplatform.org/assets/publication/PDNA/CountryPDNAs/Lesotho_Heavy%20Rain_2010_PDNA.pdf
[49] Lesotho Meteorological Services (2021). Overview. URL: https://www.lesmet.org.ls

Systems in 2015. This has been used to improve the country's preparedness and response capabilities, specifically by inter-sectoral information sharing.[50] Lesotho can continue investing in its DMA to better support adaptive social protection measures in the immediate to long-term, through key actions, such as establishing clearer humanitarian structures to support immediate need, integrate a hazard information communication network, and develop a long-term safety net and livelihoods program to support community resilience.[51]

CLIMATE CHANGE IMPACTS TO KEY SECTORS

Lesotho remains highly vulnerable to climate variability and change, particularly for the country's water, agriculture, and health sectors. Lesotho has conducted evaluations for a number of sectors regarding vulnerability and adaptation to climate change, including agriculture, soils and land degradation, forestry, water resources, livestock and rangelands, culture, and health. Significant changes in precipitation and temperature are expected to have severe impact on people's livelihoods and especially for the agricultural sector, specifically for the Lowlands, the Foothills, and the Senqu Valley, the most densely populated and crop-growing regions of the country. In these zones, increasing temperatures and decreasing precipitation might lead to a substantial decrease in crop harvests.[52] The country faces increased challenges of adverse impacts to agriculture, loss of livelihoods and food security, which are compounded by climate stressors Furthermore, environmental degradation, impacted water resources, and loss of biodiversity constitute significant obstacles to the country's continued development and poverty reduction efforts, increases vulnerability to risks and hazards as well as increases the importance for sustainable adaptation and resilience measures.[53]

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management, and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.[54]

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[50] WBG (2016). Lesotho Water Security and Climate Change Assessment. GFDRR. Open Knowledge Repository. URL: https://openknowledge.worldbank.org/handle/10986/24905

[51] WBG (2018). Building the role of social protection in disaster response and resilience in Lesotho. GFDRR. URL: https://www.gfdrr.org/sites/default/files/publication/Lesotho%20%281%29.pdf

[52] IFPRI (2013). Lesotho. In: Southern African agriculture and climate change- A comprehensive analysis. URL: http://www.ifpri.org/publication/lesotho

[53] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[54] World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf

Agriculture

Overview

Agriculture is a key economic sector and a major source of employment in Lesotho, with 60%–70% of the country's labor earnings derived from agriculture. Agriculture is predominantly small-scale, and characterized by rainfed cereal production with extensive animal grazing; the livestock subsector contributes approximately double that of the crop subsector. The majority of the population (75%–80%) that are dependent on agriculture in the country reside in the Lowlands and Foothills where most of the arable land is found. Important, domestic crops for the country are maize, wheat, sorghum, potato, beans and peas, fruit trees, and fresh vegetables, such as cabbage and tomatoes, while sheep and goat (primarily for wool and mohair), cattle and pigs are the major livestock. Wool and mohair form an integral part of the economy, supporting approximately 50% of the rural households particularly in the mountain districts. Sheep and goats are mostly kept under an extensive livestock production system. Cattle and other animals such as donkeys and horses play a major role in crop production since they are used for ploughing and transporting produce to markets. The short cycle stock (chicken and pigs), especially kept by women contribute significantly to household food security.[55] Rearing of small ruminants and poultry under intensive management systems is common in the urban areas. Cattles are reared under an extensive system for subsistence milk and meat production. Beef production is limited and the country relies heavily on beef imports from neighboring South Africa. The most common production system in the country is wheat-maize mono-cropping, which despite its prevalence, is widely regarded as unsustainable and insufficient to feed the country's population. Home gardening is also an important source of horticultural produce, with an estimated 70% of rural households producing vegetables. Low productivity is partly due to the use of open pollinated seed varieties and only farmers in the northern Lowlands, especially commercial producers, utilizing hybrid seeds.[56]

Climate Change Impacts

Projected climate change impacts to food production, agricultural livelihoods and food security in Lesotho are significant national policy concerns. Subsistence dry-land farmers are more vulnerable to climate change than commercial farmers.[57] Impacts on food production and food security are linked to future projected water supply constraints as well as temperature rise. Projected changes in precipitation and increases in temperature from September to May for the northern part of Lesotho through mid-century is likely to positively impact yields for maize, sorghum, and wheat. However, the increase in precipitation and temperature during September to May is expected to negatively impact growth of crops, such as beans and cucurbits (gourds). A combination of high temperature and high humidity will likely increase the incidence of fungal diseases and offset high growth patterns induced by a combination of high rainfall and temperature. The projected decrease in precipitation for the country in July to August, that began in 2010 and will likely continue through the end of

[55] World Bank (2019). Lesotho Climate-Smart Agriculture Investment Plan: Opportunities for Transitioning to More Productive, Climate-Resilient, and Low Carbon Agriculture. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33035 License: CC BY 3.0 IGO.

