Global Water Security Center

LESOTHO, 2035: Water-Rich Country Poor in Domestic Water Infrastructure

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BLUF **Lack of infrastructure – not water supply – drives Lesotho's dire domestic water situation. Water exports (8-10% of GDP) consume ~50% of annual rainfall, but high interannual rainfall variability requires water management for dry years.**

Background

Lesotho is a landlocked, water-rich country. Much of the population does not directly benefit from the water exports, as nearly 50% of its 2.3 million population lives below the national poverty line with limited access to water and sanitation. Conditions are the worst in rural areas where 70% of the population resides.

INTERNATIONAL & DOMESTIC WATER SUPPLY SCHEMES: By 2035, average annual rainfall is not projected to change.

INTERNATIONAL PROJECTS: Water exports currently consume half of Lesotho's average annual rainfall.

- The **Lesotho Highland Water Project** sends 780 million cubic meters (MCM) of Lesotho water to South Africa annually **(Map 1, Fig. 1)**.
- If implemented, the **Lesotho-Botswana Water Transfer Project** will increase exports by 150 MCM, to about 60% of average annual rainfall **(Map 1, Fig. 1)**.

DOMESTIC PROJECTS: The benefits of domestic supply projects could be limited without adequate distribution and sanitation infrastructure.

- The **Lesotho Lowlands Bulk Water Supply Scheme** is underway to improve water access to 15% of Lesotho's population around capital city Maseru **(Map 1, Fig. 1)**.
- The **Lesotho-Botswana Transfer Project** could add 50 MCM of water for domestic use, double what is already available.

DOMESTIC DRINKING WATER: Despite enough water, lack of infrastructure causes widespread poor water access.

- **Domestic water access is limited**—A 2024 survey found 82% of households can access improved drinking water with a 30-minute round-trip walk. Other households must travel further or use unprotected water sources.
- **Sanitation deficiencies contaminate water**—Just 46% of the population has access to basic sanitation services. Fecal contamination is found in 66% of rural and 31% of urban households' water.
- **Waterborne illnesses are a severe public health problem**—Poor sanitation leads to diarrheal disease and intestinal infections, particularly in young children. Repeated pathogen exposure can lead to malnutrition and stunted growth (35% of children <5 yrs), impacting cognitive development and more.

Map 1: Lesotho Water Supply Schemes

Lesotho's temperate climate and the Senqu-Orange River headwaters make water its most abundant resource, setting the country up to be a regional water supplier for its arid neighbors.

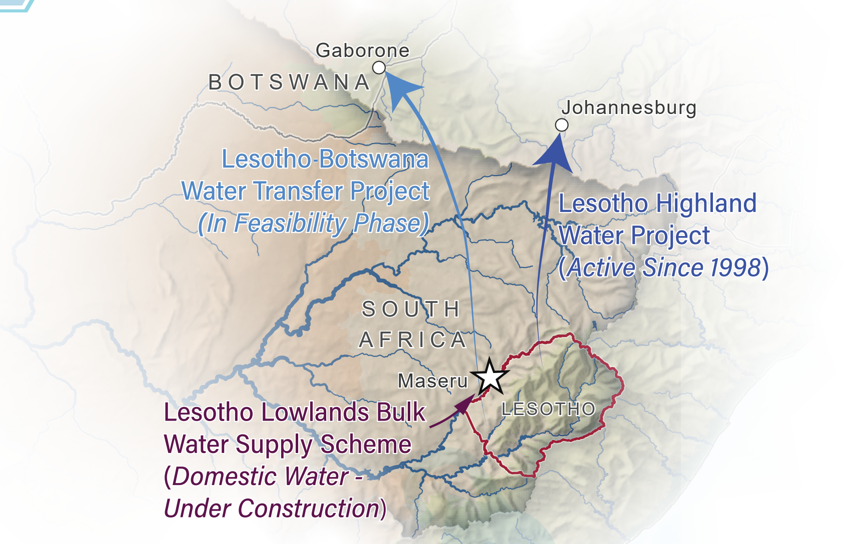
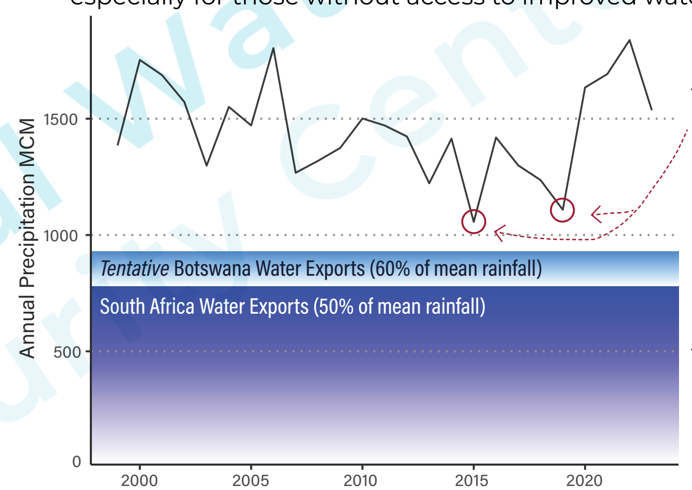


