CONCLUSION

CONCLUSION

This Arab Climate Change Assessment Report shows that the Arab region will experience rising temperatures, as well as climate change impacts, on its freshwater resources over the course of this century and that these changes will have implications for socioeconomic and environmental vulnerability in Arab States, albeit to varying degrees. The following 15 conclusions summarize some of the key findings presented in the report.

MAIN FINDINGS AND CONCLUSIONS

1.

The temperature in the Arab region is increasing and is expected to continue to increase until the end of the century.

The average mean change in temperature for RCP 4.5 shows an increase of 1.2 °C to 1.9 °C at mid-century and 1.5 °C to 2.3 °C by end-century. For RCP 8.5, temperature increases from 1.7 °C to 2.6 °C for mid-century and 3.2 °C to 4.8 °C towards end-century. Parts of the Arab region could thus witness a temperature increase of 5 °C by the end of this century compared to the reference period (1985–2005).

The highest increases in average mean temperature in the Arab region are projected in the non-coastal areas, including the Maghreb, the upper Nile River Valley, and the central and western parts of the Arabian Peninsula. The Maghreb will experience a mid-century average temperature increases of 1.4 °C to 2.5 °C under RCP 4.5 and RCP 8.5 respectively, and an end-century average temperature increase of 1.8 °C to 4.1 °C under RCP 4.5 and RCP 8.5 respectively. Meanwhile, the upper Nile River Valley is projected to experience an increase in mean temperature of 1.5 °C to 2.0 °C at mid-century under RCP 4.5 and RCP 8.5 respectively, and an increase of 1.8 °C to 3.6 °C by end-century. The highest temperature increase will be felt by the end of the century in the western inland parts of the region around the Tindouf basin.

2.

Precipitation trends are largely decreasing across the Arab region until the end of the century, although some limited areas are expected to exhibit an increase in the intensity and volume of precipitation.

Decreasing precipitation trends can be seen in most of the Arab region towards mid-century, with a reduction of about 90 mm in average annual precipitation for the Atlas Mountains under RCP 8.5. By the end of the century, both scenarios project a reduction of the average annual precipitation reaching 90–120 mm/year in the coastal areas. This is mainly projected around the Atlas Mountains and in the upper Euphrates and Tigris basin.

Some areas, however, show increasing precipitation trends, such as the south-eastern Arabian Peninsula and some parts of the Sahel, which can be better understood by looking at extreme climate indices and subdomain findings. For instance, results for Wadi Diqah in Oman indicate an increase in precipitation intensity and heavy precipitation days, together with an increasing number of consecutive dry days for future periods under both RCPs. Runoff and evapotranspiration across the region generally follow the same trends as precipitation, noting that evapotranspiration is limited by water-scarcity constraints in some areas.

3.

Extreme climate indices and seasonal projections provide valuable insights into climate change impacts, particularly at smaller scales of analysis.

Annual mean temperature and precipitation are generally insufficient to assess the impact of climate change on the region and reference to extreme climate indices and

Palm trees in Marrakesh, Morocco, 2016. Source: Carol Chouchani Cherfane.

their seasonal peaks can provide greater insight into the implications of temperature and precipitation for different subregions.
This also can help to enhance understanding and action for reducing disaster risks at smaller scales of analysis.

The projections show that the number of very hot days over 40 °C will increase significantly across the Arab region until the end of the century. The number of consecutive dry days is increasing to a more moderate extent, while the number of annual days when precipitation is over 20 mm is limited, due to averaging across the region. Analysis of smaller domains can provide greater insight of trends related to extreme climate events in specific areas.

4.

Analysis of climate change impacts on shared water resources can benefit from regional and basin-level assessments.

The impact of climate change and climate vulnerability will further complicate the management of shared water resources. Regional hydrological models can provide general trends to inform regional understanding of climate change impacts in a transboundary context, based on smaller domains that cover parts of basins included in a regional domain. While regional models can provide annual and seasonal analysis that can inform regional cooperation, basin-level analysis allows for greater representation of watershed dynamics and the application of basin-specific models focused on issues of concern to riparian states. Complementary assessments can thus be pursued when examining the impacts of climate change on shared water resources in the region, depending on the forum and scale of analysis sought.

5.

Sector case studies enhance understanding of climate change implications.

Regional climate modelling, hydrological modelling and vulnerability assessment findings can help to inform additional analysis at the sector level, such as demonstrated in the agricultural sector and human-health case studies. These case studies reveal that the impact of climate change should not be limited to examining average changes in climate trends, but should also consider the implications of maximum and minimum climate phenomena and extreme climate events, as well as changes over seasons.