[56] WBG (2018). Climate-Smart Agriculture in Lesotho. URL: http://documents.worldbank.org/curated/en/866541527750717859/pdf/BRI-p165232-PUBLIC-CSAProfileLesothoFinal.pdf

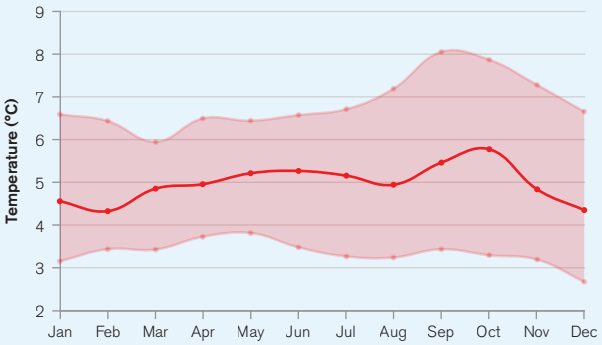
[57] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

the century, will reduce soil moisture reserves and negatively impact the growth of winter crops, such as wheat. Southern areas of Lesotho are expected to be more adversely affected regarding crop yields and productivity.[58] Increased heat will increase stress on crops and is also likely to alter the timing and length of the growing season.

Decreased water availability is likely to reduce yields and the reduction in soil moisture may alter suitable areas for agriculture or the production of specific crops. Increased heat and water scarcity conditions are likely to increase evapotranspiration, expected to contribute to crop failures and overall yield reductions.[59] An increased likelihood of droughts and prolonged dry periods will continue to exacerbate soil erosion and land degradation. Likewise, rising temperatures could alter the presence of agricultural pests and increase risks of fires. Increased frequency and intensity of extreme events may also change or impact species composition and alter 'regulating services', such as soil water maintenance, base flows and filtration.[60]

Figure 11 shows the projected change in average daily max-temperature across the seasonal cycle. Temperature thresholds for agriculture and livestock are important as temperature changes, and in particular extreme heat, it can cause damage to plants and affect the health of livestock as well as farm workers. Crops are known to have specific temperature windows for optimal growth and yield. Cold temperatures and frost can affect the early growth, but high temperatures above crop-specific thresholds rapidly reduce the yield. Lesotho's maximum temperatures are expected to increase throughout the year.

FIGURE 11. Projected Change in Average Daily-Max Temperatures (RCP8.5, Reference Period, 1986–2005)[61]



Adaptation Options

Climate change trends are entangled with the many other challenges and stressors that Lesotho's agriculture sector already faces, including environmental degradation, disease outbreaks, and higher input costs as well as challenges regarding land rights and inequality. Lesotho currently is engaged in extensive animal grazing and expansion of croplands in order to meet growing population demands. This is characterized by a monoculture agricultural cropping system dominated by maize. This continues to deplete the land resources on which production relies over time. Expanded adaptation opportunities exist through commercialization through a focus placed on commodities for which the country has distinct comparative advantage, such as horticulture, potatoes, and aquaculture;

[58] WBG (2018). Climate-Smart Agriculture in Lesotho. URL: http://documents.worldbank.org/curated/en/866541527750717859/pdf/BRI-p165232-PUBLIC-CSAProfileLesothoFinal.pdf
[59] USAID (2016). Climate Change Risk Profile – Southern Africa. Regional Fact Sheet. URL: https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20Southern%20Africa.pdf
[60] USAID (2016): Climate Change Risk Profile – Southern Africa. Regional Fact Sheet. URL: https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20Southern%20Africa.pdf
[61] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Agriculture. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-sector-agriculture

developing the country's irrigation to its full potential. Efforts can be made through developing the linkages that connect smallholders to export and domestic markets. Producers can also switch to a more traditional farming system that combines the use of crop rotation, relay cropping, and intercropping practices with the application of manure and plant ash to conserve soil moisture and replenish soil fertility.[62] Adaptation strategies to address the risks to the agriculture sector should include the implementation of climate smart agriculture practices, improved water management, improved monitoring and early warning, the development of knowledge and decision-support systems, and the development of new crop varieties and technologies to support farming. Additionally, the allocation of land and production to high value crops to increase and improve income generation as well as adoption of drought resistant crops like sorghum for the southern region of the country and development of water harvesting techniques throughout the country will lessen the impacts of climate change.[63]