Fig. 1: Low-Rain Years – Not Exports – Hurt Households

Mean annual rainfall over Lesotho, presented in million cubic meters (MCM), likely will not change by 2035. Low-rainfall years, usually associated with El Niño, already have severe domestic impacts, especially for those without access to improved water.



The 2015-16, and 2018-19 El Niño-driven droughts caused widespread water shortages; food insecurity and malnutrition; an increase in childhood stunting; increase in typhoid, measles, and diarrheal disease; resource conflicts; and livestock disease and death.

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Thrasher, B., Wang, W., Michaelis, A. et al. (2022) NASA Global Daily Downscaled Projections, CMIP6. Sci Data 9, 262, https://doi.org/10.1038/s41597-022-01393-4

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Data Analysis Methods:

DATASETS: •
- ERA5 Historical Weather Data 1990-2024
- NASA Earth Exchange Global Daily Downscaled Projection CMIP6
  - Climate change scenarios: SSP245 & SSP585 | years: 2025 – 2060
  - Historical 2000-2020
  - 17 models were used: ACCESS-ESM1-5, BCC-CSM2-MR, CanESM5, CMCC-ESM2, FGOALS-g3, GISS-E2-1-G, MIROC-ES2L, MPI-ESM1-2-HR, MRI-ESM2-0, NESM3, NorESM2-MM, CNRM-ESM2-1, EC-Earth3-Veg-LR, GFDL-ESM4, INM-CM5-0, IPSL-CM6A-LR, KIOST-ESM

CALCULATIONS: Baseline (sometimes called "normal") and representative future values for each year of interest are calculated using 21-year time intervals around the date of interest. Our historic normal is based on the year 2000 (1990-2010) using ERA5 data. To bias correct future values, we calculate the difference or ratio between NEX-GDDP-CMIP6 modeled future [2035 (2025-2045) and/or 2050 (2040-2060)] and modeled historic [2000 (1990-2010)] values and add this difference to the historic baseline value or multiply the ratio by the historic baseline value for each metric of interest. All calculations are spatially distributed (quarter-degree grid cells) and aggregated as the final step.

We grouped our results based on two Koppen Zones from the Orange Senqu watershed – arid and temperate – and Lesotho itself.

Precipitation
Mean Annual Precipitation: The sum of the total daily precipitation for each year, averaged over the time period of interest.
Total Yearly Precipitation Volume: The sum of the total daily precipitation for each year multiplied by Lesotho's area and converted into million cubic meters per year.

Temperature
Mean Annual Temperature: The mean of the daily average temperature for each year, averaged over the time period of interest.

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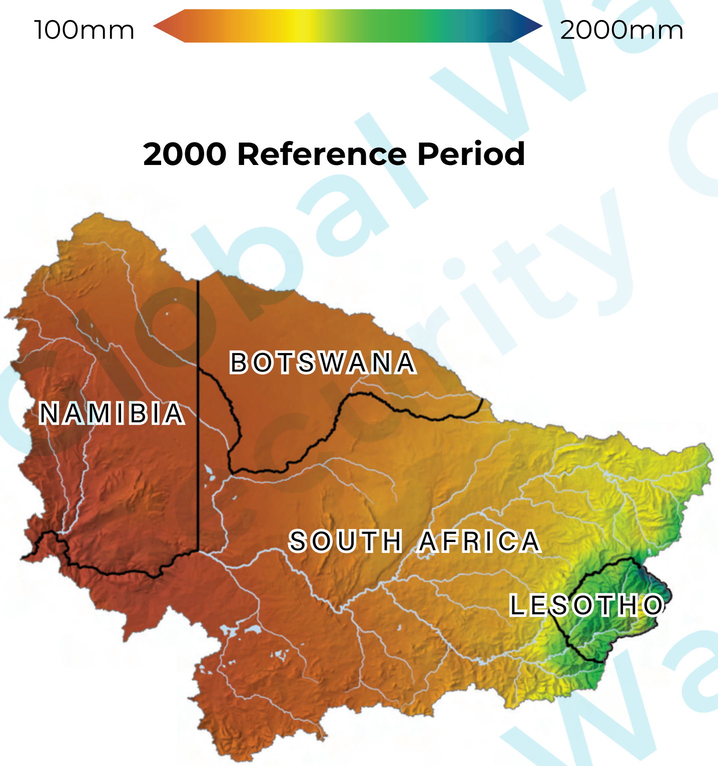
Supplemental Materials: Lesotho and the Senqu-Orange River Basin

