

Cascading climate risks and options for resilience and adaptation in the Middle East and North Africa

Glada Lahn and Greg Shapland
March 2022





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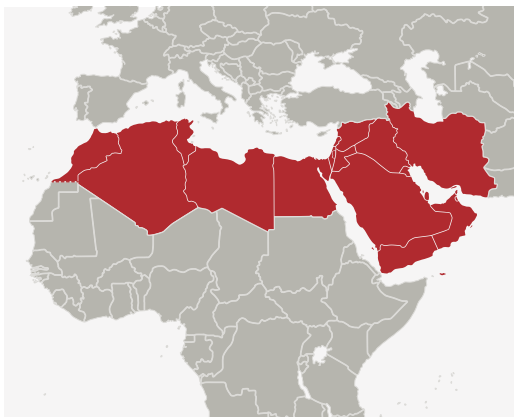
Executive summary

Climate change is a shared challenge for the MENA and European regions

The societies of Europe and the Middle East and North Africa (MENA) are historically, socially and economically intertwined. Climate change presents a shared and urgent challenge. Stretching from Morocco in the west to Syria in the north, Iran in the east and Yemen in the south, the MENA region covered by this report comprises 19 countries and is home to an estimated 472 million people, with a fast-growing young population. Conditions are diverse with some nations registering among the highest national income per capita in the world (e.g. Qatar, Kuwait, UAE) while others are low-income, conflict-affected societies, where human displacement and extreme poverty are rife (e.g. parts of Syria, Iraq, Yemen, the Occupied Palestinian Territories and Libya).

The MENA region is exposed to physical climate impacts that threaten human life and political stability on several fronts. Water and agricultural production are particularly sensitive to the extremes of global warming, given the region's already arid and semi-arid climates. Sea level rise

The Middle East and North Africa (MENA) region covered by this summary



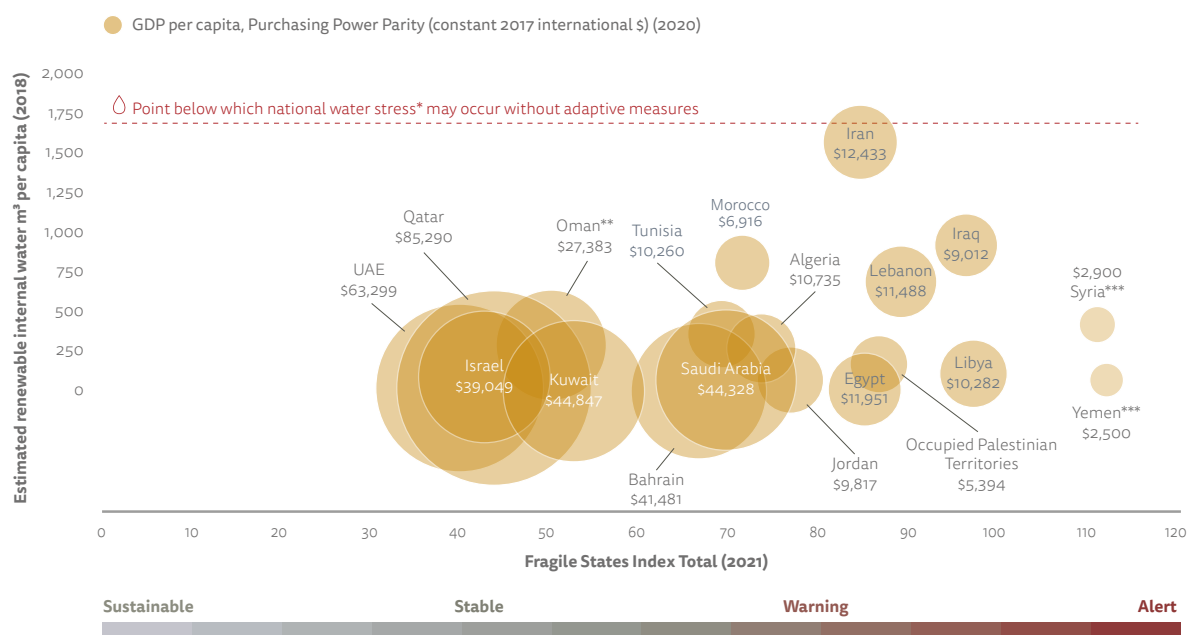
threatens rapidly expanding urban and industrial coastlines over the next century and most cities are ill-prepared for the ravages of cyclones, sand storms and flooding. Humidity may become the most serious challenge to human life, especially for coastal cities.

Climate change is already interacting with more immediate threats from armed conflict, environmental degradation, corruption and social and gender inequalities. Such compound conditions have worsened the humanitarian fallout from flooding in war-torn Yemen and facilitated extremist militant recruitment in drought-affected northern Iraq. Across the region, the role of long-term environmental mismanagement in worsening the impacts of climate change is brutally clear.

How communities and governments respond to evolving climatic conditions will affect the severity of effects that cross borders and continents, 'cascading' into European societies. As witnessed with forest fires in Lebanon in 2019 and recent water shortages in Iraq, Iran and Algeria, government failure to deal with environmental stress can trigger violent, potentially revolutionary, protests. Figure 1 illustrates variation in the capacity to cope with and adapt to climate threats. While all countries are challenged by their levels of fresh water relative to population and none are ranked as politically 'sustainable', some have a larger economic cushion to enable adaptation than others. The countries towards the right of the figure, affected by war and economic crisis, are the most vulnerable.

At the same time, climate change policies and rapidly changing costs of technology will alter oil- and gas-dominated trade relationships with MENA countries. Europe's demand for petroleum imports is set to decline and new regulations for

Figure 1. MENA country variation in renewable freshwater availability, socio-political stability and spending capacity



* This indicator is drawn from an estimate of human, agriculture, energy and industry needs developed in the 1990s. It is only a rough guide and does not take into account increasing technological efficiencies.

** Oman data is for 2019.

*** Data for Syria (2015) and Yemen (2017) are real GDP per capita estimates.

Sources: World Bank World Development Indicators, 2022; CIA World Factbook; Fund For Peace Fragile States Index 2021; FAO (2022). AQUASTAT Core Database. Food and Agriculture Organization of the United Nations.

The Fragile States Index (FSI) ranks 179 countries each year based on various pressures they face that impact their levels of fragility. Scores are apportioned for every country based on twelve key cohesion, economic, political and social cross-cutting indicators and over 100 sub-indicators.

Figure 2. Oil and gas dependence in selected MENA exporter countries



Sources: World Bank World Integrated Trade Solutions (WITS) data; International Monetary Fund (IMF) data.

green growth and alignment with the Paris Agreement goals will affect imports and foreign investment. As Figure 2 shows, most countries would not be able to sustain their current economies for long with oil prices below \$50/barrel. These present both challenges and opportunities for MENA countries and several are pursuing long-term visions for economic diversification, the success of which will depend on new investment and trade relations.

The MENA region already imports more than 50 per cent of its food and will require increasing foreign exchange to meet growing demand. Meanwhile, sensitivity to food price rises due to, for example, droughts in other parts of the world, is high.

Climate resilience strategies, green economic diversification and investment in long-term adaptation are critical to achieving sustainable peace and prosperity in the region. The European Union (EU) and European countries can harness existing relationships, investments and capacities to contribute to this effort. These range from the EU's evolving neighbourhood partnerships, humanitarian assistance and development bank lending to traditional bilateral diplomacy, trade agreements and engagement with UN bodies. The EU is already extending the principles of its Green Deal to partnerships in its Southern Neighbourhood with reinvigorated commitment to green transition and climate resilience through the Agenda for the Mediterranean. With a fast-changing combination of conditions intersecting with climate change, EU institutions and businesses will need to both learn lessons from the past and anticipate new realities on the ground.

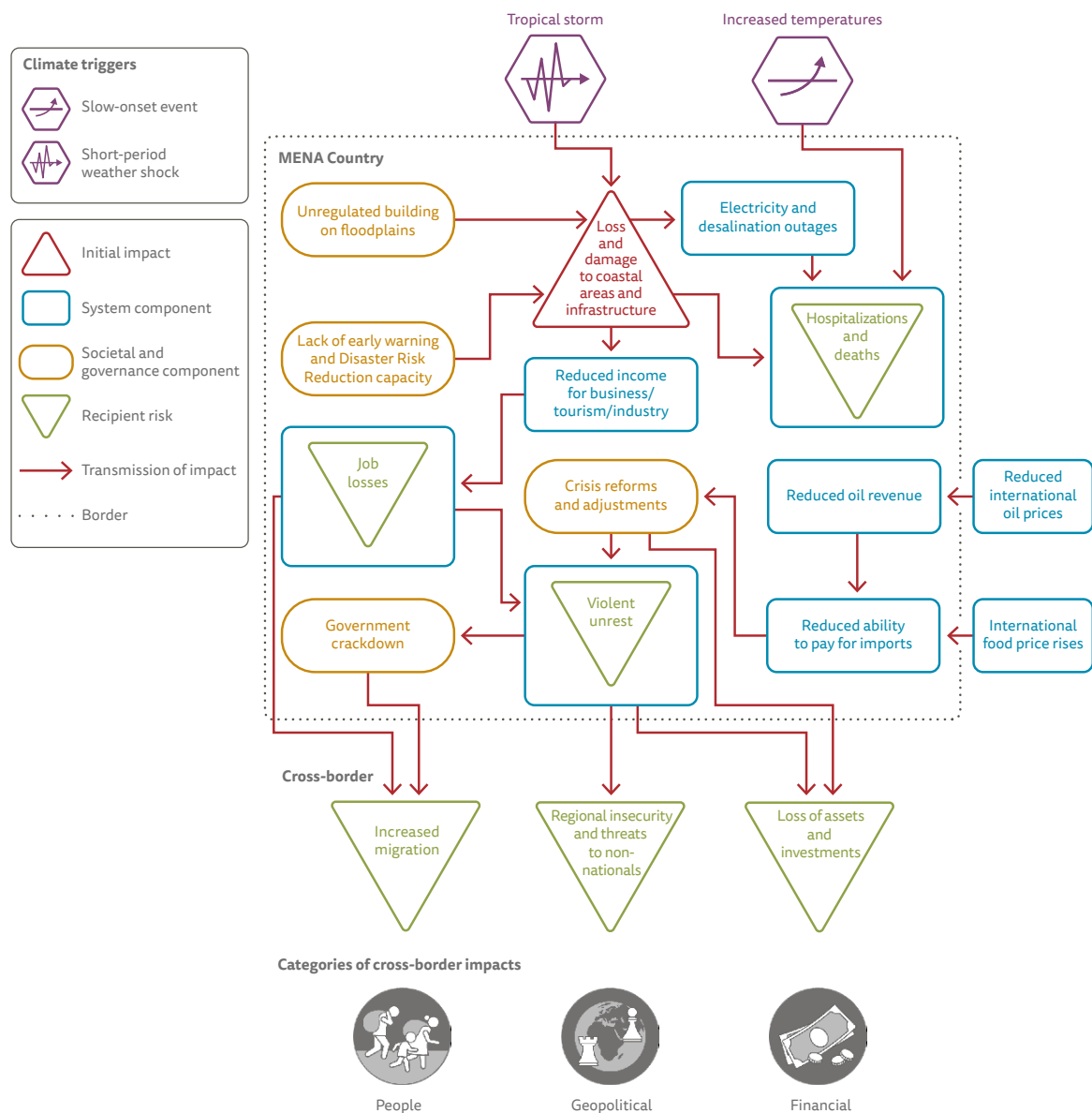
The purpose of this report

This report assesses the current situation and future projections of possible and likely biophysical climate impacts in the MENA region, based on a literature review, news articles and CASCADES climate impact data analysis.

The authors adopt a water–food–energy nexus perspective, given that this resonates with environmental interests in the region. However, this concept remains open to new understandings that put a greater emphasis on ecosystems and well-being – for example, air quality, biodiversity and nutrition. Irrigation for crops and agricultural processing, water for energy, energy for potable water as well as oil and gas revenues to pay for food imports are some of the dependencies that climate change is challenging in the region. These are also some critical areas offering opportunities for resilience-building.

Scenarios illustrate ways in which climate impacts in the MENA could compound other stresses and cascade, with effects that cross borders and affect Europe and European interests. Figure 3 shows a generic example of cascading risks. We highlight five subregions: Iraq (with relevance for Iran and Syria), North Africa, the Jordan Valley, the Nile and the Gulf Cooperation Council countries. Sister CASCADES studies on the Euphrates–Tigris Basin and North Africa, which are referred to in this study, provide more insight. The purpose of the scenarios is to enhance understanding of how resilience and adaptive actions might help to mitigate risks and limit the scope of harm that climate impacts could set in motion.

Research benefited greatly from a series of interviews and workshops with regional experts. There are significant geographical, climatic and political differences between the subregions and within several countries. As such, this can only be a broad-brush introduction to the changes taking place and their interactions with ongoing resource and societal issues. The views and opinions of experts in the region have shaped the report's discussion of vulnerability and resilience factors, the scenarios for the future and the recommendations.

Figure 3. An example of climate-related risks in the MENA that can cascade across borders

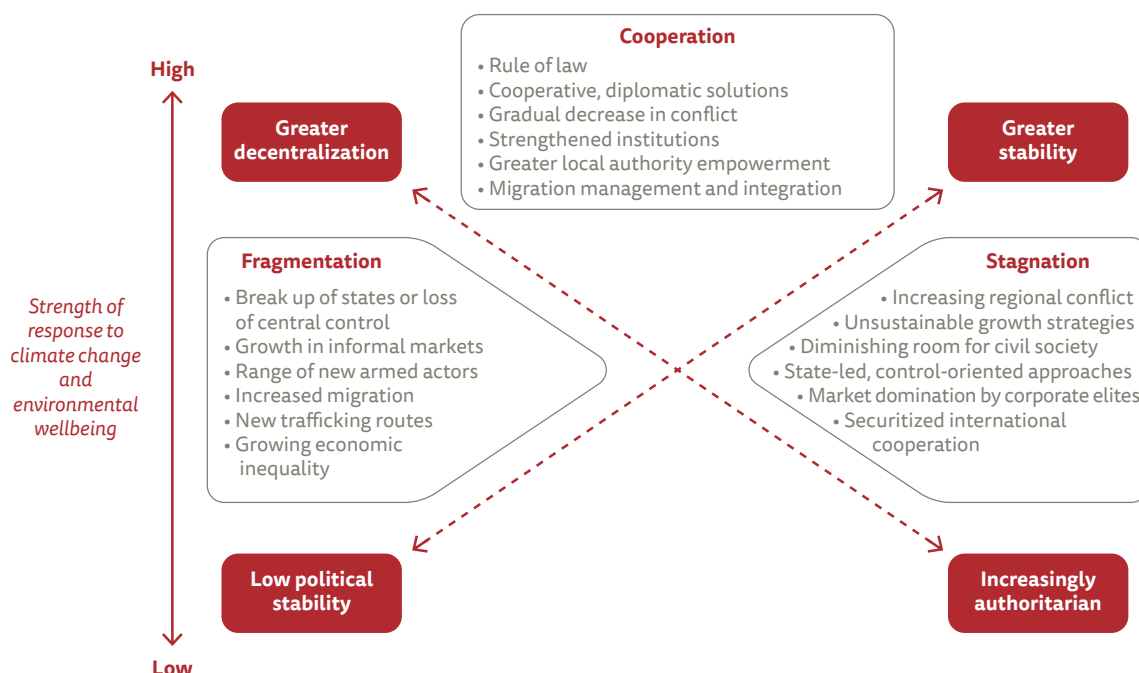
Key findings

Climate impacts are damaging human security in the MENA, yet resilience to climate change has been low on most public and political agendas. Climate change, particularly in the form of drought, flooding and storms, is already threatening lives and economies. The water and agricultural crises in Iraq are a case in point. Authorities and people in the region have generally not considered climate change and environmental health urgent issues, given more immediate threats of war, poverty,

unemployment and human rights abuses. However, this is changing. In Oman, for example, cyclone devastation has spurred greater attention to disaster risk reduction (DRR) preparation for climate change. Civil society, particularly in parts of the Levant and North Africa, is increasingly vocal on environmental issues, often tackling them through a heritage conservation, local economy or social justice lens.