Water

Overview

Lesotho is renowned for its relatively abundant water resources and constitutes one of Southern Africa's principal water catchment areas, capturing approximately 50% of the total catchment run-off. Lesotho's high altitude and geographic proximity to major demand centers in southern Africa, makes water one of the country's most valuable renewable and sustainable natural assets.[64] This water resource plays a critical role in supporting and advancing socio–economic development and supporting the country's ecosystem integrity. The Lesotho Highlands Water Project provides water to the Gauteng Province, South Africa and Lesotho's ability to export water remains a significant contributor to its GDP; estimated to contribute approximately 10% in 2018.[65] Climate change-induced effects on Lesotho are expected to have a far-reaching regional impact on both the national and regional fresh water resources as the country forms major source of fresh water and drainage areas extending into the Atlantic basin through South Africa, Namibia and Botswana. Effectively, the impact will be detrimental to national and regional water supplies, dependents, ecosystems, and socio-economic activities.[66] While Lesotho is characterized by high levels of poverty and income inequality, water contributes roughly 10% to its overall GDP. A large portion of this benefit comes from revenues associated with the Lesotho Highlands Water Project, a multistage infrastructure project that enables the transfer of water from the water-rich highlands of Lesotho to the economic engine of the African continent in Gauteng and contributes to the development of hydropower resources in Lesotho.[67]

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[62] World Bank (2019). Lesotho Climate-Smart Agriculture Investment Plan: Opportunities for Transitioning to More Productive, Climate-Resilient, and Low Carbon Agriculture. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33035 License: CC BY 3.0 IGO.

[63] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[64] WBG (2016). Lesotho Water Security Climate Change Assessment. URL: http://documents.worldbank.org/curated/en/446521472206603986/pdf/108018-PUB-Box396303B-PUBLIC-PUBDATE-7-6-16.pdf

[65] Workman, C. (2019). Ebbs and Flows of Authority: Decentralization, Development and the Hydro-social Cycle in Lesotho. *Water*. 11(2). DOI: https://doi.org/10.3390/w11020184

[66] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

[67] WBG (2016). Lesotho Water Security Climate Change Assessment. URL: http://documents.worldbank.org/curated/en/446521472206603986/pdf/108018-PUB-Box396303B-PUBLIC-PUBDATE-7-6-16.pdf

Climate Change Impacts

Changes in precipitation and temperature are expected to impact the water sector. The number of frost days in Lesotho is expected to fall from 70 to 40 days, and the growing season is likely to lengthen from 340 to 360 days. These trends could create opportunities for growing new crops, especially in the highlands due to changes in precipitation and temperature. The expected gradual warming would have positive effects on the productivity of most crops and livestock during the winter. As discussed, some crops grown in Lesotho (such as legumes and tubers) could benefit from the increase in heat indices. However, these gains will also alter water demand for area producers. In contrast, crops such as sorghum, which require sufficient soil moisture during the period of early growth may be adversely affected. Increasing temperatures may also reduce available soil moisture during periods of inadequate rainfall. The annual total wet-day precipitation (indicating precipitation of more than one millimeter) demonstrates a slight upward trend from about 650 mm to a little more than 700 mm. The biophysical features of the country, especially the high proportion of high-altitude rangeland and the acutely erodible soils in the lowlands, increase vulnerability to precipitation changes and reduced water availability. Longer dry spells interspersed by heavy rainfall events could intensify the potential for soil erosion.[68]

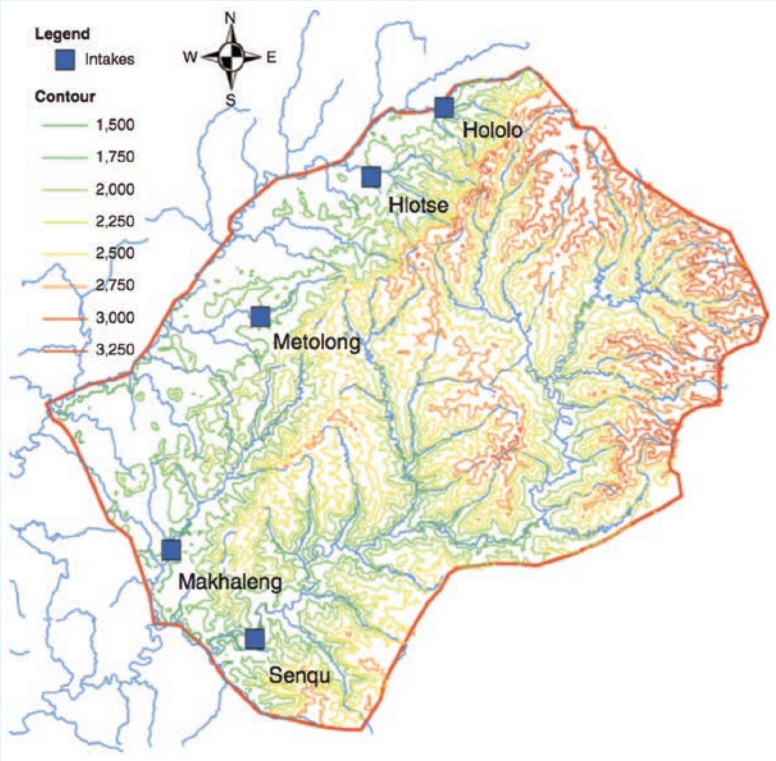
Changes in evapotranspiration are expected to impact the water balance of runoff, soil moisture, water in reservoirs, and salinization of shallow aquifers. Changes in streamflow, dams, and wetlands capacity depend on changes in volumes and timing of precipitation. For Lesotho, reduced precipitation in winter and summer will reduce streamflow, the result of which will be hydrological drought. This will directly affect water supply and sanitation. Changes in water quality and availability are expected to be the dominant challenges for Lesotho through the end of the century. A greater degree of variable rainfall is also likely to increase disasters associated with droughts, floods, and waterborne diseases. Additionally, for the region, water resources cut across a number of transboundary river basins and are unevenly distributed, both seasonally and geographically. This presents a significant challenge and concern for the region. Infrastructure developments intended to safeguard water supplies have increased the geographical unbalance of water resources, as many dams have been built to store water during the unpredictable and often long dry periods. Increased temperatures are expected to decrease water availability and thus stream flows, increasing evapotranspiration and reducing runoff. An increase in the intensity of rainfall, coupled with a change in seasonality and duration is likely to result in the increased occurrence of floods and droughts, which may also compromise irrigation potential.[69] The lower surface flow water and river run-off could also affect the 30-year multi-billion water project, the Lesotho Highlands Water Project, which was initiated in 1986 with the construction of two giant dams at Katse and Mohale, and an elaborate water transfer system to South Africa.[70] **Figure 12** shows the location of intake for Lowland demand.