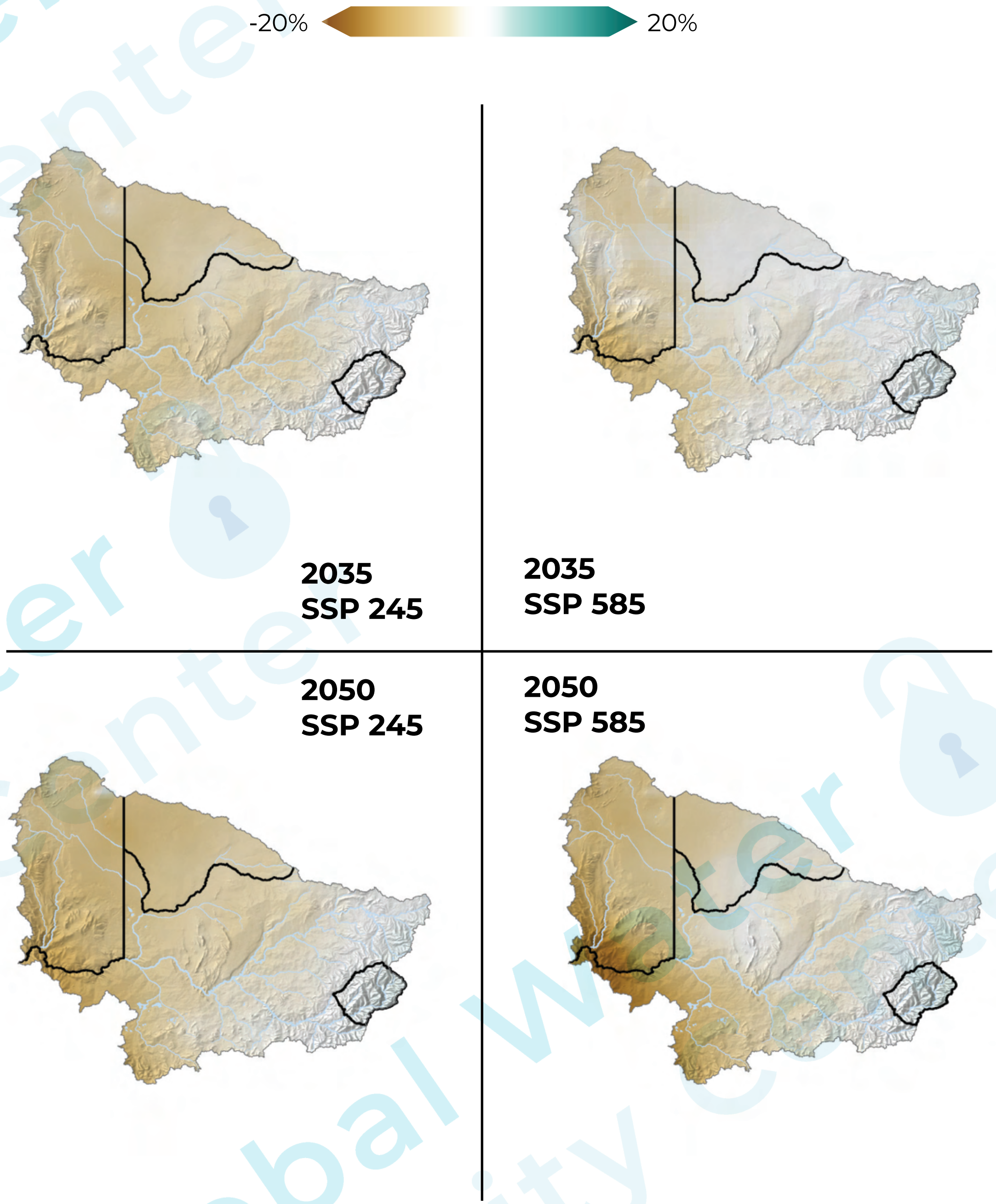
Precipitation Maps

Mean annual precipitation 2000 (mm)
(reference period 1990-2010)

2000 Reference Period



Percent change in precipitation (averaged across 17 CMIP6 models) in 2035 and 2050 for SSP245 and SSP585.