The two upcoming climate summits (COP27 and COP28) to be hosted by Egypt and the UAE, and the Saudi-led Middle

Figure 4. Meta scenarios for 2025–2035 which would affect countries' ability to respond and adapt to climate change



East Green Initiative provide platforms for stronger cross-regional coordination and international partnerships.

Over the next 30 years, current water use, agricultural and building practices will become untenable; beyond 2050, liveability in the MENA region will be determined significantly by our global emissions trajectory. Irrespective of mitigation, cumulative emissions mean that the current warming trajectory will continue until at least around mid-century. While there are fewer long-term projections focusing on a 1.5°C scenario, this would suggest a far less damaging prospect for MENA countries than 2°C+, given existing aridity and coastal exposure. The extent of coastal land mass loss through sea level rise in this century will largely be determined by these trends.

Local and regional treatment of the environment is integral to climate risks.

In all cases, local human developments and practices such as the density of population, overgrazing and monocropping, urban development on floodplains, damming of rivers, land reclamation and destruction of natural barriers such as mangroves and

deforestation affect the vulnerability and severity of impact of climate-related events. At the same time, governance factors such as lack of transboundary water management systems, insufficient rule of law and military occupation affect a society's ability to take resilience and adaptation measures.

Without effective measures, climate impacts will compound local vulnerabilities and have severe consequences for human lives, livelihoods, economies and security in the region.

For example, in the absence of radical changes in water management and food production methods, competition among water users will grow and food security will diminish. While poorer and conflict-affected countries remain the most vulnerable, richer ones also face high risks. Transition risks will be at least as important as physical climate risks for economies depending on oil and gas export revenues. The sensitivities of failing public services including water provision and electricity, combined with higher food prices and declining ability to pay for imports, could lead to political instability (as shown in Figure 3).

Cascading risk scenarios show how climate impacts in the MENA could affect EU interests, including the prospects for peace, development and business investments, expatriate workers, migration flows, human rights and the demand for international humanitarian aid.

They also suggest how things might play out differently depending on national, regional and international factors, which will determine the ability to cope with and adapt to climate stresses. Three broad medium-term meta scenarios – stagnation, fragmentation and cooperation – suggest different outcomes (see Figure 4). The actions of major powers, including the EU, will strongly influence how these factors evolve. More concerted, thoughtful diplomacy is essential to reduce conflict and to address shared environmental issues.

Recommendations

In early 2022, the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) made clear that the window of opportunity for climate resilient development is closing and will require transformative adaptation measures. This report identifies urgent priorities for the MENA region in the areas of improving water management, regeneration of landscapes and infrastructure resilience. National stakeholders and their international partners cannot address these effectively without acting within the wider political and economic context to strengthen sustainable peace and good governance.

Firstly, climate resilience and adaptation projects must include co-benefits that meet immediate country needs and align with national aspirations.

Secondly, given the transboundary nature of many of the risks we discuss above, planners should consider how measures

might promote greater cooperation. This could be through knowledge sharing and technical exchanges, infrastructure that benefits more than one country, cross-border community land restoration and joint early warning systems and DRR cooperation.

Thirdly, deepening engagement with local cultural and religious understandings will be important in fostering stronger, long-term public awareness and more equal partnerships for environmental resilience.

Exploring future scenarios can improve understanding of how climate impacts might interact with societal dynamics, and suggest how investments might foster better conditions for long-term adaptation. For example, a particular challenge noted by regional experts was the lack of enablement at municipal, civil society and micro-to-medium-sized enterprise levels. The immense human capacity of the region, fully inclusive of women and youth, will be essential to address climate and environmental challenges nimbly, and with greater co-benefits for societal well-being.

The report makes six recommendations for EU approaches in the region.

The EU should:

- 1. Take advantage of its role as a major trading partner of the region to push for regional peace and cooperation through alignment with its European Green Deal.**
The EU's Agenda for the Mediterranean (AfM), launched in 2021, aims to do just this. As cooperation and investment packages develop, careful thought should be given to creating policy coherence across the five key policy areas, and with member states.¹
- 2. Provide climate change modelling tools to support national and local scenario building and assist with monitoring and early warning**

¹ These are: 1) Human development, good governance and the rule of law; 2) Strengthen resilience, build prosperity and seize the digital transition; 3) Peace and security; 4) Migration and mobility; and 5) Green transition: climate resilience, energy, and environment.

systems for climate-related hazards.

Emerging and existing programmes such as Copernicus² and I-CISK³ could be usefully extended or deployed through partnerships to improve local knowledge production.

3. Explore ways in which remedial and post-conflict rehabilitation work can help address humanitarian needs while fostering long-term environmental resilience.

This could include assessing and supporting local action to remediate conflict-affected environments and encourage green infrastructure.

4. Build climate resilience in cities and subnational areas of the MENA region by developing technical skills to address climate-related issues and manage the water–energy–food nexus. This would build on the ‘human-centred’ approach of the AfM, targeting solutions-oriented capacity building at the municipal and community levels.

5. Pay close attention to the effectiveness of mechanisms to scale up sustainable finance and disburse funds, taking into account the respective capabilities of centralized bureaucracies versus local agencies and other actors in the area concerned. Greater inclusion of civil society, women, youth and vulnerable groups in consultation and decision-making can help improve accountability.

6. Use financial instruments for climate resilience and adaptation to empower local actors and build better national to subnational linkages.

EU partnerships could, for example, help to scale up projects initiated by civil society organizations that have proven successful by linking them up with the relevant government authorities and making follow-up funding conditional on co-created plans for implementation.

² Copernicus is the European Union’s Earth Observation Programme.

³ Innovating Climate services through Integrating Scientific and local Knowledge (I-CISK) is an EU-funded project running from 2021 to 2025.

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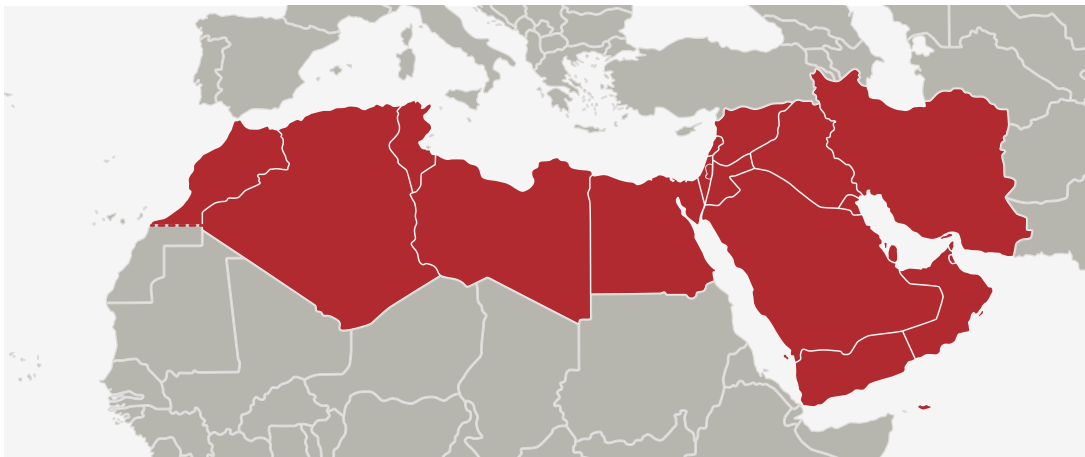
1. Introduction

1.1 Climate change in the Middle East and North Africa

Human-induced environmental stresses and climate change in the Middle East and North Africa (MENA) region are already damaging human security. In the course of this century, these trends – and human responses to them – will profoundly alter the geography, demography and economies of the region. The common language of 1.5, 2 or 3.5 degrees celsius of average temperature change over pre-industrial levels fails to capture the volatility and extremes in climate that this region will face. As the first comprehensive assessment of climate change impacts in the Arab region puts it: ‘Changes in extreme weather events are sometimes even more important, as they can have severe impacts on human health, built infrastructure, the natural environment, the transportation sector and the economy at large’ (UNESCWA et al., 2017). The Intergovernmental Panel on Climate Change’s study on ‘Impacts, Adaptation and Vulnerability’ for its Sixth Assessment Report reinforces this picture (IPCC, 2022).

The geographical area that this report covers is shown in Figure 1. It includes Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, the Occupied Palestinian Territories, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates (UAE) and Yemen. This corresponds with the MENA region as defined by the US State Department (US Department of State, 2021) rather than the wider area defined by the Arab League.

Figure 1. The MENA region as covered by this report



This region is the driest of the world’s major regions and has for many years been using more water than is naturally renewed – for example, by over-drawing from aquifers or by increasing the supply of water through desalination. According to the ranking of baseline water stress published by the World Resources Institute which is based on ‘the ratio of total water withdrawals to available renewable water supplies’, all 19 MENA countries suffer from ‘extremely high’ (12) or ‘high’ (seven)

baseline water stress (World Resources Institute, 2021).¹ In 2040, with expected increases in population and business-as-usual extraction trends, the water situation in much of the region will come under extreme stress (World Resources Institute 2021). Agriculture, which, including fisheries and forests, provides 11 per cent of employment and augments a tenuous level of food security and interregional trade, is under threat from the water situation. Heatwaves are also likely to have severe effects on human and animal health.

The region's rapidly expanding built environment – which includes buildings, roads, water, electricity and waste and industrial infrastructure – is under threat from climate change, too. Flooding, already one of the most frequent environmental hazards in the region, will continue to take lives, damage infrastructure and increase the risks of disease. The effects on rivers and groundwater, already overexploited, have implications for rural-to-urban migration and food security. In some places, such as the Arabian peninsula, dust storms, tropical storms and sea-level rise challenge vital infrastructure such as electricity and water, and consequently, national economies.

Countries of the MENA region each face a special set of political economy conditions with respect to climate vulnerability and resilience. Their historical relationships with major powers, including Europe and the US; post-colonial, conflict and occupation dynamics; and more recent evolving relationships with Asian states and Russia define power and partnerships. Predominantly centralized, patronage-based forms of government; fast-growing young, educated populations; tightly networked, family-based societies and reliance on a number of types of rent – oil and gas, security and aid² – each present opportunities and constraints. Countries face not only physical risks from climate change, but also transition risks, related to the global shift to decarbonized energy systems (Task Force on Climate-related Disclosures, 2017). While this report only touches on transition risks in the context of broader compound risks and food security, they arguably present a bigger and nearer-term threat to security than physical climate risks for the most dependent countries.

1.2 A deeply troubled region

Environmental and climate challenges continue to be overshadowed by many factors: war damage and humanitarian crises arising from militarized conflict in Syria, Iraq, Libya, Yemen and Gaza in the last decade; the worsening conditions of occupation in Palestinian areas; governance breakdown and economic failure in Lebanon; and diplomatic tensions among Gulf countries. From the destruction of water facilities, housing and schools to the soil, water and air pollution from makeshift refineries and bombs, conflict is negatively affecting the environment, increasing vulnerability to a host of health impacts and climate change. This is evident, for example, in the death toll from flooding in Yemen and the poisoned land that cannot be used for food growing in northern Syria (Zwijnenberg et al. 2021).

As of 2020, the UNHCR, the United Nations Refugee Agency, estimated that there were 10.3 million internally displaced people, 2.7 million refugees and 682,000 stateless persons and asylum seekers in the region, the majority of whom face the challenges of insecure shelter, constrained access to resources, and income

1 The occupied Palestinian Territories are included in Israel in this ranking but we have counted it separately within the 12 highly water stressed countries.

2 For Egypt and Yemen in particular, remittances play an important role in the economies.

generation (UNHCR, 2020a). In addition, there are more than 5 million Palestinian refugees registered with the United Nations Relief and Works Agency (UNRWA), around 1.5 million of whom live in camps that have become 'hyper-congested masses of multi-storey buildings with narrow alleys, characterized by high concentrations of poverty and extreme overcrowding' (UNRWA, no date).

While income levels vary widely from country to country, a 2020 report found that inequality between people in the MENA region is the highest in the world. According to Moshrif (2020), 56 per cent of national income accrued to the top 10 per cent, and 12 per cent to the bottom 50 per cent in 2019. While data is hard to come by, it is likely that inequality in the region is worsening in those countries suffering most from conflict, oppression and COVID-19-induced economic losses. In several countries affected by unrest and/or degrading governance conditions, the rise of black markets and the breakdown of public services is widening class divisions. These trends increase the vulnerability of women and children in particular. For example, spikes in domestic violence against women and girls during the lockdown periods has been registered in both Lebanon and Jordan (PLAN, 2020). Meanwhile, conflict situations, vulnerable livelihoods and migration have increased child labour, early marriage and the trafficking of women and girls (Kirollos et al., 2018). Climate impacts and environmental degradation are already playing a role in compounding inequality and discrimination (Hassan et al., 2021; Luthen et al, 2021).

The capacity of a society to prepare for and respond to risks, and the current state of economic and social vulnerability in a country will affect the severity of climate change impacts. Section 4 examines these vulnerabilities further. Climate factors can also interact with local frustrations, potentially playing a driving role in conflict, as will be explored in section 5.

1.3 Growing engagement with environmental threats

As section 3 will demonstrate, the effects of environmental degradation and climate change are already having a profound effect on socio-economic well-being. Challenges regarding water scarcity and pollution, electricity outages during heatwaves and rising food costs have been underlying factors in many of the public protests in the region in recent years (International Centre for Not-for-profit Law, 2021). Regionally, the Arab States are increasingly discussing the nexus between climate security and the sustainable development goals (SDGs).³

Since 2015, all countries in the region except Libya have submitted Nationally Determined Contributions (NDCs) or Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC), which discuss adaptation. All have ratified the Paris Agreement on climate change with the exception of Iran, Libya and Yemen – three of the four countries globally yet to do so.⁴ Engagement with the UNFCCC process in many MENA countries has often been limited to ministries of environment or petroleum, although this is changing with wider awareness of the link between climate change and all aspects of economy and security. In 2015, Iran's Supreme Leader issued a letter on environmental threats

3 Climate resilience was a focus at the Arab Forum for Sustainable Development 2021, alongside post-COVID-19 recovery. See, for example, www.arabstates.undp.org/content/rbas/en/home/presscenter/articles/2021/sdgs-climate-security-nexus-in-the-arab-states---a-special-sessi.html and https://afsd-2021.unescwa.org/sdgs/pdf/background-notes/21-00244_%20AFSD-2021-Background-Note-On-Sdg-13-En.pdf.