[68] WBG (2016): Lesotho Water Security Climate Change Assessment. URL: http://documents.worldbank.org/curated/en/446521472206603986/pdf/108018-PUB-Box396303B-PUBLIC-PUBDATE-7-6-16.pdf

[69] Ministry of Energy, Meteorology and Water Affairs (2013): Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

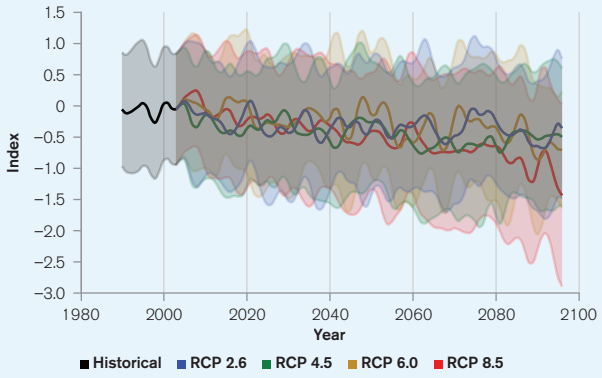
[70] Ministry of Energy, Meteorology and Water Affairs (2013): Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

FIGURE 12. Location of Hydrologic Intake for Lowland Demands[71]



Rainfall and evaporation changes will also impact rates of surface water infiltration and groundwater recharge. This has the potential to decrease the reliability of unimproved groundwater sources and surface water sources, especially during droughts or prolonged dry seasons. Increased strain on pump mechanisms can lead to breakdowns if maintenance is neglected and the potential for falling water levels in the immediate vicinity of well or borehole, particularly in areas of high demand.[72] Additionally, temperature increases could decrease available soil moisture even under conditions of more rainfall. **Figure 13** presents the projected annual Standardized Precipitation Evapotranspiration Index (SPEI). SPEI is a drought

FIGURE 13. Projected Annual SPEI Drought Index (Reference Period, 1986–2005)[73]



[71] WBG (2017): Lesotho WEAP Manual. p. 14. URL: https://documents1.worldbank.org/curated/en/543441486622913509/pdf/112725-WP-PUBLIC-Lesotho-Weap-Manual.pdf

[72] IOM (2017). Spaces of vulnerability and areas prone to natural disaster and crisis in six SADC countries. Disaster risks and disaster risk management capacity in Botswana, Malawi, Mozambique, South Africa, Zambia and Zimbabwe. URL: https://publications.iom.int/system/files/pdf/spaces_of_vulnerability.pdf

[73] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/water/land-use-/-watershed-management?country=LSO&period=2080-2099

index, which represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with values below –2 indicating severe drought conditions, likewise positive values indicate increased wet conditions. This is an important understanding for the water sector in regards to quantity and quality of supply for human consumption and agriculture use as well as for the energy sector as reductions in water availability impacts river flow and the hydropower generating capabilities. Lesotho is projected to experience heightened dry conditions, with likely increased pressure on water resources for the country and region by mid-century and by end of the century.

