WEATHERING RISK

Climate Risk Profile Jordan

Summary for policymakers

This climate risk profile provides an **overview of projected climate parameters and related impacts** on different sectors in Jordan until 2080, **under different climate change scenarios provided** (called Representative Concentration Pathways, RCPs). RCP2.6 represents a low emissions scenario that aims to keep global warming below 2 °C above pre-industrial temperatures; RCP6.0 represents a medium to high emissions scenario. **Model projections do not account for effects of future socioeconomic impacts**. The full Climate Risk Profile can be downloaded here.

For high-quality **quantitative climate change impact data for the analysis of climate-related security risks**, we draw on the methodology developed by the AGRICA[ii] project applied to the data and modelling work by the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) at the Potsdam Institute for Climate Impact Research (PIK). ISIMIP provides a framework to assess past, current and future climatic changes and related impacts under different climate change scenarios in a comprehensive and consistent way. It synthesises the results of various global and regional impact models to better understand how climate change affects different sectors such as water, agriculture and health and how impacts in different sectors interact and amplify each other.[iii] The simulations from the Climate Risk Profile Jordan are based on the output data of different global models.[iv]

Main findings

In Jordan, concerns are rising about the effects of climate change. In the last decades, the country has experienced recurring droughts, flash floods, and landslides. Most concerning, however, is the already highly critical water shortage: Jordan currently is the fifth-highest ranking country in terms of water stress.[v] Climate change-induced increases in temperature, decreases in precipitation and heightened evapo-transpiration will continue to reduce water supply and further exacerbate water scarcity in the future, posing a substantial risk to the country's people, natural resources and economy.[vi]

Uncertainties are always part of climate change projections. They arise from a variety of factors, including natural variabilities, uncertainties in greenhouse gas (GHG) emissions scenarios and differences in the models used. Consequently, no future climate change projection comes without some level of uncertainty. The level of uncertainty differs in either the range or in the direction of impacts. We present the results of ten different global models. To indicate the (un)certainty of the projections we consider model agreement.

High-certainty projections

Temperature: Depending on the climate change scenario, temperature in Jordan is projected to very likely rise by **between 1.4 and 2.5 °C by 2030, 1.7 and 3.1 °C by 2050, and 1.7 and 4.5 °C by 2080**, compared to pre-industrial levels. Rising air temperatures will affect the whole country, but will be comparatively higher in the already dry northeast and south. Furthermore, the **annual number of days with a maximum temperature above 35 °C is projected to augment with high certainty all over Jordan**. Until 2030, depending on the scenario and region, the number of very hot days will rise by between around 15 and 26 days, compared to 2000. In the long term, the **increase will be highest in the more populated northwest and west of Jordan**, with an increase by up to 71 very hot days by 2080, compared to the year 2000.

Health: Rising temperatures and the increase in very hot days will very likely result **in more heat-related mortalities.** According to the best estimates, heat-related fatalities will go from 1 death per 100,000 people and year in 2000 to 1.7 and 1.8 deaths per 100,000 people and year until 2030 under RCP6.0 and RCP2.6 respectively.[v] **By 2080, heat-related deaths will grow to 2.2 (RCP2.6) and 4.2 (RCP6.0) deaths per 100, 000 people annually**. Under a high emissions scenario (RCP8.5), temperature extremes are projected to **exceed a threshold for human habitability in many cities in the MENA region towards the end of the century**.[vii]

Infrastructure: Throughout all time frames (2000–2080), the **exposure of major roads and urban land area to river floods is projected to hardly change** under either RCP. Even under RCP6.0, the annual exposure of major roads to flooding will amount to between 0 and 0.41 % by 2080 (very likely range), while flooding exposure of urban land area is very likely to remain below 0.15 % under both emissions scenarios.

Precipitation: Higher greenhouse gas emissions will lead to a **drier future for Jordan**. All models project a clear **decrease in mean annual precipitation** over Jordan. The decline will be comparatively higher on the eastern border and in the southwest. Still, the magnitude of decrease is uncertain and natural rainfall variabilities will persist. Under RCP6.0, precipitation will decrease stronger, but also with higher uncertainties: Until 2030, annual rainfall will decrease by between 2 and 20 mm, by 13 to 23 mm until 2050, and 13 to 26 mm annually by 2080. **Heavy precipitation events can be expected to some degree decrease** under both scenarios, with slightly stronger declines in the very south and northeast of Jordan. However, uncertainties regarding the magnitude of the decrease are high.