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Supplemental Materials: Lesotho and the Senqu-Orange River Basin

Temperature Maps

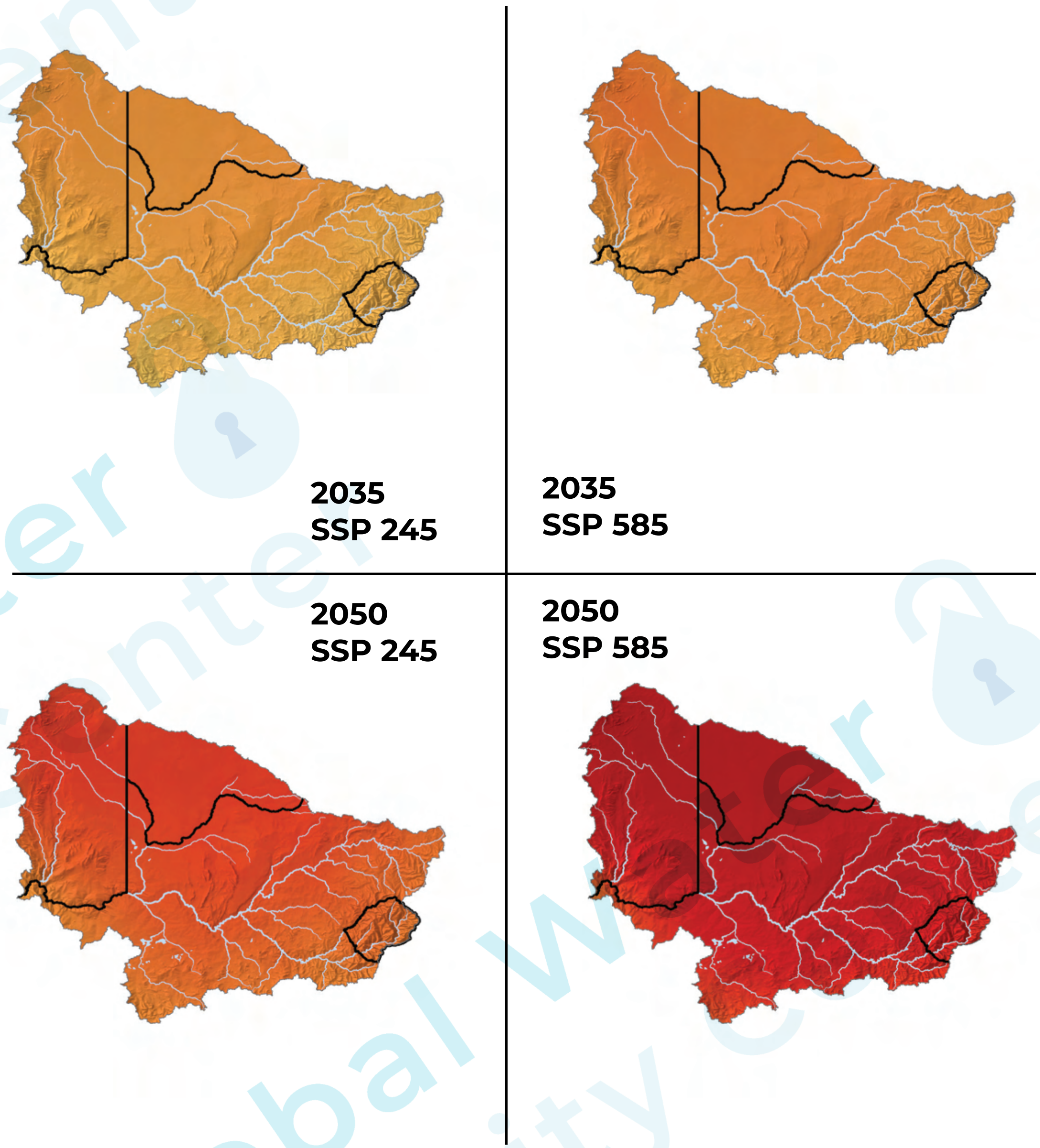
Mean annual temperature 2000 (°C)
(reference period 1990-2010)

0°C 25°C

2000 Reference Period

Change in temperature (averaged across 17 CMIP6 models) in 2035 and 2050 for SSP245 and SSP585.

+1°C +3°C



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