Adaptation Options

Safeguarding the long-term management of its water resources is a priority for the Government of Lesotho, which is committed to improving water resource adaptation mechanisms through a variety of actions. Rehabilitation of degraded wetlands has become a priority as a form of adaptation. The development of clear, environmentally sustainable policies will improve pastures and grazing land and would protect wetlands from persistent degradation and land use mismanagement. The encouragement of fodder production could lead to stall feeding. Decentralization can relieve urban centers of increasing population that exerts pressure on water resources. The movement of people from urban to rural areas can be promoted if services and jobs are created in rural communities.[74] The government has committed to implementing integrated catchment conservation and management programs, expand rainwater harvesting, water storage and conservation techniques, water re-use, water-use, and irrigation efficiency. Support is also committed to expanding the construction of dams and to enhance water storage. Planning and adaptation strategies for water resources should also be included within development strategies for agriculture, infrastructure, and energy sectors.[75]

Energy

Overview

Lesotho has no indigenous sources of oil, coal, or natural gas and the country imports approximately 2,000 barrels of oil per day. There are no in-country oil refineries and as a result, all petroleum products, including kerosene, jet fuel, and gasoline are imported. The Lesotho Highlands Water Project, originally commissioned in 1986 and designed to capture, store and transfer water to South Africa, has rendered Lesotho almost energy self-sufficient due to the production from the Muela Hydropower station. Power generation at full capacity satisfies electricity needs of the country in the summer season. However, in winter, during the peak period for electricity demand, electricity is imported from South Africa to meet consumption which reaches 130MW (nearly double domestic capacity). Electricity, however, only accounts for 3% of the energy that is consumed in Lesotho. It is estimated that 60% of households in the country use biomass for heating and cooking, and that 95% use paraffin or candles

[74] Workman, C. (2019). Ebbs and Flows of Authority: Decentralization, Development and the Hydrosocial Cycle in Lesotho. *Water*. 11(2). DOI: https://doi.org/10.3390/w11020184

[75] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

for lighting. Biomass accounts for 72% of the national energy balance, about three quarters of the total energy demand is met by biomass in the form of wood, shrubs, animal dung and agricultural residues.[76] Despite large-scale electrical infrastructure development in the county over the last years, access to electricity remains at 28% of households in Lesotho, mostly located in urban areas, with an estimated 4% of rural households having access to reliable electricity.[77]

Climate Change Impacts

The majority of Lesotho's electricity is generated by hydro sources; however, the country requires energy imports from neighboring countries to meet its demand. In addition to hydropower, the country remains heavily reliant on biomass, specifically in rural areas which use biomass for cooking as well as heating. Lesotho still has one of the lowest rates of energy access in Africa. Wood and charcoal (among other fuels), are predominantly used for lighting, cooking, and heating, especially in unserved villages. In addition to contributing to Lesotho's CO_2 emissions, these sources place an undue economic strain on vulnerable households; result in adverse health effects to the home use of charcoal, wood and dung, and fuel gathering activities that damage the environment, contributing to accelerated rates of deforestation.

As a result, deforestation has become a serious problem and since 1990, the country lost forest cover at the rate of 0.5% a year, largely due to rural household fuel demand. Lesotho has begun importing wood fuel and charcoal. When wood or charcoal is unavailable, households turn to substitutes, such as crop waste, dung, or Liquid Petroleum Gas (LPG). The use of crop waste and dung for heating and cooking deprive agricultural land of manure, contributing to a loss of soil fertility. Other fuels such as LPG are considerably more expensive and can put strains on household budgets. Environmental barriers such as declining biomass stock, increasingly variable rainfall and periods of drought, and limited availability of suitable land for renewable energy development increases the cost of renewable energy deployment.[78]

The projected decrease in precipitation and change in seasonal rainfall patterns are likely to reduce hydropower generation potential as well as the potential for revenue loss due to overbuilt hydropower, which may be under supplied. Increased evaporation rates from existing water storage facilities will also increase production costs, resulting in increased process for consumers. Increased temperatures and changing rainfall pattern may alter seasonal demand for energy, increasing demand during peak loads with a projected increase in net electricity usage, specifically for urban areas.[79]

Cooling Degree Days show the relationship between daily heat and cooling demand, typically sourced through a form of active cooling or an evaporative process. The change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) might increase **(Figure 14**). Warming is expected to sharply increase in the second half of the century and seasonal patterns for increases for cooling demands are expected to increase over an extended summer period (September to April), **Figure 15**.