Water availability: Water availability in Jordan **is already highly insufficient today.[v] When accounting for population growth, per capita water availability for Jordan will decline to very low levels.** However, model disagreement remains very high. Projections for 2030 range between 46 and 385 m^3 (multi-model median of 94 m^3) per person and year under RCP2.6, and between only 32 and 301 (multi- model median of 80 m^3) under RCP6.0. This decline will continue: By 2080, per capita water availability is projected to very likely range between 22 and 230 m^3 (multi-model median of 60 m^3) per person annually under RCP2.6, and between 15 and 206 m^3 (multi-model median of 44 m^3) under RCP6.0. In light of the **threshold for absolute water scarcity, which is below 500 m^3 per person and year,[viii] these projections are a serious warning sign.**

Exposure to heatwaves: Rising temperatures and the increasing number of very hot days will result in a **heightened exposure to heatwaves**, in comparison to the year 2000. While the population exposed to heatwaves under RCP2.6 will be comparatively low, **exposure to heatwaves will augment sharply between 2030 and 2080 under RCP6.0**. However, modelling uncertainty about the magnitude strongly augments, too: Between 1.7 and 20.5 % of the population will be exposed to heatwaves annually by 2080 (very likely range).

GDP exposure to heatwaves: Under RCP2.6, GDP exposure to heatwaves will remain low over the period 2000 to 2080, ranging between 0.1 and 4.5 % (very likely range). **Under RCP6.0**, GDP exposure will remain similarly small until 2045. From this point the models assume **a sharp increase, with between 2.2 and 18.3 % of the GDP to be exposed to heatwaves by 2080** (very likely range). However, modelling uncertainty about the magnitude of increase rises, too.

Lower-certainty projections

For the following areas and sectors, climate projections are much less certain and therefore the results need to be interpreted with caution.

Agricultural yields: The uncertainty of the projections regarding water availability translates into a **high uncertainty of crop exposure to drought,** with some models projecting a significant increase, and some no change. Potential evapotranspiration, an important indicator for drought conditions and thus agricultural productivity, [ix] is projected to intensify, though the magnitude of increase is highly uncertain**. Projections of future wheat and maize yields are also highly uncertain** due to different models projecting different directions of change.

Ecosystems: The **uncertainty regarding projections of species richness is high**, particularly under the low emissions scenario RCP2.6. Wherever data are available, medium (2050) and long-term (2080) projections under RCP6.0 suggest declines by up to 14 % (2050) and 19 % (2080) for the northwest and west of Jordan. **Model agreement on the direction of change in tree cover is low** and consequently, no reliable conclusions can be drawn under either RCP.

References

[i] The information in the summary are drawn from the more comprehensive Climate Risk Profile Iraq.

[ii] AGRICA is a project implemented by PIK in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

[iii] Frieler, K. et al. (2017). Assessing the Impacts of 1.5°C Global Warming – Simulation Protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development, 10, 4321–4345.

[iv] The simulations are based on the output data of:

- 4 Global Climate Models (GCMs) that simulate the physical, chemical and biological dynamics of the climate system.
- 6 Global Hydrological Models (GHMs) that simulate the hydrological cycle at the land surface of continental-scale river basins.
- 3 Global Gridded Crop Models (GGCMs) that simulate crop growth at the grid scale for a selected number of crops.
- 3 Global Vegetation Models (GVMs) that simulate the dynamics of terrestrial vegetation and soil as well as the associated carbon pools and fluxes.
- 2 Global Species Distribution Models (GSDMs) that simulate species distribution based on known locations of a species and information on environmental conditions.
- 1 Temperature Related Mortality Model (TRMM) that simulates excess mortality attributable to high or low temperatures.

Further information on the models underlying the analysis presented in this profile is available in the Climate Risk Profile – Supplemental Information sheet.

[v] Resourcewatch (2022). Water Stress Country Ranking. https://resourcewatch.org/data/explore/wat036rw1-Water-Stress-Country-Ranking (accessed Apr. 22, 2022).

[vi] Jordan Ministry of Environment (2021). Updated Submission of Jordan's 1st Nationally Determined Contribution (NDC). http://faolex.fao.org/docs/pdf/jor205905E.pdf (accessed Apr. 1, 2022).

[vii] J. S. Pal and E. A. B. Eltahir (2016). Future Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability. Nat. Clim. Change, vol. 6, no. 2, Art. no. 2. https://www.nature.com/articles/nclimate2833 (accessed May 23, 2022).

[viii] UNDESA (2006). International Decade for Action "Water for Life" 2005-2015. Focus Areas: Water scarcity. https://www.un.org/waterforlifedecade/scarcity.shtml (accessed May 23, 2022).

[ix] M. B. Singer et al. (2021). Hourly Potential Evapotranspiration at 0.1° Resolution for the Global Land Surface from 1981 -Present. Sci. Data, vol. 8, no. 1, p. 224, doi: 10.1038/s41597-021-01003-9.

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http://www.pik-potsdam.de

adelphi research gemeinnützige GmbH

Alt-Moabit 91, 10559 Berlin
office@adelphi.de
https://www.adelphi.de/en

Main authors

Lisa Binder (PIK), binder@pik-potsdam.de
Barbora Šedová (PIK), sedova@pik-potsdam.de
Lukas Rüttinger (adelphi), ruettinger@adelphi.de

Layout

Alina Viehoff (adelphi)
Johanna Caitlin Dieffenbacher (adelphi)
Lisa Binder (PIK)

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