4 At the time of writing, Libya had signed the Paris Agreement (2021) and its parliament had agreed to ratify it. The Iranian government has said it would do so if sanctions were removed.

to the country noting the need to ‘manage climate change and environment threats such as desertification, especially dust pollution [and] drought’. In 2021, Israel’s prime minister talked of climate change as a ‘national security priority’.

Since Qatar hosted the eighteenth session of the Conference of the Parties to the UNFCCC (COP18) in 2012, there has been a visible change in the positions of some of the major oil-exporting country governments in terms of recognizing the vulnerability of their economic models and seizing opportunities to invest in infrastructure for a more sustainable future. Ambitions tend to outpace political and economic reforms and there remains cynicism over state-led ‘prestige’ projects, some of which are promoted as sustainable but are either isolated examples or cancelled out by competing, unsustainable, projects.⁵ However, the growth in expertise and attention to sustainability and resilience issues is undeniable, especially among the younger generation. All Gulf Cooperation Council (GCC) countries have overarching national ‘visions’, to 2030, 2035 or 2040, that focus on economic diversification and include goals for sustainable use of resources, renewable energy and economic reforms. Energy and water efficiency regulations and fuel and water price reforms in the last few years demonstrate a commitment to deeper resource conservation and lay the foundations for greener growth (Lahn, 2016; Clean Energy Business Council, 2021).

With growing domestic environmental challenges and international engagement on the SDGs and climate change, the last decade has witnessed rapid growth of environmental movements and increasing expert and media pressure on governments to act. Catastrophic weather events that hit the Omani and Saudi coastlines have, for example, spurred grassroots environmental movements and demand for research to support wider disaster risk reduction (DRR) strategies. The local and regionally networked abilities that civil society can offer is essential to climate resilience yet remain suppressed. Securitized responses to instability and perceived threats following the Iraq war in 2003 and the Arab Spring in 2011 included new laws limiting freedoms, heavier policing of public spaces and cyber surveillance. These measures have tended to reduce the space for local and international civil society in the region (Battaloglu and Farasin, 2017; Brechenmacher, 2017; Knoope, 2018), weakening collaborative action on climate resilience and adaptation. While Israel has a longer history of civil society activism in the area of environment and climate change, it too has faced increasing political constraints, especially since 2016 (Asseberg, 2017).

1.4 EU engagement with the region

Europe and MENA are historically and economically intertwined. If taken as a single entity, Europe was the MENA region’s largest trading partner between 2014 and 2017 with \$637 billion exchanged for goods and services (European Council on Foreign Relations, 2019). The EU has engaged in a series of overlapping partnership agreements with a number of states in the MENA region as part of its neighbourhood policy.⁶ Many European companies have invested in infrastructure and business in the region – between 2014 and 2017, EU foreign direct investment totalled around \$292 billion (Zarhloule, 2019) – and Europe contributes substantially to humanitarian relief and development operations. In 2019, EU institutions and EU countries together provided

5 See for example Syal, R. (2021), ‘From 1m trees to a tree graveyard: how Dubai’s conservation plans went awry’, *Guardian*, 24 August 2021, www.theguardian.com/environment/2021/aug/24/1m-trees-tree-graveyard-dubai-conservation-plans-desertification-real-estate (accessed 13 Sept. 2021).

6 Initially this was through the Euro-Mediterranean Partnership (EUROMED), which aimed to create a free trade area, then through the European Neighbourhood Policy and the Union for the Mediterranean, which enlarged membership. There has also been engagement through the EU Partnership for Peace, primarily aiming for a resolution of the Israeli–Palestinian conflict.

the region (as defined in our report) with \$2.33 billion for humanitarian relief and \$7.77 billion in official development assistance (OECD, 2019). These humanitarian relief numbers are higher when one includes funds going to countries receiving refugees from the MENA region, including Turkey, Greece and Italy. Migration from and through the MENA region into Europe has increased significantly with the onset of the Syria crisis in 2011. Europe now hosts about one-third of all people migrating from MENA countries, including 4.9 million Syrian refugees (International Organization for Migration, 2016).

The EU and its development banks have become prominent contributors to climate resilience capacity-building and projects in the Mediterranean region (including countries sharing the Mediterranean coastline as well as Jordan) with a strong focus on energy and water security. There are also several bilateral technical assistance partnerships between EU and MENA governments that focus on these areas, particularly Germany's GIZ and Sweden's SIDA.

Climate change and environmental issues present opportunities for peacebuilding and longer-term cooperation. Several European organizations, including the EU, SIPRI, PAX⁷ and the Finnish, Dutch and Swedish governments, have supported various environmental peacebuilding initiatives. While evidence of success is so far lacking, we identify areas where it could play a positive role in future. In 2021, the European Commission announced a renewed strategy for partnerships in the Southern Neighbourhood, the new Agenda for the Mediterranean which features a strong commitment to green transition and climate resilience alongside human development, digitalization, peace and security and migration and mobility priorities (European Commission, 2021a).

1.5 About this report

Based on the available literature, climate impact data analysis and a series of interviews and workshops with regional experts, this report surveys the range of potential climate impacts on the MENA region. It focuses on how these might compound each other and affect sociopolitical and environmental factors on the ground. The focus on countries is not equal but the report attempts to capture dynamics and cascading effects that will enable understanding of how resilience and adaptive actions might help to mitigate risks and limit the scope of harm that climate impacts could set in motion.

The report will seek to answer the following questions:

- How is climate change affecting the MENA region now?
- How are biophysical climate trends expected to play out in 2030–2050 and beyond?
- What factors will increase the vulnerability or resilience of MENA countries to such risks?
- How might climate-related impacts affect health, economies, livelihoods, social cohesion, internal political stability, security and foreign relations? And how might these effects cascade to affect Europe?
- What might MENA countries and external partners, the EU in particular, do to increase resilience and adaptation in the face of these impacts?

7 SIPRI is the Stockholm International Peace Research Institute, which has been working on conflict and arms control since 1966. PAX is a Dutch NGO focused on peace that has been working in the Middle East since the 1990s.

The report identifies specific resilience and adaptation priorities in the areas of improving water management, which is a theme that runs through each of these questions, followed by regeneration of landscapes and built infrastructure resilience. It argues that these cannot be achieved without acting within the wider political and economic context to strengthen sustainable peace and good governance. Exploring future scenarios (explained in appendix 1 and drawn on in section 5) could be useful, not only in understanding how vulnerable MENA societies will be to climate impacts, but also how work on climate resilience and adaptation itself might help foster an enabling scenario.

With respect to EU action, the report identifies six broad areas that should inform the EU's approach to resilience and adaptation in the region. These are: alignment of policies set out in the Agenda for the Mediterranean; deployment of expertise in modelling and anticipating hazards; post-conflict rehabilitation and sustainable rebuilding assistance; urban resilience approaches; strengthening accountability through finance; and empowering local actors through project design and delivery.

1.6 Methodology

This report uses a mixed methods approach, combining qualitative literature review, analysis⁸ and visualization of climate impact projections from the ISIMIP⁹ project, semi-structured interviews, and a participatory scenario-planning exercise conducted with regional experts. Desk research included academic papers, grey literature, technical reports and policy briefs to prepare for interviews with experts and stakeholders. Partners in the project – researchers from Chatham House, the West Asia–North Africa Institute (WANA) and the European Centre for Development Policy Management (ECDPM) – conducted 28 interviews with regional experts. Ten were conducted by ECDPM (in French), 10 by Chatham House (in English), seven by WANA (in Arabic and English) and one jointly using Zoom (in English). Ten of these interviews were used to help draw up 'cascade' diagrams, drawing attention to specific subregional risks. Together, the partners organized a workshop in two parts, using an online roundtable format. This involved two mornings focusing on testing climate risk cascades and developing scenarios for non-climate factors affecting the region (see section 5 for a further explanation of these scenarios and the risk cascades) and two mornings looking at resilience and adaptation measures. We used Miro and real-time Mentimeter surveys to capture participants' input throughout. Care was taken to recruit participants from diverse professional backgrounds (e.g. academics, policymakers and advocates, as well as development and security sector practitioners).

The exercise resulted in the development of three scenarios for the region, imagined to run 2025–2035 and evolve thereafter. The scenarios are not exhaustive but rather are meant to offer insights into different plausible futures and to inform policies and adaptation strategies.

The report focuses on the projected and potential impacts of climate change on societies in the MENA region, in particular how physical risks translate into sociopolitical, economic and security risks, within and across borders. It does not consider the contribution (both actual and potential) of MENA countries to global climate change and the mitigation thereof. The time horizons used in the

⁸ Through maps, figures and descriptive statistics that are partly shown in this report.

⁹ The Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) 'offers a framework for consistently projecting the impacts of climate change across affected sectors and spatial scales. An international network of climate-impact modellers contribute to a comprehensive and consistent picture of the world under different climate change scenarios', www.isimip.org.

literature for plotting climate change impacts on the region vary. For this reason, we have split the future impacts into those we are seeing now (in the now to 2030 timeframe), those from 2030 to 2050, and those beyond 2050. We refer frequently to the IPCC's Representative Concentration Pathways (RCPs), which are scenarios based on potential emissions trajectories. In particular, we focused on the stringent greenhouse gas emissions reduction scenario, '*likely* to keep global temperature rise below 2°C' (RCP2.6), an intermediate one where emissions decline slowly (RCP4.5) and the unabated high emissions scenario (RCP8.5) (IPCC, 2014).¹⁰ Given the novelty of the RCP1.9 scenario, which assumes a mitigation pathway compatible with 1.5°C, there is little to draw on from the literature. However, we can assume that impacts under this scenario will be similar to around mid-century, given the level of warming already locked in, but that extremes would be limited from there on.

This report is limited in scope, and focuses on those risks understood to have the strongest impact on Europe and EU interests. Climate and other environmental risks are not uniform across the region in their degree of severity; nor are they uniform in terms of their likely economic, social and political impacts, bearing in mind the capacity of the states concerned to respond to them. For the purposes of this report, we considered the biophysical *exposure* to climate change, which takes into account the areas affected that are important to human society, and the *risks*, based on the *vulnerability* of the area and society, considering a system's sensitivity to the changes and its adaptive capacity. As vulnerability is a complex issue, and essential to define prior to thinking about resilience and adaptation measures, we go into more detail about how we can understand vulnerability in the MENA region.

The effects of climate change in other parts of the world and the responses to these that could affect the MENA region will also be considered here, most notably food price shocks and changes in demand for oil and gas. Scientists are also advancing understanding of climate 'tipping points': low probability, potentially high impact events that could cause drastic global weather changes and/or biodiversity loss and speed up warming (Lenton et al., 2019). While the specific effects of these are not dealt with here, it is important to bear them in mind – particularly with regard to global food production, which could intensify global changes that would, in turn, affect MENA through transmission mechanisms such as trade.

10 For a clear explanation, see the primer on mitigation at <https://climatescenarios.org/primer/mitigation>.

2. The present: water, food, energy and climate change in the MENA region

Water, energy and food security are tightly connected, and climate change creates new conditions for all three areas. In the MENA region, that nexus plays out in specific ways that will be key to the discussion of climate impacts and risks. There is also a wider context for this nexus, which includes health and well-being, biodiversity and air quality. Current evidence of a changing climate demonstrates how effects are both influenced by and rippling through these interdependent areas.

2.1 Key water-food-energy interdependencies

Irrigation for crops

Rain-fed farming is important for around 70 per cent of the region's cropland area (World Bank Group, 2014). In many parts of the region rainfall is not sufficient for rain-fed (that is, un-irrigated) agriculture, which normally requires annual rainfall of around 200–250 millimetres. Even where the average annual rainfall is high enough for rain-fed agriculture, it is still a precarious business, given the variability in rainfall from year to year (Food and Agriculture Organization, 2020).



Cheap local production of fuel and/or subsidies and generally unregulated, unpriced groundwater have encouraged the expansion of unsustainable water pumping and irrigation in most countries across the region

Irrigated agriculture accounts for more than 50 per cent of total agricultural production in the region (World Bank Group, 2014) and this uses around 85 per cent of the region's water (Zafar, 2021). There is no unexploited water that could be used to expand production. Indeed, almost all water resources are already over-used. Regional river basins, including the Nile, Jordan, Euphrates and Tigris are 'closed', with no unallocated water remaining, and many aquifers continue to be exploited beyond natural rates of replenishment (Benzie et al., 2012). Jordan's Ministry of Water and Irrigation, for example, has estimated that groundwater is being pumped at twice the rate at which it is being replenished (Whitman, 2019). This over-exploitation of groundwater reserves means that they are less able to perform their traditional function as 'buffers' during times of lower rainfall and reduced river flows (World Bank Group, 2014).

Cheap local production of fuel and/or subsidies and generally unregulated, unpriced water have encouraged the expansion of unsustainable water pumping and irrigation in most countries across the region. The availability of cheap diesel to power pumps in tube wells has enabled the exploitation of the deeper parts of aquifers, leading to increased production of crops but at the cost of depleting aquifers. It is remarkable, for example, that Saudi Arabia was the sixth largest wheat exporter in the world in the mid-1990s, while its groundwater resources have reduced rapidly since oil-enabled, mechanized agriculture began to take off in the early 1980s.¹¹ Yemen's groundwater has also rapidly depleted over the last 40 years, with the increase in production of water-intensive qat, a leafy plant cultivated for its stimulant properties. The consumption of qat, and the deployment of diesel pumps, were initially fostered by the oil boom in neighbouring countries and increased remittances (McCracken, 2012).

Water for electricity

The use of river water to produce energy through damming and hydroelectric plants affects agricultural production. River water is used to generate power in many locations, such as the Aswan High Dam (Egypt), Tabqa Dam (Syria), Mosul and Darbandikhan Dams (Iraq) and the Seimare Dam (Iran). The damming involved in hydropower plants affects the flow of rivers and leads to increased evaporation (Moran et al., 2018). For example, in Iran, it was estimated in 2011 that 'dams are one of the main factors leading to environmental degradation of aquatic ecosystems and to the evaporation of about 5 billion cubic meters of renewable water' (Hoominfar and Radel, 2020 citing PurQiyomi et al., 2011). Iraq is estimated to lose around 8 billion cubic metres of water each year in evaporation, due to reservoirs and damming (Cooke et al., 2020). Damming competes directly with agriculture by flooding farmland and through filling reservoirs with water during growing seasons; large reservoirs can also increase upstream evaporation. As rivers often run across borders, such activities can become issues for cross-border tension as discussed in section 3.3. For example, in 2018, the filling of the Ilisu Dam in Turkey led the Iraqi government to ban rice growing due to the reduced river flow. Mueller et al. (2021) explain these dynamics in detail with respect to the Euphrates and Tigris rivers in a sister CASCADES report.