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[76] Love, I. and George, M. (2020). Biomass Burning in Lesotho. *Biomass Burning in Sub-Saharan Africa*. pp. 71–81. URL: https://link.springer.com/chapter/10.1007/978-94-007-0808-2_6

[77] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[78] GCF (2018). Lesotho Green Energy Program. URL: https://www.greenclimate.fund/documents/20182/893456/21220_-_Lesotho_Energy_Programme.pdf/8e1e8a02-2536-0be6-fb25-c8beae57f8f0

[79] USAID (2016). Climate Change Risk Profile – Southern Africa. Regional Fact Sheet. URL: https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20Southern%20Africa.pdf

FIGURE 14. Projected Change in Cooling Degree Days (Reference Period, 1986–2005)[80]

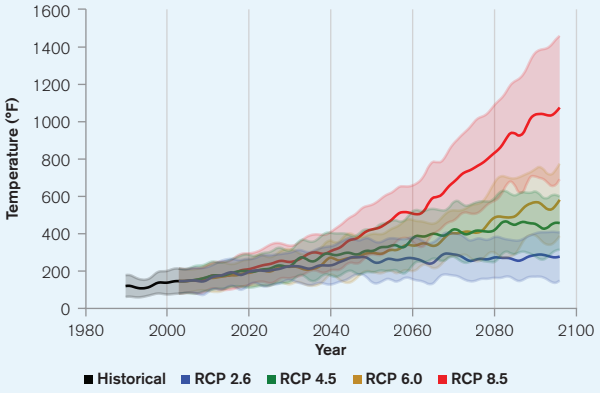
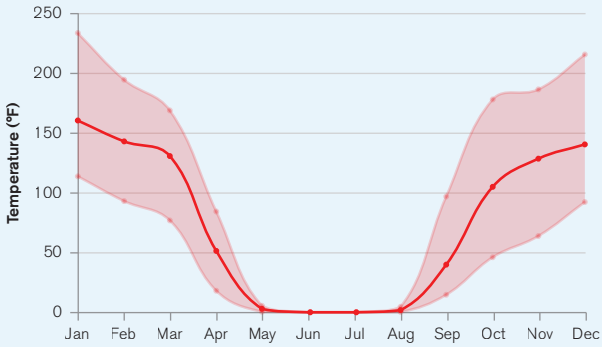


FIGURE 15. Projected Change in Cooling Degree Days, (RCP8.5, Reference Period, 1986–2005)[81]



Adaptation Options

Distribution of electricity in Lesotho is through the Lesotho Electricity Company (LEC). In coordination with the Government, Lesotho and LEC has embarked on the rural electrification project designed to increase electricity to those rural communities closer to the national grid. Plans are also underway to increase the capacity of the 'Muela hydropower facility from the current maximum nominal generating capacity of 72 MW to 1000 MW (via pumped-storage), through construction of the Polihali Dam which is still under negotiation. Extension of the national grid into remote mountainous areas continues to pose a difficult challenge to rural electrification. The government has created the Rural Electrification Unit in order to develop and utilize renewable energies for these communities. A number of pilot schemes to introduce wind and solar-based energies are also under development. A wind farm is in the process of being established at Letseng-la-Terae, in the mountainous District of Mokhotlong and the adoption of wind energy as the major source of energy for the future with the estimates of up to 6,000 MW to be produced by 2020, is currently prioritized.[82] Additionally, in an effort to alleviate the heavy use of biomass, especially for cooking, Lesotho is promoting the use of improved, fuel-efficient cooking stoves, which can reduce biomass consumption and reduce indoor air pollution.[83] The government has also committed to promoting a more diverse energy mix to move people away from biomass usage, construct more storage dams for hydropower generation, and promote afforestation campaigns which include growing of drought tolerant species.[84]

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[80] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho – Energy. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-sector-energy

[81] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Energy Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/energy/oil-gas-and-coal-mining?country=LSO&period=2080-2099

[82] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[83] GCF (2018). Lesotho Green Energy Program. URL: https://www.greenclimate.fund/documents/20182/893456/21220_-_Lesotho_Energy_Programme.pdf/8e1e8a02-2536-0be6-fb25-c8beae57f8f0

[84] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

Health

Overview

Health services in Lesotho are limited both in scope and quality. A priority of the country's government is to upgrade access infrastructure in order to improve social conditions, specifically in rural areas. However, despite a three-decade investment towards this goal, social conditions have deteriorated, particularly in the rural areas, as poverty worsens and HIV/AIDS continues to spread. The country continues to have one of the highest infection rates in the world. The HIV/AIDS pandemic has been associated with deepening poverty in rural Lesotho and constitutes an alarming threat for the country and is an impediment to the country's economic development and also hampers responses to humanitarian and development needs. With the upsurge in HIV/ AIDS related chronic illnesses, family members have assumed greater roles in care giving, a practice that represents a drain on household resources, depresses productive capacities, and further threatens food security and livelihoods.[85] Additionally, the country has faced food deficits for several consecutive years. The growing vulnerability and deepening food insecurity are generally associated with widespread livelihood failure for many rural households today, leading to premature urbanization and impacts on public health.[86]

Climate Change Impacts

In Lesotho, climate change is predicted to further the trends of marked temperature rise and increased rainfall variability, and more frequent extreme weather events. Impacts are expected on food and water security, human settlements, infrastructure, and ecosystems. Health systems and outcomes will also be affected, as climate change trends could aggravate heat stress, increase the range vector-borne diseases including malaria, dengue fever and yellow fever, and exacerbate air pollution, which could impact communicable diseases such as HIV/AIDS, TB, and other respiratory disease. These are compounded by poor living conditions. In particular parts of the country, the coverage of vector-borne diseases like malaria, rift valley fever, and schistosomiasis may spread due to climate change, requiring a further expansion of public health initiatives to combat these diseases.[87]