The findings related to the agricultural sector clearly show how changes in temperature, precipitation and evapotranspiration are contributing to water scarcity and affecting green sectors in the Arab region. The findings related to the health case studies show that increases in temperature towards the north is creating new health challenges for the region in terms of heat, humidity and certain neglected tropical diseases.

6.

Predicted vulnerability is largely moderate to high and exhibits a generally increasing gradient from north to south across the Arab region.

Throughout the Arab region and across all sectors and subsectors, the vulnerability of Arab States to climate change is moderate to high and is generally increasing over time and across both RCP scenarios.

The resultant vulnerability tends to be lowest in the Maghreb, Levant and, to some extent, the Zagros Mountains in the upper Tigris–Euphrates basin. Conversely, the southern third of the Arab region, which includes the Sahel, southern Sahara Desert, the south-western Arabian Peninsula and the Horn of Africa, exhibit the highest projected vulnerability in the region. The areas in-between generally indicate moderate vulnerability.

7.

Both components of potential impact are important to consider when conducting vulnerability assessments.

Exposure is based upon a selection of different indicators that can generally be classified into precipitation-based or temperature-based parameters. The vulnerability assessment results suggest a stronger correlation to change in precipitation than temperature. This assessment is reasonable, considering many subsectors are dependent upon water availability.

Sensitivity is correlated with population density, which generally confines areas of higher sensitivity to urbanized coastal areas and the lower Nile River Valley; the remaining areas, which encompass most of the Arab region, demonstrates low sensitivity. It is noted that over half of the subsectors studied have the population dimension weighted more heavily than the other two sensitivity dimensions. Other than the population density indicator, indicators within this dimension are based on national data and thus the dimension

has little spatial variation at a subnational level. Although other subsectors do not emphasize population, they highlight certain indicators that are correlated with population density, such as livestock density and flood-prone areas, which are affected by rural development and urbanization, respectively.

8.

Of the three components of the integrated vulnerability assessment, adaptive capacity is most likely to influence vulnerability, suggesting that the ability of mankind to influence the future is stronger than that of climate change and environmental stressors.

While the respective contributions of potential impact (the aggregated result of exposure combined with sensitivity) and adaptive capacity to vulnerability were weighted equally in the assessment, adaptive capacity often reveals a stronger correlation with vulnerability. This is partly because sensitivity is generally low across the region and particularly in less populated areas that constitute over three-quarters of the Arab region's surface area. This, in turn, reduces the potential impact generated when combining sensitivity with exposure.

The findings also reveal that large areas situated in some of the Arab region's least developed countries are projected to witness increases in precipitation with moderate average increases in temperature relative to other parts of the region over the course of the century, but that these trends are insufficient to offset their low levels of adaptive capacity. Thus, low projected exposure to climate change is insufficient to counterbalance low adaptive capacity.

9.

Areas with the highest vulnerability, which have been defined as hotspots, generally occur in the Horn of Africa, the Sahel and the south-western Arabian Peninsula, irrespective of sector, subsector or projected climate scenario.

Vulnerability hotspots have been defined by the top 10% of vulnerability aggregated values, combined with a top 20% and top 30% buffer. All hotspots exhibit low adaptive capacity, although their exposure to climate change varies. Vulnerability hotspots generally recur in the Sahel extending northwards into the Sahara Desert, the south-western Arabian Peninsula along the Red Sea, and the Horn of Africa.

For instance, most of the Horn of Africa shows low-to-moderate exposure due to increasing precipitation coupled with modest increases in temperature. Moreover, sensitivity in this area is generally low and potential impact is thus largely low to moderate. Nevertheless, this modest potential impact is not sufficient to counterbalance the low adaptive capacity in that part of the region.

10.

Despite declining precipitation, areas with the lowest vulnerability relative to the region include the western Mediterranean, coastal Maghreb, and the coastal Levant due to higher adaptive capacity in this area, as compared to other parts of the region.

Relatively large decreases in precipitation and runoff coupled with small increases in temperature results in variable exposure, ranging from low to high, depending on the sector or subsector and scenario.

Sensitivity is generally low, other than in population centres near the coast, affecting much of the coastal Levant and selected areas in the Maghreb. Adaptive capacity is moderate, compensating for areas which reveal higher potential impact. The resultant vulnerability is low to moderate.

11.

Even though the central Mediterranean coast and Green Mountains are subject to particularly strong warming, the area is indicative of moderate vulnerability due to relatively higher adaptive capacity, as compared to other parts of the region.

Exposure is variable along the Mediterranean coast because increases in temperature are modest and precipitation is found to be unchanged or decreasing slightly; meanwhile, indices such as the number of summer days over 35 °C are expected to increase substantially.

Sensitivity is also wide-ranging, but is often high immediately near the coastline, where population density is highest. Lastly, adaptive capacity in this area is generally moderate.