Energy for potable water

Energy is also used to treat and distribute water – and in some regions to produce freshwater from seawater through desalination. In Jordan, for example, the Water Authority accounts for around 14 per cent of total electricity consumption, mainly for pumping (Lahn et al., 2016). The greater the demand for freshwater in agriculture, the greater the pressures to secure alternative sources for urban use.

Desalination is most prevalent in the Gulf Arab states but is increasingly significant for Iran, which is planning a huge project to transfer desalinated water from the Persian Gulf and the Gulf of Oman to its central plateau and eastern regions, and for Israel and Jordan, where the stressed Jordan River and other freshwater sources are failing to meet demand. Without desalination, the present levels of population in the Gulf states would be untenable. However, the process is not cost-free in environmental terms: the burning of oil and gas to desalinate water contributes

¹¹ A 2004 study based on government data estimated that reserves of non-renewable groundwater (estimates differ significantly) could run out between 2026 and 2042 at levels of extraction at the time (Elhadj, 2004).

to global warming and the by-product (concentrated brine) alters the ecology of the sea around the desalination plant. In the GCC countries, the share of total oil and gas consumption used for desalination was estimated to be between 10 per cent in Saudi Arabia and around 30 per cent in Qatar and UAE in 2013 (Lahn et al., 2013). These countries are increasingly investing in solar-powered reverse osmosis plants to reduce the call on fuel and increase the efficiency of the process. The Emirate of Dubai, for example, is aiming to run all of its desalination plants using solar power by 2030 (Hawa, 2020). However, solar desalination alone is not a sustainable fix for the MENA region's increasing water demand. Discharging brine effluent into the sea damages the marine environment, while sustainable brine management techniques are in their infancy and tend to be expensive (Katal, 2020).

Energy for food production, transport and storage

As is the case globally, energy and potable water are required in the transportation, preparation and storage of food. In the MENA region, where there are few rail or waterway options, transportation depends heavily on roads and therefore diesel fuel. Liquid petroleum gas (LPG)/butane is the most common form of cooking fuel across the region. Cooling and refrigeration are powered by electricity, which is still chiefly generated by oil and gas. In some areas, particularly refugee and internal displacement camps and places affected by conflict, lack of refrigeration and unreliable or expensive cooking fuel supplies can jeopardize food security, exacerbating poverty and malnutrition.

Fuel revenues to pay for food

12 of the 19 countries that we cover in this report depend on oil and gas exports for the foreign exchange that allows them to import current volumes of food. Revenues from the oil and gas sector have also allowed some countries – particularly in the GCC and Iraq – to guarantee purchases, offer agricultural insurances and subsidize food directly (Bailey and Willoughby, 2013) and to invest in agricultural land abroad (discussed in section 4). More recently, Algeria has begun offering incentives for investment in agriculture in an attempt to reduce import dependence, partly because of its difficulties in paying for rising imports, given falling oil revenues and growing consumption from urban areas (Oirere, 2021).

Importing 'virtual water'

Between the end of the Second World War and the 1990s, the larger countries in the region variously pursued agricultural self-sufficiency policies (Egypt, Syria and the Arabian peninsula countries from the 1950s and Iran after the 1979 revolution, for example), often subsidizing inputs to agriculture and offering secure prices for farmers (although this varied from country to country). However, a combination of increasing 'rents' (e.g. oil, security, aid) in foreign currency, food subsidies, rapidly growing populations, structural adjustment accompanied by liberalization policies, changing dietary habits and the mounting stress on water resources has led most countries to import increasing amounts.

Iran is the exception, given the decades of sanctions imposed upon it. Iran has prioritized national food production and only imports about 25 per cent of its food consumption. However, sanctions have affected food security in the country and demonstrate sensitivity to supply constraints. According to one study, the re-imposition

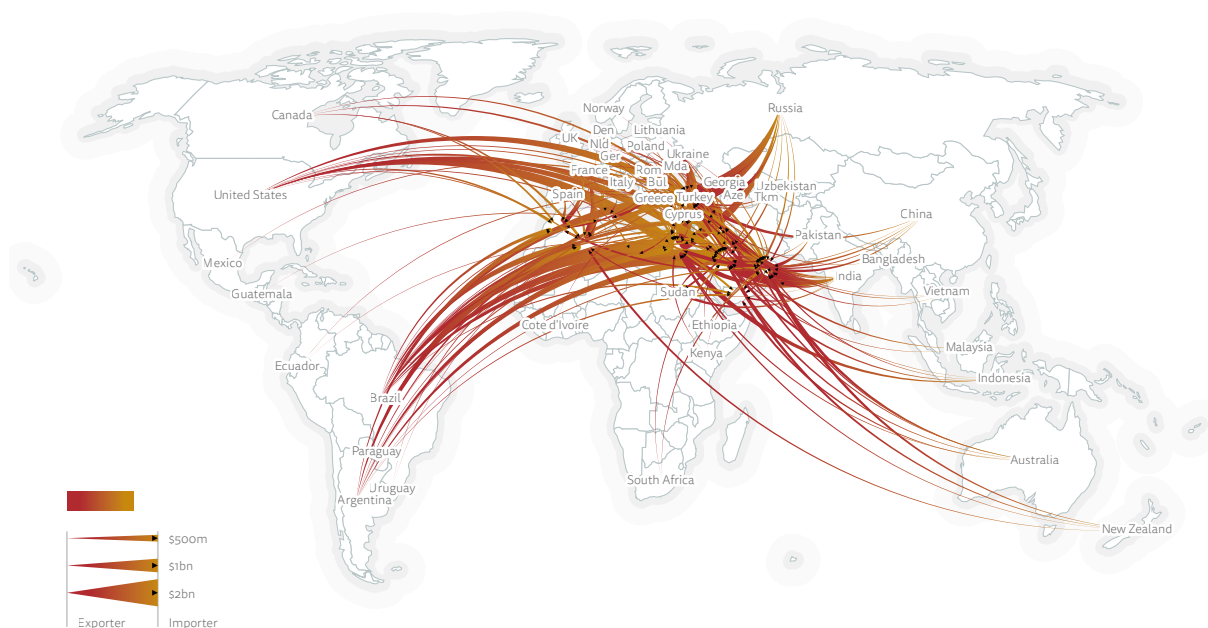
of US sanctions in 2018 more than trebled the 'annual average cost of a healthy diet for a sample Iranian family' compared with the previous year (Hejazi and Emamgholipour, 2020).

In the MENA region, according to the World Bank: 'Approximately 50 per cent of regional wheat and barley consumption, 40 per cent of rice consumption, and nearly 70 per cent of maize consumption is met through imports' (World Bank Group, 2014). In 2019, the cost of agricultural imports (primary food and fodder and live animals) from outside the region totalled \$81 billion. Around 36 per cent of that bought cereal grains, sugar and rice. Meat, poultry, dairy and animal feed (including soya beans) accounted for about 28 per cent (Chatham House Resource Trade Database).

In 2019, the cost of agricultural imports (primary food and fodder and live animals) from outside the region totalled \$81 billion

Agricultural imports come chiefly from the EU, Brazil, India, Argentina, the US, Turkey, Russia and Ukraine (Chatham House Resource Trade Database). This is often referred to as the import of 'virtual water', given the water required in production of these commodities (Allan, 2001). This cost is easily borne by countries that earn large sums of foreign currency by exporting hydrocarbons, less easily by those that do not. Egypt, which falls into the latter category, is the world's largest grain-importing country (Babar and Mirgani, 2014). Russia and Ukraine are the largest country suppliers of wheat, together sending 36 per cent of wheat imported to the region in 2019.

Figure 2. Origin of agricultural imports to the MENA region 2019



Source: Chatham House Resource Trade Database, <https://resourcetrade.earth>.

2.2 Evidence of a changing climate today

There are multiple indications that the region's climate has already begun to change. Observed changes show small but significant and escalating rises in average mean temperature and reductions in rainfall over the last century, with a stronger effect evident in the last 30 years.

Box 1. Observed changes in the Levant, Egypt and Iran between 1901 and 2013

According to the German Climate Service Centre (2015a and b), between 1901 and 2013 a temperature increase of +0.11°C per decade was observed for the Levant (Jordan, Lebanon, the Occupied Palestinian Territories, Syria and Israel) and +0.07°C for Egypt, based on a review of the literature available in 2015. A greater increase (+0.4°C and +0.53°C per decade respectively) was noted over the last 30 years (Rechid, 2015). In Iran, annual mean temperature has risen by about 0.3°C per decade over the last 50 years, especially in the eastern parts of the country (Rahimi et al., 2019).

Over the same 112-year period, there was a 'small but significant' fall in precipitation (–4 per cent/30 years for the Levant, –6 per cent/30 years for Egypt), again with a stronger effect observable over the last 30 years (–11 per cent/30 years and –22 per cent/30 years respectively). A reduction of 12 per cent in available freshwater since the 1970s was estimated for the coastal zone of the Levant, where 60 per cent of the population of this subregion live.¹²

Temperature extremes

Extremely hot days appear to be increasing in frequency. In the summer of 2021, parts of Iraq, Iran, Kuwait, Oman, Saudi Arabia and the UAE each registered temperatures of above 50°C (Hansen, 2021; Reuters, 2021). This level of heat is challenging both for outside manual and animal labour, for evaporation and for the health of plants (Nievola et al., 2017). Meanwhile, there have been record-breaking periods of freezing temperatures across the Levant (Salameh et al., 2019).

Dead zones

A 2020 study observed an increase in surface sea temperatures of 0.7°C per decade along the western side of the Gulf, suggesting that it could be above the tolerance limit of coral reefs. In the Gulf, surface sea temperatures have increased to the extent that bleaching of coral is observable in seven locations (Hereher, 2020). At the same time 'dead zones', where lack of oxygen makes areas uninhabitable for most sea life, appear to be deepening and widening as the warming increases, specifically in the area between Oman and Iran (Queste et al., 2018).

Changing seasons

Significantly for agriculture, many rural regions note the changes that have taken place in the seasons, with a more abrupt shift from winter to summer and a shortening of the growing season. This is expected to influence future food production (Choudri et al., 2013).

¹² The GERICS Climate-Fact-Sheet for Egypt does not offer an equivalent figure. In Iran, annual precipitation has slightly decreased, by 7 millimetres/decade (Rahimi et al., 2019).

For example, the 2019 IPCC Climate Change and Land report drew attention to the threat of climate change to oasis systems and agricultural areas in the Arabian peninsula, particularly the effects of 'strong decreases in winter chill' affecting well-established species (Mirzabaev et al., 2019). The last two decades have already seen severe reductions in fruit tree production in the high mountain oases of Al-Jabal Al-Akhdar (literally, 'the green mountain') in Oman. The abundance of temperate zone (Mediterranean) fruit and nuts fell by between 86 and 100 per cent during certain years, potentially due to the warmer winters (Mirzabaev et al., 2019; Al-Kalbani et al., 2014; Al-Kalbani et al., 2016).

Drying, salinization and forest fires

It is difficult to estimate the extent to which climate change has contributed to droughts in the region, given that they have been a longstanding natural phenomenon. However, Karami (2019) notes the 'relative correlation between drought intensification in the Middle East and global warming intensification'. Whereas land would historically return to its former fertile state following drought, the combination of extreme high temperatures alongside dry periods appears to be leading to long-term 'drying up' of land. Consequences of these trends are noticeable in the farming community. For example, several studies note that longer periods of dryness in the region are combining with damming, diversions and unsustainable uses of coastal aquifers to increase groundwater salinization (Abulibdeh et al., 2021). In parts of Oman, for example, vegetation is turning brown from the increasingly saline water, causing the abandonment of farms.¹³



Whereas land would historically return to its former fertile state following drought, the combination of extreme high temperatures alongside dry periods appears to be leading to long-term 'drying up' of land

Exceptional forest fires have raged across parts of the Levant and North Africa. 90 people were reported to have been killed in the Algerian fires in 2021 for example (El-Sayed, 2021). These are thought to be partly the result of longer periods without rain combined with extreme heat.

Sand and dust storms

Another sign of a change in the region's climate is the increased frequency of dust and sand storms and cyclones (IPCC, 2019). Dust and sand storms happen in arid and semi-arid areas when winds whip up dry loose dust or sand into the air where it becomes suspended and transported. These storms can last for days and can have a deleterious effect on health, especially when sand and dust are mixed with other airborne pollutants; create hazardous driving conditions; and interfere with many economic activities. Dust and sand storms mainly occur in the spring and summer months from the Levant to the Gulf regions when strong winds travel from Syria, through Iraq, Iran and the Arabian peninsula. They also occur in winter and spring

¹³ Comment made during the regional expert interviews.

in North Africa when winds blow north across the Sahara towards the Mediterranean. While sand and dust storms play a role in spreading nutrients, their increasing frequency is a concern as they also add to air pollution and can spread disease.

In Iraq, increases in sand and dust storms have been attributed to climatic changes, 'especially the drastic decrease in the annual rate of rain fall' together with localized human changes to the environment changes such as marshland drying, removal of vegetation and military operations (Sissakian et al., 2013). Such storms also create electrostatic discharges which can interfere with electrical equipment – shorting transformers, for example, which has already caused significant power outages in Iraq and Iran.

Tropical storms

Cyclones originating in the Arabian Sea or Bay of Bengal then travelling across the Arabian peninsula appear to be increasing in intensity and frequency, mainly affecting areas of Oman, Yemen, the UAE, and Iran (Guy, Miller and Khan, 2019). Box 2 gives some examples.

Box 2. Tropical storm threats to life and infrastructure in Oman

In the last two decades, Oman has witnessed changes in its historical monsoon season, with increased frequency of cyclones. In June 2007, a super cyclone – Gonu – hit the Sea of Oman and the coastal areas. This cyclone was 'the strongest on record in the Arabian Sea, with 900 mm of rain falling on a single day (5 June 2007) and average wind speeds reaching about 130 km/h' (Al-Awadhi et al., 2018). Fifty people died as a result of the storm and economic losses were estimated at \$4.2 billion. In 2010, Cyclone Phet caused the death of 21 people in Oman, and in 2011, Tropical Storm Keila led to 12 deaths (Ministry of Transport and Communications, Oman, 2012), both causing significant damage to bridges, roads, desalination plants, electricity and water pipes and economic losses.

At the end of October 2019 another super cyclone (Cyclone Kyarr) reached a peak of around 250 km/h (155 kilometres per hour) in the Arabian Sea (Gonu reached a peak of 270 kilometres per hour) but avoided the Omani coast. Kyarr was the fourth typhoon-strength storm in the Indian Ocean basin in 2019, the most ever recorded by October (Guy et al., 2019). Cyclones including Gonu and Shaheen in 2021 are also affecting the Iranian coastline, a relatively recent development. Studies have attributed this trend to climate change and expect increased severity with further global warming (Murakami et al., 2017).

Most of the population and built-up areas in the Arabian peninsula are spread out along the flat area by the coast below a low mountain range, so exposure to cyclones as well as flooding is high. Storm remnants can also lead to sand and dust storms further into the interior, including in Saudi Arabia.