Increased aridity and drought diminish dietary diversity, reduce overall food available for consumption, and may therefore lead to additional micronutrient deficiencies for the country's already vulnerable population. The persisting droughts may cause many farmers, especially subsistence farmers, to leave their fields fallow, further impacting food security. Extended droughts will cause increases in the incidence of this bacteria borne disease as animals groping for fodder will be liable to feed off soil infested with the anthrax bacteria. It is expected that with the predicted changes in temperature, people especially the poor and rural communities, will be more vulnerable to measles because of crowding especially in confined spaces. While Lesotho lies outside of the current malaria zone, it is anticipated the belt will expand deeply into southern Africa with the possibility of reaching some parts of the country by the mid-century.[88]

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[85] UNICEF; World Bank (2017). Lesotho Public Health Sector Expenditure Review. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/29344 License: CC BY 3.0 IGO.

[86] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[87] USAID (2016). Climate Change Risk Profile – Southern Africa. Regional Fact Sheet. URL: https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20Southern%20Africa.pdf

[88] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

Rising temperatures are an increasing concern for Lesotho. The annual distribution of high-heat days provides insight into the health hazard of heat. **Figure 16** shows the change in the expected Number of Very Hot Days (Tmax >35°C). The country is projected to experience a sharp increase in very hot days, starting to accelerate by mid-century and continuing to sharply increase under a high-emission scenario by end of the century. Night temperatures (>20°C) are expected to only increase in a high-emission scenario in Lesotho. Increased health threats can be projected and monitored through the frequency of tropical nights. Tropical Nights (Tmin >20°C) (**Figure 17**) represents the projected increase in minimum nighttime temperature greater than 20°C. This is projected to increase in the 2060s under RCP8.5 emissions pathway.

FIGURE 16. Projected Change in Number of Very Hot Days (Tmax >35°C) (Reference Period, 1986–2005)[89]

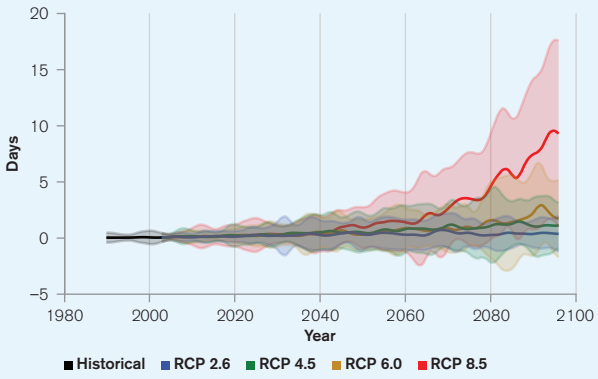
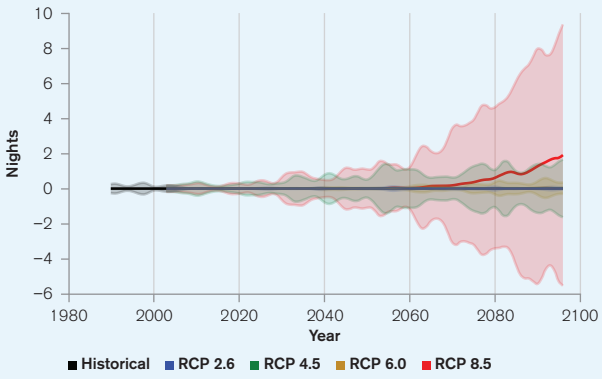


FIGURE 17. Projected Change in Tropical Nights (Tmin >20°C) (Reference Period, 1986–2005)[90]



Adaptation Options

Lesotho's health sector is focused on the development of health surveillance and monitoring systems such as the establishment of early warning systems that focus on key health outcomes. The Ministry of Health's education program should be expanded to include climate change education. The introduction of work schedules that avoid peak daytime temperatures for outdoor workers are being considered.[91] Additionally, Lesotho's health-care infrastructure can be upgraded to support more systemic climate change resilience. Capacity needs to be built to support the adaptation to extreme weather events and support the necessary response capacities. Health care system personnel are not fully aware of the relationship between climate change, seasonal variability, and health impacts. Increases in training and capacity can improve the level of knowledge and skills to prevent diseases connected with climatic factors, however this knowledge remains relatively limited among the general population.[92]

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[89] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Health Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/health/systems-and-service?country=LSO&period=2080-2099

[90] WBG Climate Change Knowledge Portal (CCKP, 2021). Lesotho Health Sector. URL: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-sector-health

[91] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[92] Lesotho (2017). Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