This is in line with the findings in other parts of the region where vulnerability is strongly influenced by the adaptive capacity of areas to respond to changes in climate.

12.

Despite precarious environmental, economic and social conditions within the lower Nile River Basin, the area demonstrates projected moderate vulnerability due to high adaptive capacity relative to other parts of the region.

The lower Nile River Basin towards the Mediterranean exhibits the highest population density in the Arab region, thus projecting high sensitivity. Exposure is variable, depending on the climate scenario under study and the indicators selected for each subsector. Adaptive capacity is high in some parts of the basin, which compensates for elevated potential impact.

13.

Although the Euphrates and Tigris rivers face challenges due to demographic pressures, hydro-infrastructure developments and water-quality degradation, socioeconomic vulnerability to climate change is found to be moderate relative to other parts of the region.

Exposure to climate change in the Euphrates and Tigris is variable relative to the rest of the region. Precipitation is generally decreasing in the upper part of the basin and increasing in the lower part, but can vary depending on the time period and climate scenario. Temperature increases are modest. Sensitivity is generally low, despite a high population density near Baghdad and generally high degradation of vegetative cover. Adaptive capacity is variable, but generally moderate. The net result signals moderate vulnerability in general.

14.

Despite remaining among the hottest areas in the Arab region, and signalling increasing temperatures, the Arabian Gulf generally projects moderate vulnerability to climate change.

Like the entire Arab region, the central and eastern Arabian Peninsula is experiencing higher temperatures. Exposure is low to moderate as projected temperature increases are mid-range as compared to the Sahel and Sahara.

Meanwhile, projected precipitation is relatively unchanged compared to the reference period, except along the Sea of Oman and nearby mountain range.

Overall sensitivity in the central region of the Gulf is low to moderate, while adaptive capacity remains moderate. As a result, vulnerability to climate change is moderate for the central and eastern areas of the Gulf compared to the rest of the region.

15.

Region-specific integrated vulnerability assessments can be drawn upon to inform regional cooperation, as well as basin-level, country-level and sector-level analysis to advance understanding and collective action on climate change.

The Arab Ministerial Water Council, the Council of Arab Ministers Responsible for the Environment, the Arab Permanent Committee for Meteorology and intergovernmental mechanisms responsible for agriculture and health have identified climate change as a challenge to consider within the context of regional and national efforts to achieve sustainable development. Arab Member States have drawn upon the RICCAR impact assessment and integrated vulnerability assessment findings to inform their work on climate change.

Luxor, Egypt, 2016. Source: Dounia Chouchani.

NEXT STEPS

Continued support will be provided by the RICCAR partners to assist regional stakeholders to access and draw upon the regional assessment and associated case studies, which will inform further work on climate change impact assessment and vulnerability in the Arab region, particularly with respect to water resources. This includes building capacity for further analysis and providing technical assistance to Arab Member States and regional stakeholders.

Access to the assessment findings and associated datasets is being made available on the RICCAR regional knowledge hub, which includes an interactive portal for accessing maps, data files and fact sheets. This online platform complements, and builds upon, the findings already presented in the main report and its technical annex, as well as the series of RICCAR publications that elaborate further on the work being pursued collectively under this regional initiative. Efforts will also be made to encourage the preparation of internationally peer-reviewed journal articles based on the assessment input and outputs for reference in future reports of the Intergovernmental Panel on Climate Change.

In tandem, smaller-scale analysis drawing upon the RICCAR knowledge base will be encouraged to support further understanding of the effects of climate change at the basin-level, country-level and sector-level. Broader assessments may also be advanced to better clarify how the Arab region fares in comparison with the rest of the world in terms of climate change vulnerability. Such analysis is already being pursued and will support greater understanding and action on climate change in the Arab region based on regional climate modelling, hydrological modelling and integrated vulnerability assessment tools developed and applied under the initiative through regional partnerships and collaborative frameworks fostered by RICCAR.

NOTES

NOTES

NOTES

RICCAR PARTNERS

UNITED NATIONS ESCWA

UN environment

FAO FIAT PANIS

THE LEAGUE OF ARAB STATES THE ARAB CENTER FOR THE STUDIES OF ARID ZONES AND DRYLANDS 1968

SMHI

WORLD METEOROLOGICAL ORGANIZATION

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

UNISDR The United Nations Office for Disaster Risk Reduction

UNESCO United Nations Educational, Scientific and Cultural Organization Cairo Office مكتب القاهرة منظمة الأمم المتحدة للتربية والعلم والثقافة

UNITED NATIONS UNIVERSITY UNU-INWEH Institute for Water, Environment and Health

DONORS

SWEDEN

german cooperation DEUTSCHE ZUSAMMENARBEIT