Flooding and landslides

Globally, 2021 witnessed some of the worst flooding on record, with high death tolls due to both flooding and subsequent landslides occurring in Iran and Yemen (Floodlist, 2021). In the MENA region the incidence of damaging flood events seems to be increasing as urban expansion and deforestation reduce natural drainage and

soil stability.¹⁴ Yemen, the worst affected country in the region in term of flood-related deaths, also has little resilience to disasters, given its state of conflict, humanitarian needs and low income. In 2020, torrential rains and severe flash floods combined with the fallout of conflict to create a humanitarian disaster. An estimated 300,000 people lost their homes, crops and animals and at least 148 people died in two months. Cholera, dengue fever and malaria as a result of flooding caused further deaths (UNHCR, 2020b, ACAPS, 2020).

Floods have also caused damage and loss of life in wealthier areas: for example, in Jeddah in Saudi Arabia (in 2009, 2011 and 2017); in Israel and Jordan in 2018; and in Iran from 2019 onwards. Horizontal expansion of the urban areas along coastlines in some of the Gulf states has increased exposure. Building on wadis (main channels for the outflow of water to the ocean) has contributed to the extreme flash flooding in Muscat and Jeddah, for example, exacerbated by the lack of sewerage and storm drainage systems.

Landslides, which can also lead to rock avalanches, can occur with heavy flooding, especially where vegetation has been removed. Most provinces of Iran register high hazard levels for landslides whereby '[C]limate change is likely to alter slope and bedrock stability through changes in precipitation and/or temperature' (ThinkHazard!, 2020). The cost to life, homes and other infrastructure can be high. For example, heavy flooding killed 70 people and affected around 10 million in Iran in the spring of 2019. One landslide on the border between Golestan and Semnan provinces destroyed 250 homes (Motagh et al., 2020).

Land subsidence is also a problem that is compounded by drought and flooding. The arbitrary digging of groundwater wells, coupled with poor building practices, can increase the risk of this. Iran's Transport, Housing, and Urban Development Research Center identified 18 densely populated areas, including Tehran, that are prone to sinking (Bakhtiari, 2021). Tehran is reported to be sinking by more than 25 centimetres each year in some parts.

Sea level is rising slowly and not yet having a noticeable effect. In the eastern Mediterranean, a rise in sea level of about 1.4 millimetres per year has been recorded since 1955 (Rechid, 2015 using GERICS).

Human interaction with climate change

As is clear from the examples given above, local human impacts such as the density of population, overgrazing and monocropping, urban build up, damming, land reclamation, military operations and destruction of natural barriers such as mangroves and deforestation affect the vulnerability to and severity of impact of climate-related events. At the same time, restoring ecosystems and harmonizing construction practices can play a role in helping to regulate climates at the local level; for example, trees play a role in providing shade, enhancing soil stability and in groundwater recharge while the shape, materials and positioning of buildings can reduce exposure to heat. Such aspects will be discussed in section 6.

¹⁴ Landslides occurred, for example, in 2014 in Saudi Arabia (EmTech MENA, 2019) and 2019 in Morocco (Gulf News, 2019), Yemen (Xinhua Net, 2019) and Iran (Motagh et al., 2020).

3. Expected biophysical impacts

Given cumulative emissions to date, climate science suggests that global average temperatures will continue to rise along projected trends to around the mid-2040s. We therefore consider the period from now until around 2050 as 'locked-in' although the IPCC shows some variations between scenarios in the 2040–2050 window. From 2050 onwards, we can consider the implications of the IPCC's Representative Concentration Pathways (RCPs) for the MENA region. These pathways plot alternative emissions scenarios, of which we mention three, with the best case (RCP2.6) seeing emissions peak in 2020; the intermediate case (RCP4.5), in which emissions peak around 2050 and decline rapidly thereafter, and the worst case, where emissions continue to grow (RCP8.5).



We can assume that observable climate change trends in the MENA region continue over at least the next two decades, although regional actions will influence how harshly these are felt at the local level

We can assume that observable climate change trends in the MENA region continue over at least the next two decades, although regional actions will influence how harshly these are felt at the local level. Global emissions mitigation actions have the potential to influence which of the projected climate pathways becomes reality from mid-century onwards. Bearing this in mind, we summarize some of the key trends identified in existing literature in Table 1.

In considering the material presented in this section, readers should be aware that baseline periods used by studies are sometimes different, as are the time horizons adopted. Data and projections for Iran may not be as reliable as those for other parts of the region (Vaghefi et al., 2019).

Table 1. Expected effects in the MENA region under selected IPCC representative climate pathways

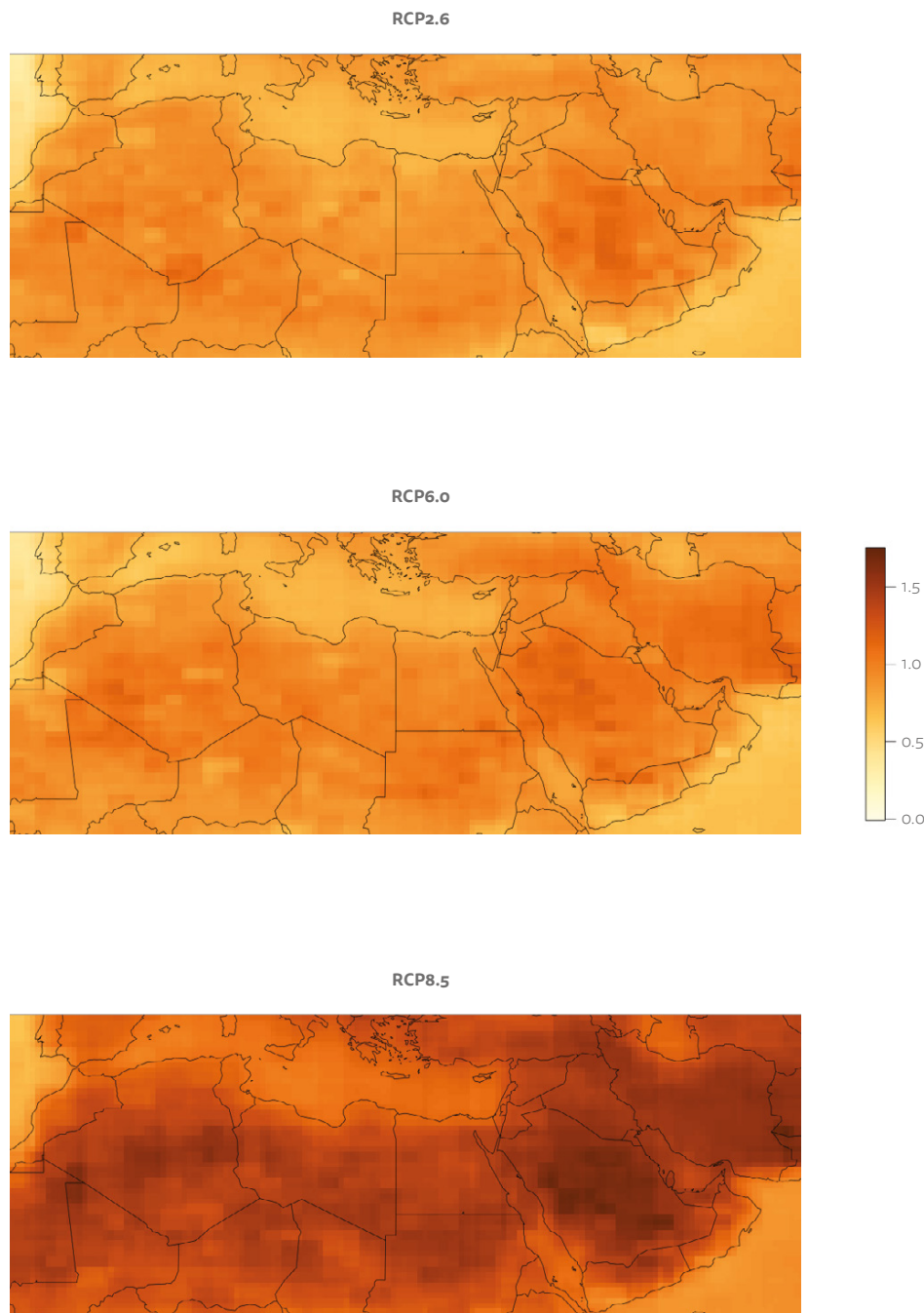
RCP	2.6 – Stringent mitigation	4.5 – Intermediate, rising emissions to 2050 then rapid decline	8.5 – Worst case, emissions continue to grow
Average global temperature rise by 2081–2100 relative to pre-industrial levels	Temperature likely to keep to under 2°C	Temperature rise above 2°C (often expected in the range of 2.5–3°C)	Temperature reaches 4°C+ and continues to rise
By 2050	<ul style="list-style-type: none"> • Overall temperature increasing with stronger warming effect in summer • More very hot days • Longer periods of extreme temperatures in certain areas e.g. Southern Iran, Iraq, Syria • Declining precipitation overall but increasingly variability • Increased precipitation in areas with very little at present e.g. southern Algeria, Libya, Egypt and the southern Arabian peninsula • Significantly less winter precipitation in certain areas e.g. Atlas mountains of Morocco, Mediterranean coast • More frequent, more intense rainfall events (potentially causing flooding and landslides) • Storms occur more often; this includes dust and sand storms (e.g. across Iran, Iraq, Saudi Arabia) and cyclones (Arabian/Persian Gulf coastline) • Mountain snowpacks melt earlier in the year (Zagros and Alborz mountains, Iran) • Sea level rise and associated storm surges in coastal areas (variable geographically, with potential rises of between 0.2–0.4 metres over 1990s levels). Coastal Egypt, Qatar, Oman and other low-lying parts of the Gulf such as Palm Jumeirah, an archipelago of artificial islands in Dubai, are most vulnerable 		
By 2100	<ul style="list-style-type: none"> • Fewer than 30 days of at least moderate drought conditions on average every year in 2080–2100 • Trends mentioned above continue • Sea level rise 0.2–0.65 metres over levels in the 1990s 	<ul style="list-style-type: none"> • Highly unusual heat extremes may occur in 30 per cent of days in summer months • Most parts of the region will be drier than in 2050 (precipitation and soil moisture both lower) • Southwest Arabian peninsula will be wetter, causing more flooding • Sea level rise 0.3–1 metre by 2100 and associated storm surges will affect some coasts 	<ul style="list-style-type: none"> • Unprecedented heat extremes in 80 per cent of days in summer months. There may be more than 200 heatwave days per year • Most parts of the region will be much drier than in 2050 (and much drier than under RCP4.5) • Southwest Arabian peninsula will have more frequent and more intense rainfall events, causing severe flooding • Sea level rise of 0.4–2 metres by 2100 and associated storm surges will affect most coasts

Source: Collated from the literature; sub-regional projections, IPCC, 2021; Sea level rise range, authors' rounding from various sources.

3.1 A snapshot of the region – 2030 to 2050

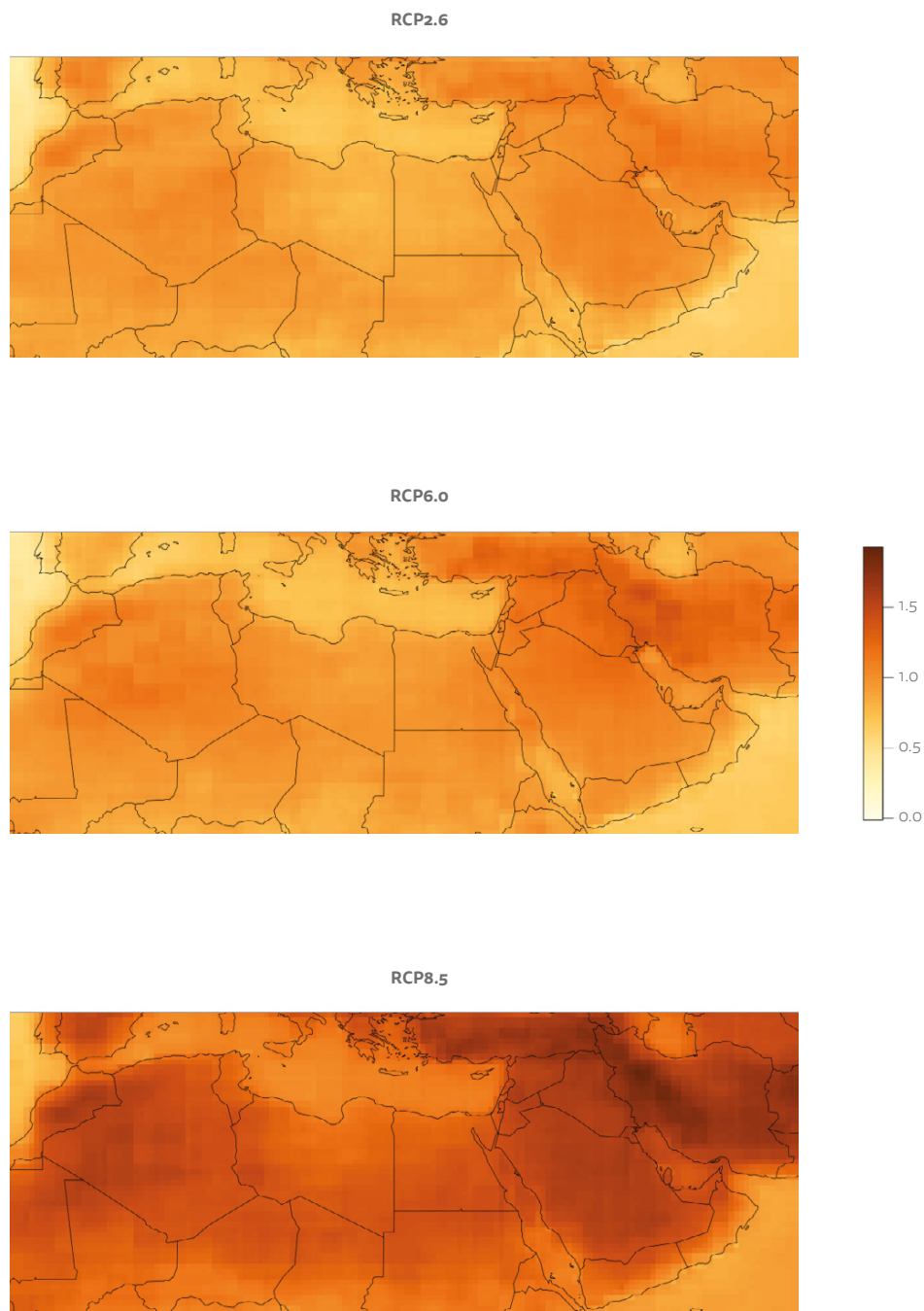
The MENA region will become hotter and drier over the next 20 years, but with variation between regions in both precipitation patterns and temperature extremes.

Figure 3. Increase in mean daily average near-surface temperature (°C): difference between 1991–2020 and 2021–2050 under RCP2.6, 6.0 and 8.5 projections



Source: ISIMIP.

Figure 4. Increase in mean daily maximum near-surface temperature (°C): difference between 1991–2020 and 2021–2050 under RCP2.6, 6.0 and 8.5 projections



Source: ISIMIP.