Institutional Framework for Adaptation

Lesotho's Ministry of Energy, Meteorology and Water Affairs (MEMWA), under the Department of Meteorology is responsible for the country's climate change strategies. MEMWA also serves as the national climate change focal point, tasked with ensuring the full implementation of the strategies and measures for curbing the adverse impacts of climate change and variability for all sectors, and to promote sustainable economic growth and development. Lesotho is also actively coordinating its climate change policies and strategies with stakeholders in the public and private sector organizations, including Non-Governmental Organizations (NGOs), civil society, the donor community, and local communities.[93] The Lesotho Meteorological Service is responsible for the regular collection, processing, formatting, and management of data relating to weather, climate and climate change for the Government. It supports reporting on climate change to the UNFCCC and for managing applications for carbon trading through the Clean Development Mechanism respectively.[94]

Policy Framework for Adaptation

Lesotho submitted its Second National Communication to the UNFCCC in 2013, and its Nationally Determined Contributions to the UNFCCC in 2017. At the time of writing, Lesotho's Third National Communication was under development.[95] These documents, in conjunction with the country's National Climate Change Strategy (2017) provide the guidance and platform to integrate responsible environmental management with climate change adaptation strategies and economic development priorities. Other key documents such as Lesotho's National Vision 2020 and its Poverty Reduction Strategy Paper, National Strategic Development Plan, and the National Adaptation Program of Action all provide additional guidance in coordination with the development agendas and actions.[96] Lesotho is focused on the preparation and strengthening of institutional frameworks for improved management of climate change impacts and to make available the necessary resources to support strategic adaptation activities and reduce the country's vulnerability.[97]

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[93] Ministry of Energy and Meteorology (2017): National Climate Change Policy 2017–2027. URL: https://www.gov.ls/wp-content/uploads/2019/02/National-Climate-Change-Policy-2017-2027.pdf

[94] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[95] Lesotho Meteorological Services (2021). Third National Communication on Climate Change. URL: https://www.lesmet.org.ls/home/open/Third-National-Communication-on--Climate-Change

[96] Ministry of Energy, Meteorology and Water Affairs (2013). Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

[97] Lesotho (2017): Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdff

National Frameworks and Plans

- Lesotho Vision 2020 (2018)
- Nationally-Determined Contribution (2017)
- National Climate Change Strategy 2017–2027, (2017)
- National Resilience Strategic Framework and Theory of Change (2016)
- National Action Program (2015)
- Second National Communication to the UNFCCC (2013)
- First National Communication to the UNFCCC (2001)
- Disaster Management Act (1997)

Recommendations

Research Gaps

- Improve Lesotho Meteorological Service capabilities in projecting future climate trends and identifying the occurrence and magnitude of hazards
- Widen the participation of the public, scientific institutions, women, and local communities in planning and management, accounting for approaches, and methods of gender equity
- Strengthen environmental observation and monitoring capabilities for strengthened and more effective environmental management
- Expand capacity to use and apply analytical tools and models for enhancing effective and efficient decision making
- Increase priority research related to climate change research and environmental sustainability efforts in Lesotho
- Strengthen the technical capacity to integrate climate-smart agriculture, agricultural financing opportunities, and risk management for small scale farmers
- Design and implement a national inventory system and to develop a framework for domestic Monitoring Reporting and Verification (MRV) of GHG emissions[98]

[98] Lesotho (2017): Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

Data and Information Gaps

- Increase sectoral data availability, particularly regarding Land Use and Land Use Change and Forestry and Health sectors
- Develop early warning systems about dangerous hydrometeorological phenomena and climate risk management
- Develop a geo-information-based approach in storage and management of data is advocated for data accessibility and manipulation within the context of Lesotho's National Spatial Data Infrastructure
- Establish a Unit within the Bureau of Statistics that will facilitate data collection and archiving for environmental and climate change studies.
- Quantify the required international financial, technological and capacity building support for the implementation of vulnerability abatement measures up to and beyond 2030
- Ensure that nation-wide climate change and atmosphere monitoring systems are maintained and enhanced where necessary, including through monitoring networks at appropriate spatial density and frequency[99]

Institutional Gaps

- Intensify coordination across Ministries, Departments and Sectors on collection and exchange of specific data among stakeholders;
- Ensure integration of National Climate Change Strategy goals are developed within sectoral and regional plans and in line with financial opportunities with donors[100]
- Integrate climate change concerns into relevant policies and planning processes at the state and national levels

[99] Lesotho (2017): Nationally-Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/LesothoFirst/LesothoFirstNDC.pdf

[100] Ministry of Energy, Meteorology and Water Affairs (2013): Lesotho's Second National Communication to the Conference of Parties of the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/LESOTHO%20SNC%20FINAL%20REPORT%20November%202013%20final.pdf

CLIMATE RISK COUNTRY PROFILE

LESOTHO

WORLD BANK GROUP