The ISIMIP maps (Figures 3 and 4) above show the projected average annual temperature increases over the next 30 years. Keeping emissions within the 1.5°C target – which is not modelled here, given the newness of that scenario (RCP1.9) – would further limit increases. However, cumulative emissions mean that warming will continue on a path to around mid-century. The warming effect will be stronger in summer than in winter. The number of very hot days will increase (Driouech et al., 2020).

As far as extreme temperatures are concerned, the science has been conservative. Lelieveld et al. (2014) wrote that ‘the maximum temperature during the hottest days in the recent past was about 43°C, which could increase to about 46–47°C by mid-century’. Maximum temperatures in the region are already exceeding 50°C in some interior regions of Arabian Gulf countries. Certain areas are likely to experience more extended periods of such extreme maximum temperatures; for example, in the southern part of Iran, which is already suffering heavily from droughts (Vaghefi et al., 2019).

More specifically, for the Levant (Jordan, Lebanon, the Occupied Palestinian Territories, Syria and Israel), it is ‘likely’ that annual average temperatures will be 1.2–1.9°C higher by 2030 and 1.7–2.9°C higher by 2050 (...), relative to a 1971–2000 baseline (Rechid, 2015). Similar figures apply to Egypt.

Precipitation is more challenging to project than temperature and the various models do not always agree. Depending on which model is chosen, there is more variation from place to place in the region. Iran is projected to experience extended periods of dry as well as wet conditions, with a higher frequency of floods (Vaghefi et al., 2019). For Arab countries ‘[d]ecreasing trends can be seen’ (United Nations Economic and Social Commission for Western Asia (ESCWA) et al., 2017, p. 89). The ISIMIP maps in Figure 5 show possible changes in annual average precipitation but not the seasonal differences, which may account for the lack of change across North Africa. Some parts of the region are projected to experience particularly heavy reductions in precipitation in winter (December–February). This effect will be more noticeable, for example, in the Atlas Mountains in Morocco and in northern Algeria and elsewhere along the Mediterranean coast than in other parts of the region.

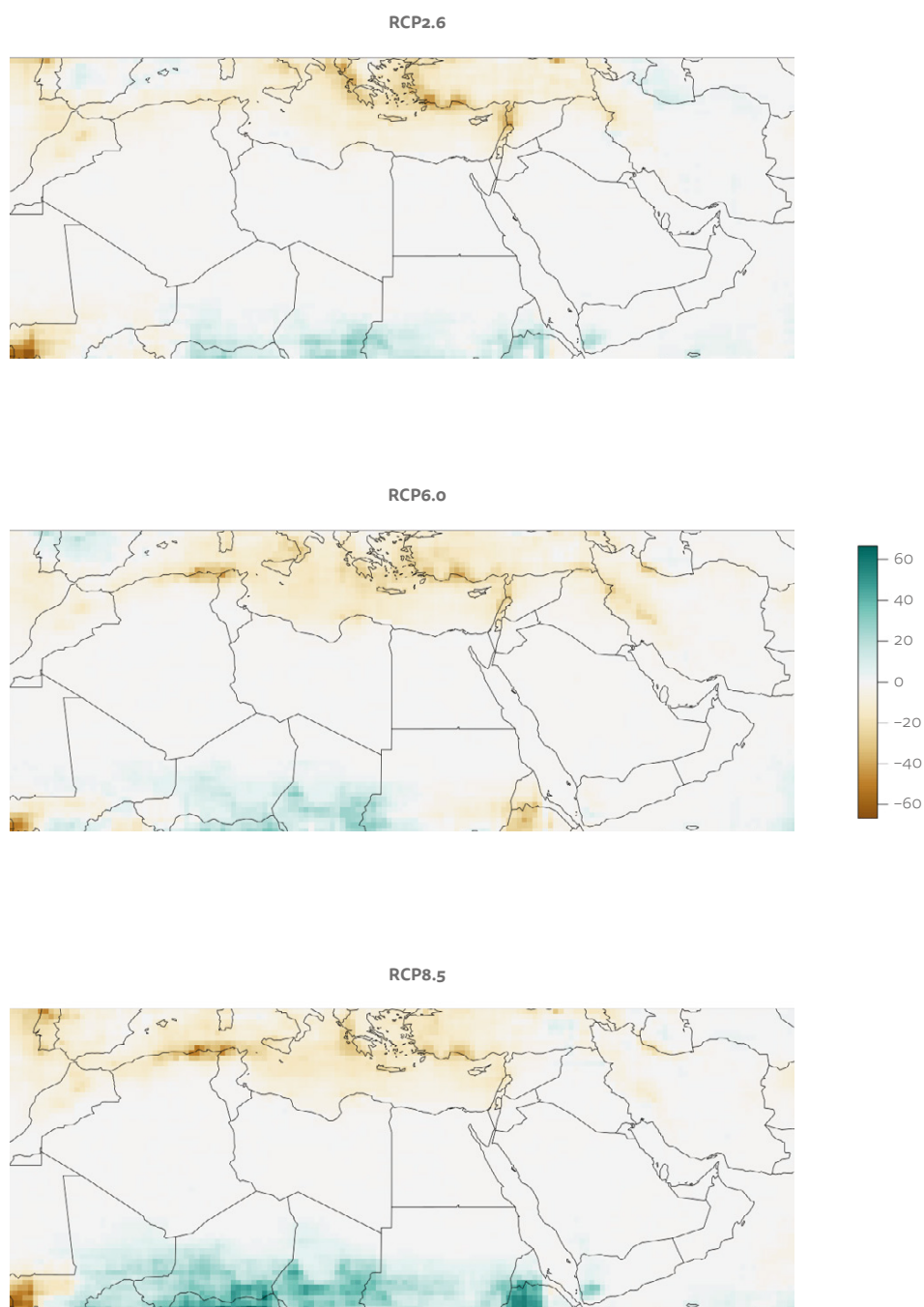
The reliability of rainfall from year to year seems likely to decrease too (that is, its variability will increase), although the literature is uncertain about the greater likelihood of longer runs of drought years.

This picture of generally declining precipitation does not hold for the entire MENA region. In the southern parts of Morocco, Algeria, Libya, Egypt and the Arabian peninsula there may be increases in precipitation (ESCWA et al., 2017). This may offer some agricultural opportunities if sustained, but may also cause damage to unprepared communities, as flashfloods in these areas have done in recent years.

While precipitation will be lower over much of the region, intense rainfall events will become even more intense and occur more often, causing more frequent and more destructive flooding. This flooding is likely to trigger more landslides. Other extreme weather events (storms, including dust storms, cyclones, etc.) will become more frequent (Murakami, Vecchi and Underwood, 2017).¹⁵ In Saudi Arabia the leadership has made the link between deforestation and increasing dust storms, explaining the co-benefits of the country’s mass tree-planting initiative (Arab News, 2021). There is often a transboundary effect to dust storms: for example, southwest Iran is affected by dust blown in from Iraq (Javadian, Behrangi and Sorooshian, 2019).

¹⁵ While there are no direct projection studies on dust storms in the region, wind as a driving factor can be projected from climate models. However, there are no regional studies on changing wind patterns under climate change in the region as yet, and future trends have to be derived from global studies.’ (World Bank Group, 2014).

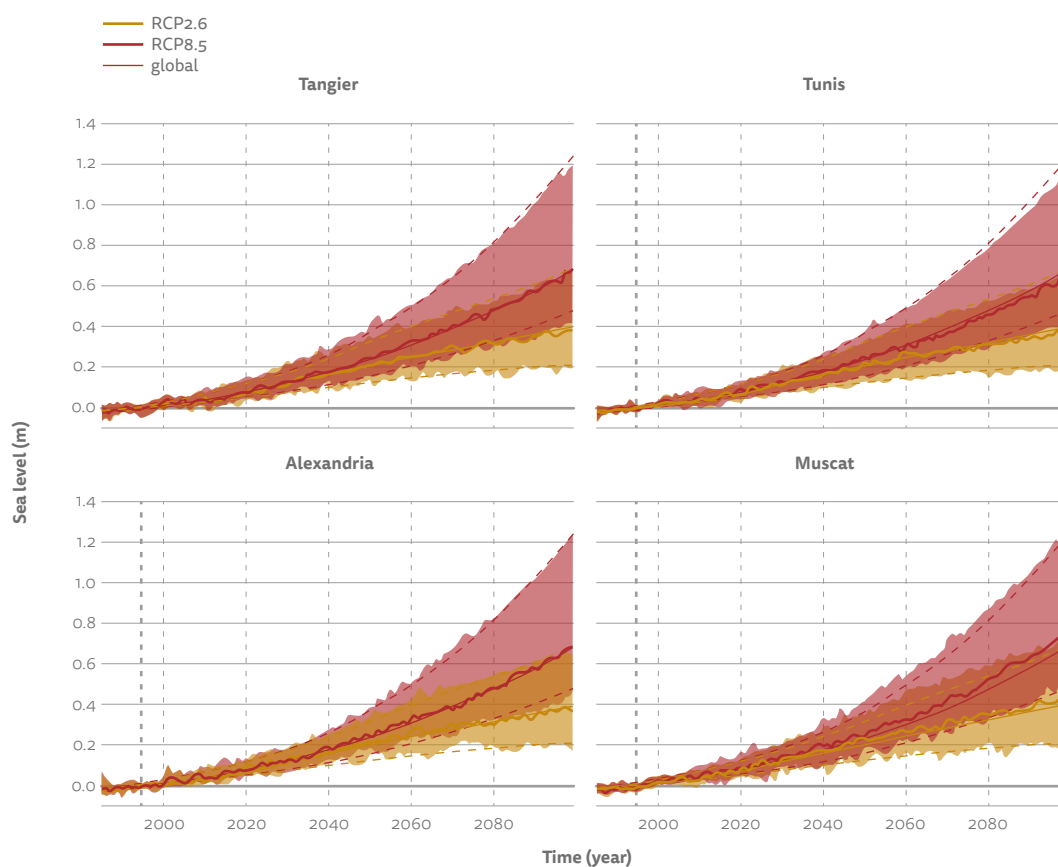
Figure 5. Mean annual precipitation (millimetres per year): difference between 1991–2020 and 2021–2050 under RCP2.6, 6.0 and 8.5 projections



Source: ISIMIP.

Sea levels will rise. By 2050 they may have risen between 0.2m and 0.25m at Tangier, Tunis, Alexandria and Muscat, as shown in Figure 6 (World Bank Group, 2014, p. 129). This level threatens artificial islands such as the Dubai Palm Island (Mulhern, 2020), fisheries such as those on the Red Sea coast in Egypt, and low-lying coastal regions such as the tourist areas of Oman. Under a 0.2 to 0.5 metre rise, which is feasible in the 2030–2050 period, 400 square kilometres of land would be inundated, with ‘the Al-Batinah and Muscat governorates [being]... the most vulnerable under all [sea level rise] scenarios’ (World Bank Group, 2014; Al-Awadhi et al., 2016). However, in terms of the number of people relative to total population at risk from sea-level rise, the UAE, Qatar and Bahrain face the highest impact (Hereher, 2020).

Figure 6. Sea-level rise projections for Tangier, Tunis, Alexandria and Muscat



Note: Time series for sea level rise for the two scenarios RCP2.6 (1.5°C world, orange) and RCP8.5 (4°C world, red). Median estimates are given as full thick lines and the lower and upper bound given as shading. Full thin lines are global median sea level rise with dashed lines as lower and upper bounds. Vertical and horizontal black lines indicate the reference period and reference (zero) level.

Source: World Bank Group, 2014, Figure 4.12.

Storm surges will make the phenomenon more destructive than the figures for the overall rise in sea level would suggest. Coastal areas are home to the majority of people in many MENA states, making sea level rise a serious threat to residents and infrastructure. For example, Qatar’s INDC (Intended Nationally Determined Contribution) states that 96 per cent of people in the country live in coastal areas (Ministry of Environment, 2015). According to one academic study: ‘Digital elevation models showed that there are more than 3100 km² of coastal areas that occur at 1 m level along the Arabian countries of the Gulf’ (Hereher, 2020).

3.2 What could happen beyond 2050?

Towards the end of the century, average temperatures will rise and heatwaves will intensify in number, duration and magnitude under all scenarios (although the parameters used in the projections differ considerably) (Driouech et al., 2020). By the end of the century, according to the World Bank, 'highly unusual' heat extremes will occur in 30 per cent of days in summer months almost everywhere in the region, even if global warming is held to 2°C.

In a 4°C world (RCP8.5) 'warming continues almost linearly beyond 2040, reaching about 7.5°C above the 1951–1980 baseline by 2100' (World Bank Group, 2014, p. 121). If this happens, we can expect 'unprecedented heat extremes' in 80 per cent of days in summer months by 2100. Other sources project lower figures but use later (and warmer) baseline periods (e.g. the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) gives 3.2–4.8°C for the Arab world 'towards end-century', using 1986–2005 as the baseline (ESCWA et al., 2017, p. 89). Under this scenario, there may be more than 200 heatwave days each year by the end of the century under RCP8.5 (Lelieveld et al., 2014).



If global warming reaches 4°C there will be 'unprecedented heat extremes' in 80 per cent of days in summer months by 2100

'Using a high-resolution regional climate model, Lelieveld et al. (2014) projected a substantial increase in the warm-spell duration ['heatwave'] index (WSDI) for several capital cities in the region (Table 4.2) [for 2071–2099]. The mean WSDI over the observational period lies between zero and about one week; it is projected to exceed four months for most capital cities in the region in a 4°C world and even six months for Beirut and Riyadh' (World Bank Group, 2014, p. 124). In terms of extreme temperatures, the RCP8.5 scenario suggests especially harsh living conditions by the end of the century, notably along the Mediterranean coast of eastern Libya and Egypt (ESCWA et al. 2017, p. 92), Iran and the Arabian interior (World Bank Group, 2014).

For some places in the Gulf (Abu Dhabi, Dubai, Doha, Dhahran and Bandar Abbas), humidity, measured by the 'wet-bulb temperature'¹⁶ is projected to exceed 35°C several times in the 2071–2100 period. A wet-bulb temperature of 35°C represents 'the level at which prolonged exposure becomes intolerable', given the reduced effectiveness of sweat to cool the body down (Pal and Eltahir, 2016; US National Ocean and Atmospheric Administration (NOAA), 2020).

Most parts of the region will be drier in 2100 than in 2050. 'By the end of the century, both scenarios [RCP4.5 and RCP8.5] suggest a reduction of the average monthly precipitation reaching 8–10 millimetres in the coastal areas of the Arab Domain, mainly around the Atlas Mountains in the west and upper Euphrates and Tigris rivers in the east' (ESCWA et al., 2017). For the Jordan basin, one academic article projects a decrease in rainfall of 30 per cent in 2070–2100 (compared to the baseline period of 1981–2010), while 'multiple drought-type occurrences increase from ~8 in 30 years

¹⁶ The wet-bulb temperature is affected by how much moisture is in the air, which reduces the cooling effect of a moist cloth wrapped around a thermometer.

to ~25 in 30 years' (Rajsekhar and Gorelick, 2017). The same article projects a 28 per cent decline in soil moisture and a 58 per cent decline in streamflow (run-off) over the same period in the basin (assuming RCP8.5), leading to an increased need for irrigation.

Under the RCP8.5 scenario, studies generally project a substantial intensification of extreme precipitation events over the 21st century across the southern tip of the Arabian peninsula (Yemen and to a lesser extent, Oman) (Kharin et al., 2013; Sillmann et al., 2013). This is consistent with the robust projection for increasing annual precipitation over the Horn of Africa (World Bank Group, 2014, p. 125). One academic study suggests an increase in rainfall in Yemen by 11 per cent in the periods 2020–30 and 2040–50 (compared with 2000–09) (Droogers et al., 2012). Increased intensity of tropical storms and cyclones will contribute to this on a seasonal basis along the Gulf coastlines.

In most of the region, meteorological droughts will increase, particularly under the RCP8.5 scenario, with the Mediterranean and the western and northern parts of the Arabian peninsula most strongly affected. The number of consecutive dry days will increase, resulting in a lengthening of the dry summer season (ESCWA et al., 2017, p. 94). For Iran, the projections are less robust but predominantly show drought conditions that are less extreme relative to the rest of the Middle East and North Africa (World Bank Group, 2014).



Without restored vegetation, dust and sandstorms are likely to be even more frequent and more severe than in 2050. A contraction of the area cultivated in the MENA region will expose soils to wind erosion

Without restored vegetation, dust and sandstorms are likely to be even more frequent and more severe than in 2050. A contraction of the area cultivated in the MENA region will expose soils to wind erosion. There is no regional modelling on these phenomena as yet (World Bank Group, 2014).

The IPCC's Sixth Assessment Report report (2021) highlights how sensitive sea level rise is to temperature rise, and thus to the level of emissions produced. Projections show that globally, the high emissions scenario (corresponding to RCP8.5) could mean a difference of between 50 centimetres and 1 metre of sea level rise by 2100 compared with a low emissions one (RCP2.6).¹⁷ According to the World Bank (2014), sea level will not have risen at a uniform rate across the region by 2100. For example, the sea level at Tunis will have risen less than at Muscat, whichever RCP level is chosen, with that of Tangier (on the Atlantic coast) somewhere in between: '[P]rojected high-end rates of sea-level rise range from 6.4 mm per year (Alexandria) to 7.8 mm per year (Tangier) in a 1.5°C world and from 20 mm per year (Tunis) to 21.4 mm per year (Alexandria) in a 4°C world (Table 4.5).'

One academic study asserts that 'Iraq, KSA, UAE, and Qatar have the largest low-lying [sic] areas along the coast. The sea-level rise by 1 m should overwhelm about 1910, 614, 270, and 147 km² of those countries, respectively.' The same study adds that 'the UAE, Qatar, and Bahrain have the highest impact of sea-level rise in terms of the number of population at risk to the total number of population' (Hereher, 2020). A think-tank

17 See for example Figure 9.27 and FAQ 9.2, Figure 1, IPCC, 2021.

report notes that a 2-metre rise by 2100 would flood a large part of central Doha (Lambert and D'Alessandro 2019). While this is considered unlikely based on current trends, feedback loops, which could increase warming, mean that this 'cannot be ruled out' (Oppenheimer et al., 2019).

3.3 Transboundary effects

Water supplies from outside the region (transboundary rivers)

There is considerable agreement among climate models regarding the future flow of the Euphrates and Tigris rivers, which rise mainly in the eastern Anatolian mountains of Turkey and flow through Syria and Iraq. '[A] runoff decrease of 25 per cent to 55 per cent [by 2100] is projected with 4°C warming [= RCP 8.5].' Snow-melt will occur earlier in the year, possibly affecting the potential for cropping (World Bank Group, 2014, p. 116). As downstream countries, Syria and Iraq, will be affected not only by these trends, but also by actions in Turkey, for example to retain more water for its own irrigation and energy generation.

In the Nile basin, on the other hand, climate models do not agree to the same extent, as different parts of the basin may be affected differently by climate change. It remains unclear whether the Nile may carry more water entering Egypt in the future or less. The modelling shows an overall reduction in precipitation over the Blue Nile basin in Ethiopia, from which 60 per cent of the Nile's main watercourse derives. Another 14 per cent is contributed by the Atbara, which also rises in northwest Ethiopia. Projections show a decline in precipitation in this region of 3–6 per cent by mid-century; they also show higher temperatures, which would result in increased evaporation, including from the reservoir impounded by the Grand Ethiopian Renaissance Dam (GERD). However, attempts to translate changes in climate into changes in run-off in the Blue Nile basin remain inconclusive, showing a wide range of possible scenarios (ESCWA et al., 2017, p. 125). The operation of the GERD will have as much impact on Egypt's water supply as will climate change (Wheeler et al., 2020). Once the reservoir behind the GERD has been filled, Egypt will be in a better position than Syria and Iraq are: the dam's purpose, to generate electricity, requires Ethiopia to maintain the flow. Yet without careful planning and cooperation, long-term operation could reduce downstream surface water and soil fertility (see Box. 13).

Food security

As noted in section 2.2, the MENA region is heavily dependent on food imports, notably wheat. The main sources of wheat are the EU (specifically Poland, Romania and France), Russia, Ukraine, the US and Canada.¹⁸ In these circumstances, MENA countries are vulnerable to developments in supplier countries, which may, in extreme cases, restrict exports to maintain domestic supplies, as Russia (a major source of wheat for Iran and Egypt) did in 2010 (Welton, 2011) and 2014, following droughts. In 2010, the supply of Russian wheat to Egypt was cut by 500,000 tonnes, the equivalent of 5 per cent of its total wheat imports (Devitt and El Dahan, 2014). Ukraine's grain export bans and European and North American sanctions on Russia

¹⁸ The EU accounted for the origin of about 36 per cent of wheat imports to the region (Chatham House Resource Trade database 2020).

due to the Russia-Ukraine conflict again illustrate these vulnerabilities. In March 2022, shortages and higher priced imports from elsewhere are set to impose particular hardship on Yemen, Syria, Libya and Lebanon where there is pre-existing economic and food insecurity (Human Rights Watch, 2022).

A number of sources highlight the risks that climate change poses to global food supplies. 'Climate change is projected to undermine food security... Global temperature increases of ~4°C or more above late 20th century levels, combined with increasing food demand, would pose large risks to food security globally...' (IPCC, 2015). More apocalyptically, 'a stoppage or reversal in the Atlantic Meridional Overturning Circulation (AMOC) ... would wreak havoc on food production globally...' (Lenton et al, 2019). 'In Russia, climate change may lead to a food production shortfall, defined as an event in which the annual potential production of the most important crops falls 50% or more below its normal average' (Field et al., 2014).

Given these dynamics, global food price rises due to climate change are likely to heavily impact the MENA region. The effects of the COVID-19 pandemic coupled with sanctions in Iran from 2020, and the sharp inflationary impacts of the economic crisis in Lebanon in 2021 show the rapid effect that reductions in foreign exchange can have on food security. Food prices in Lebanon rose by as much as 400 per cent between 2020 and 2021 in a situation of rising import dependence and declining exports compounded by a public loss of faith in government and capital flight (Ramadan, 2021). The catastrophic economic effects of conflict, fall in oil export revenue and high grain and fuel import dependence (around 90 per cent of domestic consumption for wheat and rice) in Yemen since 2015 illustrate worst case humanitarian impacts (Salisbury, 2022).

4. Factors influencing vulnerability and capacity for resilience

While actual climate effects and events will be harsher in some parts of the MENA region than others, the impacts on society and human systems will depend on many variables that will be in flux over the next few decades. The possible risk cascades and effects in the region (which are discussed in more detail in the next chapter) are conditional on factors that influence the vulnerability or resilience of affected people, economies and political systems (see Box 4).

The likelihood of these risks materializing will depend on the evolution of these conditioning factors, which may look very different in 30 years' time. As such, this section first describes the factors that will make an area more or less vulnerable to climate change impacts. As we are particularly interested in understanding compound risks and the way that several pressures could result in transboundary and systemic impacts, we also give weight to regional and international factors that could increase or reduce vulnerability. The factors chosen – which combine 'sensitivity' and 'adaptive capacity' as described in Box 3 – have been identified from interviews with regional experts and our review of the literature.

Box 3. Defining vulnerability

Vulnerability to impacts can be measured in various ways depending on both the exposure to the hazard and the way the exposure can affect people. While the probability of a climate occurrence or trend might be the same in several areas, the impact on inhabitants may be felt differently depending on a number of variable factors. The RICCAR's Arab Climate Change Assessment Report (ESCWA et al., 2017) adopts a model building on the approach developed for the IPCC's Fourth Assessment Report for studying levels of vulnerability. This takes into account four variables:

Exposure: changes in climate parameters that might affect socio-ecological systems either directly or through, for example, disrupting the flow of goods, finance, information or people into an area.

Sensitivity: the state of the physical and natural environment that makes the affected systems particularly susceptible to climate change, including population density, migrant and refugee populations and urban extent.

Potential impact: determined by combining the exposure and sensitivity to climate change on a system.

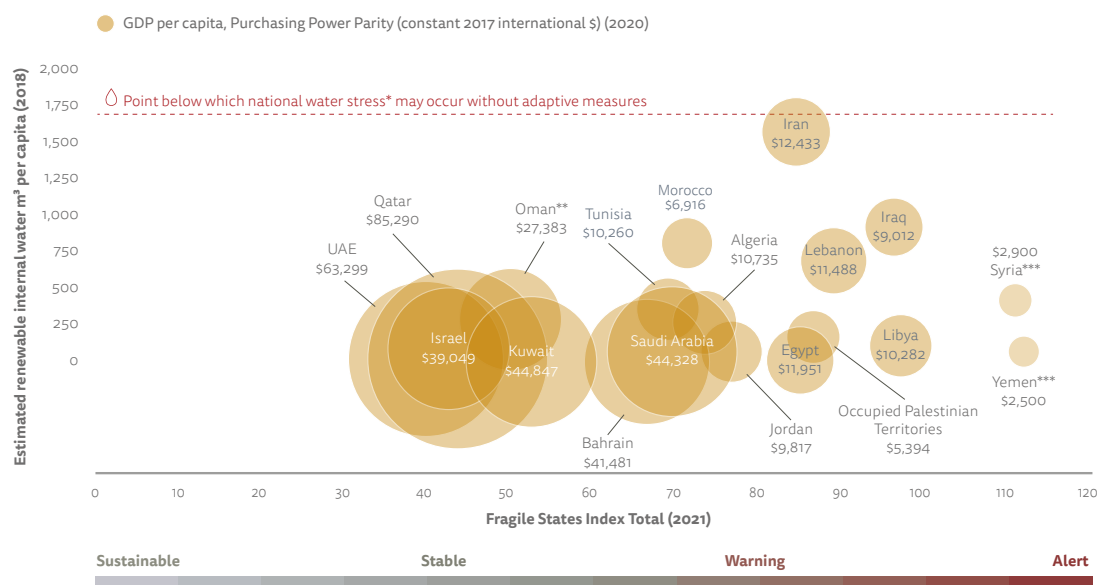
Adaptive capacity: the ability of a system to adjust to climate change categorized as: knowledge and awareness, institutional capacities, infrastructure, economic (including food imports) and technological resources and equity.

The vulnerability assessment takes into account 'potential impact', which results from levels of exposure and sensitivity factors, and 'adaptive capacity'. Therefore, if the potential impact is high but adaptive capacity is high then vulnerability could be low to medium, whereas a lower potential impact could result in higher vulnerability if adaptive capacity was low.

Sensitivity to climate risk (and other trends and shocks) are not evenly distributed across the MENA region. Countries that depend largely on rainfed agriculture will be more sensitive to drought in terms of productivity. Some phenomena will be strongly felt where there is high density urban development in exposed geographic areas, for example, coastal Egypt, Gaza, Morocco and the Gulf coast.

However, the ability of MENA governments to cope with the additional challenges posed by climate change (**adaptive capacity**) also varies from one country to another. Access to finance, technology deployment and the efficacy and preparedness of local and national institutions will make a difference in terms of the humanitarian outcome, economic losses and the period of disruption. For example, in spite of being in the path of tropical storms, Oman currently exhibits less vulnerability to climate change than neighbouring Yemen, given the latter's state of conflict, fragmented governance and dilapidated infrastructure.

Figure 7. MENA country variation in renewable freshwater availability, socio-political stability and spending capacity



* This indicator is drawn from an estimate of human, agriculture, energy and industry needs developed in the 1990s. It is only a rough guide and does not take into account increasing technological efficiencies.

** Oman data is for 2019.

*** Data for Syria (2015) and Yemen (2017) are real GDP per capita estimates.

Sources: World Bank World Development Indicators, 2022; CIA World Factbook; Fund For Peace Fragile States Index 2021; FAO (2022). AQUASTAT Core Database. Food and Agriculture Organization of the United Nations.

The Fragile States Index (FSI) ranks 179 countries each year based on various pressures they face that impact their levels of fragility. Scores are apportioned for every country based on twelve key cohesion, economic, political and social cross-cutting indicators and over 100 sub-indicators.

To illustrate such differences, Figure 7 plots three measures: water scarcity, GDP per capita as a proxy for economic wealth, and state fragility. While all MENA countries feature inadequate renewable water resources which could make them vulnerable to increasing weather-related water stress and food insecurity, countries with more available wealth can compensate. To the left, we see that the oil exporters with small populations relative to export value and Israel stand out. These countries are able to access technology and deploy large scale infrastructure (such as desalination,

solar power and cooling) to mitigate climate impacts as well as to import food. At the opposite end are conflict-affected countries with much lower per-capita resources; these feature the least adaptive capacity in the region.

This chart only provides a snapshot. Current spending power and political stability alone miss two important points about adaptive capacity. First, sensitivities around consumption and living standards. For example, while farmers in the Nile Delta and Jordan Valley might be poorer, with less technology, they also require less to maintain current standards of living and have traditional knowledge and experience of adapting to change. In the GCC countries and Israel, there are high expectations about standards of living and citizenship benefits. Falls in standards of living due to climate change may more quickly evoke public outrage.

Second is the influence of and relations with neighbouring states and external actors, especially in cross-border management of resources. For example, Israel is better equipped to cope with climate changes than some of the richer Gulf countries because of its organizational ability and its exceptionally inventive private sector. Its status as a climate resilient country is, however, complicated by the fact that its government occupies Palestinian and Syrian territories, which are much less able to cope given occupation restrictions (see Box 12). This will inevitably draw resources into militarization rather than sustainability and increase risks to shared resources such as water contamination.

When considering the 30-year time horizon of this report, there are many local and international conditions that will evolve and change, including demography, trade and forms of governance, which will all affect abilities to cope and adapt. Table 2 outlines six non-climate factors that include several variables that emerged strongly in the literature and expert consultations. These will interact with climate impacts, and are likely to influence vulnerability to climate change and its socio-economic and political effects.

Table 2. Summary of regional vulnerability/resilience factors and variables

Factor	Variables
Political stability	<p>Regional: level of conflict, constructive/unconstructive level of cooperation or conflict in regional politics, state of conflict in countries, infrastructure damage</p> <p>Subregional: differences in subregional levels of peaceful cooperation/coexistence/tension, e.g. transboundary river relations</p> <p>International: interest and engagement from major powers</p>
Governance: political will and efficacy of institutions	<p>Regional: Political will, rule of law/human rights, institutional efficacy including governmental competence, public perceptions of legitimacy and trust in state institutions, level of corruption and enablement, land management, water management</p> <p>Subregional: differences in subregional efficacy and governance coordination, e.g. sustainable shared water management plans</p> <p>International: aid, assistance and capacity building</p>

Factor	Variables
Governance: local empowerment	Level of decentralization of power (e.g. to municipalities), funding, quality of education and critical thinking, public awareness of climate change and environment; civil society competence International: engagement and capacity building at the local level
Economic structure and well-being	Regional: economic health including income equality, ecological well-being, infrastructure, dependence on agriculture, dependence on high-carbon commodities, available market instruments, balance of trade, aid flows International: food prices, oil and gas prices, terms of trade, aid
Access to finance and technology	Regional: readiness for and access to credit and funds (including climate finance), technology transfer and innovation, energy, water and food pricing/subsidies, room for the private sector International: availability of international finance including climate finance, foreign direct investment, engagement on technology transfer
Demography	Regional: population increase, age structure, mass displacement including rural-to-urban migration and cross-border migration

4.1 Political stability

The level of regional and national stability was flagged by most experts interviewed as the most important determinant of political will to address resilience and adaptation. The immediacy of civil or cross-border conflict – even if this does not erupt into military conflict – will mean that the attention of governments is diverted from planning for longer-term challenges such as climate change. In a state of insecurity, public interest will be focused on putting food on the table and keeping one's family safe. As one regional expert put it: 'If you're worried about your home being bombed, you don't worry about climate change'. Investments in adaptive projects and practices will be deferred. In addition, instability deters the necessary investment and finance (which was identified as another major vulnerability factor).

Moreover, instability or poor relations among states in the region may continue to hamper transboundary cooperation in confronting climate change. The cases of the Jordan Valley, Iraq and Nile basin described in section 5 all illustrate this. Another example is Iran and the GCC states, which share the waters of the Arabian/Persian Gulf, Strait of Hormuz and Gulf of Oman. Mutual cooperation between these countries will be essential in managing salinity and restoring ecosystems, yet relations are troubled and highly securitized so cooperation of this kind is not on the agenda.

Major power engagement

The actions of major powers continue to play a significant role in the region, which can either support or harm peaceful relations and cooperation. The US, EU and various European states, Iran, the Gulf states, Turkey, Russia and China are variously engaged in development activities; trade, including arms sales; diplomacy; and military and humanitarian operations in the region. Historically, the vying of different powers for control of certain regions has not proven conducive to peace in the region (for example, in Syria and Libya), and neither has overwhelming backing for one side (e.g. Israel–Palestine) or intervention to change a regime (e.g. in Iraq). The involvement of major powers in diplomatic initiatives has at times appeared

to ease tensions (e.g. the Oslo Accords) and at others increase it (for example, the US government's attempts in 2020 to broker a deal around the Grand Ethiopian Renaissance Dam (Chothia, 2020)).

More concerted, thoughtful diplomacy is essential to reduce conflict and to address shared environmental issues. The region depends on trade, investment, loans, aid and security interest from the international community. Changes in the level of international attention – e.g. to security rents that maintain Jordan and Israel – will also change the balance of power in the region.

Occupation and militarization

The restrictions imposed when space is controlled by armed actors can have far-reaching consequences for a state's ability to cope with climate change. They can inhibit adaptive migration as well as food growing and selling strategies, for example, worsening humanitarian conditions. The militarization of space is evident at national borders, but also in many internal parts of the region, particularly in Syria, Iraq, the Occupied Palestinian Territories, Yemen and Libya. For example, combined with restrictions on freedoms (e.g. to transport farm goods to market, to build water storage facilities or to have a say in water distribution plans that affect their access), the conditions of Israeli occupation in the West Bank inhibit Palestinian citizens' capacity to cope or adapt.



The restrictions imposed when space is controlled by armed actors can have far-reaching consequences for a state's ability to cope with climate change

Militarization of land, military checkpoints and confiscation all inhibit sustainable land management (as explained in Box 12). Mason and Mimi (2014) report that 'climate stresses are perceived by farmers to be less important than (post) occupational conditions in determining water availability. Israeli state practices are seen as harmful to farming livelihoods, e.g. prohibition and demolition of water infrastructure, land confiscation and/or restrictions, exclusive incentives to Israeli settlers, barriers to markets'. This is particularly true of 'Area C', the part of the West Bank under full Israeli control. In Gaza, delays in approvals and the restrictions on imports of goods present a severe barrier to adaptation, as have been shown by various attempts to build water treatment and power facilities (Barhoum, 2021).

War damage and reconstruction

Urban areas and essential infrastructure across Syria, Iraq, Yemen, Libya and Gaza have suffered large-scale damage and destruction due to multiple recent and ongoing conflicts (see Box 4). These countries also face severe levels of water stress and environmental degradation overlaid by climate change. Inadequate housing coupled with extreme temperatures and lack of access to power are already exacerbating inequalities across the region. In the coming years and decades, resilience to climate change and climate-related events will depend largely on the efficacy of reconstruction and regeneration of infrastructure and urban areas.

The danger is that reconstruction is pursued in an ad hoc manner without consideration of future safety and local needs, locking in consumptive practices (namely energy and water demand) and unsustainable land use. Reconstruction is already taking place and is likely to do so largely in a vacuum of environmental regulation, reducing countries' long-term prospects for the inclusion of returnees, social stability and economic recovery.

One climate-related environmental risk involves inadequate treatment of toxic conflict waste, contained within rubble and soil. This could be transported through the air via dust storms (which are likely to increase in frequency and intensity), potentially across borders.

Box 4. Damage vulnerability

Urban devastation has been recorded in areas of aerial bombardment and/or ground-level fighting in Iraq, Yemen, Libya and Gaza over the last decade. Each country is suffering an acute shelter crisis, deteriorating municipal and public services including waste and sanitation, and dangerous levels of water and energy insecurity. Infrastructure that enables clean water and sanitation, including water treatment plants, pumping stations, water towers and sewage treatment plants, often become targets in the fighting, in breach of international humanitarian law (ICRC, 2015).

In Yemen and Syria, conflict, including foreign air attacks, have dramatically reduced clean water access and proper forms of waste disposal in urban and rural areas and led to various outbreaks of hepatitis A, typhoid, leishmaniasis, and cholera (Al-Zarier et al., 2017, Zwijnenberg et al., 2021). Israel's 2021 attacks on Gaza increased food insecurity in the country with direct destruction of or damage to crops, animal sheds, greenhouses, citrus orchards and storage facilities as well as damage to irrigation channels and pumping equipment (World Bank Group, 2021). Gaza already suffers from toxic metal pollution in soil caused by previous bombing (Al-Najar et al., 2015).

Such conditions increase physical vulnerabilities (e.g. to water scarcity and temperature rise) and decrease basic resilience to societal impacts – e.g. through reducing access to health centres, municipal administration and services (Talhami and Zeitoun, 2015). The barriers to trade and actions of warring parties tend to create 'conflict economies' in which prices are inflated and safety and environmental regulations ignored. One current example of this is the destruction of oil refining facilities in northeastern Syria and the subsequent practice of 'artisanal refining'. This is polluting soil and water, further reducing the options for future food and rural livelihood security as land and water come under pressure from climate change (Zwijnenberg and Postma, 2017).

As Talhami and Zeitoun (2015) have shown with reference to several Middle Eastern countries, patching up infrastructure rather than more resilient recovery options after conflict damage can lead to more humanitarian suffering in time. This will be compounded by additional climate stresses.

Displacement

Internal displacement and refugee flows resulting from armed conflict and insecurity have caused sudden and unexpected increases in population in some provinces and countries. In Syria, Iraq, Yemen and Libya, conflict has brought about the internal displacement of people to areas poorly equipped to provide for them. Lebanon,

Jordan and the Kurdistan region of Iraq host large numbers of refugees. Even with immense international assistance efforts, this has put pressure on services, housing and natural resources.

4.2 Governance: effective and inclusive institutions

In surveys carried out during the experts' workshop, governance (including the political will to address climate change), institutional effectiveness, human rights and space for civil society were identified as the key factors addressing vulnerability to climate impacts and the priority for building resilience and adaptation.

Climate strategies

There is great variation in how climate change features in policy and planning across the region. Climate resilience and adaptation strategies are at an early stage. In Tunisia, climate change is part of the country's new constitution (Knaepen, 2021) while Oman and the UAE perhaps have the most advanced national climate change strategies (Luomi, 2020).

All countries in the region except Libya have NDCs or INDCs. However, this is not necessarily an indication of having an effective climate strategy in place. The State of Palestine, for example, has a National Adaptation Plan (Smithers et al., 2016) but lacks the capacity to implement it. The inclusion of Sustainable Development Goal (SDG) planning and reporting is more advanced in some countries and at regional levels and may also usefully provide the basis for tackling several elements of climate resilience. A resilience approach that recognizes and responds to an evolving environmental situation is needed to meet all SDGs. Plans for nature-based solutions at scale are beginning to emerge. Many of these will have the opportunity to build on and expand existing conservation and water security initiatives (see also section 6).

Disaster risk reduction (DRR) is at various stages of policy development in MENA countries. In general, responses have been reactive and capacity to plan for and implement risk management for climate-related disasters is low (ESCWA, 2017). However, this is changing. For example, the United Nations Development Programme (UNDP) helped Iraq to develop its National Disaster Risk Management Strategy and established the Joint Coordination and Monitoring Center. Iran has a National Disaster Management Organization and, as of 2019, was working with the United Nations on developing its first comprehensive national disaster risk reduction strategy. Tunisia has developed a national framework for disaster risk management with a comprehensive approach to DRR. In Jordan, DRR and climate change adaptation are incorporated into the country's development planning.

One study of Iraq's capacity for DRR points out that, in spite of the strategy, poor governance, the lack of a specific or sustained budget for a resilience programme and poor coordination between government agencies continue to stymie effectiveness (Al-Shamsi, 2019). These weaknesses are likely to resonate in several other countries. Oman is perhaps most advanced, having dedicated significant effort to disaster planning after Cyclone Gonu in 2007. Since 2010, Omani authorities have worked with UNESCO to develop a multi-hazard early warning system (launched in 2015) and weather radar has been developed for cyclone and flood warnings, allowing for evacuation of high-risk regions.

Institutional effectiveness

There are striking differences in terms of governmental competence – a crucial factor in determining resilience in the face of climate change. At the lower end are national governments that have little capacity to run their countries effectively (or even to provide security across the entirety of the national territory), even on a day-to-day basis (those countries to the right on Figure 7), let alone plan ahead. Recent evidence shows governmental competence declining rapidly in a state of conflict (as with Syria and Libya for example) or as a result of stasis between political rivals producing a power vacuum, as it has in Lebanon. Some middle- to higher-income countries, including Jordan, Tunisia and Oman, have relatively effective centralized bureaucracies but weaker local-level governance. Weak enablement at the local level (e.g. provincial and municipal governments) was an issue frequently cited by regional experts as a vulnerability across the region.



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Most technical ministries (such as water and agriculture) have experienced, well qualified professionals but there is often a lack of joined up government, with environment ministries allocated little power in MENA political systems. Countries that have experienced conflict in recent years (Iraq, Syria, Libya and Yemen) have lost experienced professionals, who have emigrated in search of a more secure life. Here, the United Nations, the International Committee of the Red Cross and a variety of humanitarian and development actors may play a supportive role in essential service provision but cannot orchestrate long-term strategies. These factors make it more difficult for MENA governments to protect their water and agricultural sectors from the impact of climate change. Notable successes have been achieved through long-term investment in skills and empowerment in key agencies. Good examples include the role of independent electricity and water regulators in the GCC in fostering price reform and efficiency, the cooperation of the Saudi Energy Efficiency Centre and the Zakat, Tax and Customs Authority in introducing efficiency standards, and the process of coordination between domestic and international bodies that has gone into DRR planning and preparedness in Oman.

In North Africa, some democratic reforms have taken place in Tunisia and Morocco, but reform processes have been either stagnant or reversed in more recent years. Despite efforts to bring more decentralization and empowerment of local and municipal authorities, government structures remain heavily centralized, with frequent protests erupting over the management and allocation of natural resources, notably water (Desmidt, 2021). This stands in contrast with considerable investments in renewable energy, notably solar power and green hydrogen, in Morocco. The country is a frontrunner in Africa, exporting knowledge and experts to other regions. While these plans have been lauded, it has also raised questions about the focus on exporting green energy, rather than producing energy for domestic consumption, and the technical and financial feasibility of these plans.

Land management

Poor land and water management practices add to the challenges of maintaining agricultural sectors in the context of climate change. The failure to correct these practices is often the result of governmental neglect of the agricultural sector in favour of sectors that produce higher economic returns and earn more foreign exchange. As Waha et al. (2017) note: 'Land management practices are often inefficient and many policies favour urban populations and the supply of cheap food instead of supporting rural development ...' This trend, together with drought and rising fuel prices, is likely to have prompted the urban-to-rural migration in Syria prior to the 2011 conflict (Khashan, 2016).



Another major problem for adapting to climate change is land control and land acquisition. Elite land grabbing, corruption and lack of by-law enforcement are self-reinforcing

Another major problem for adapting to climate change is land control and land acquisition. Elite land grabbing, corruption and lack of by-law enforcement are self-reinforcing. Corrupt practices and weaknesses in regulation are common features of MENA countries (World Bank Group, 2014, p. 120). Both factors seriously undermine a country's capacity to deal with climate change (and other challenges, for that matter). Corruption may lead to some rational measures being blocked by vested interests in or with connections to government; corrupt politicians and officials may siphon off international funding. At the large-scale project end, this risks inadequate and poorly maintained infrastructure (for example, the non-functioning water treatment plants in southern Iraq), while at the local level, it could mean that building regulations are not met, increasing health and flooding risks, as was the case in Jeddah in 2009.

Water management

How water is managed is acknowledged across the region as the priority for adaptation. Water facilities and management are far from ideal in many places, increasing the levels of vulnerability to water shortages and contamination. According to RICCAR: 'The Arab region has long been subject to deteriorating water infrastructure due to deferred maintenance and the inability to dedicate financial resources for new investments' (ESCWA et al., 2017). Non or low pricing of water is a critical issue inhibiting the necessary investment. In many cases this has enabled large businesses or favoured groups to monopolize sources with little incentive for efficiency. For example, in Jordan around half of all water consumed is estimated not to generate any revenue for the water authorities, due mainly to leakages and illegal wells (Qtaishat, 2020). One study suggests that '[o]verlooking unlicensed wells in the agricultural sector seems to be an attempt to protect the shadow actors', including large agribusinessmen (Hussein, 2018). In other cases, there may have been substantial investment in prestige projects with questionable utility for the citizens of the country concerned. Egypt's large commercial agricultural developments are a striking example, where colonial era agricultural structures set up to exploit cash crops have consumed large volumes of water and technological resourcing, while delivering increasingly diminishing returns to people and the state (Mitchell, 2002; Masr, 2020).

Control of the sources of river water is to a large extent out of the hands of Middle Eastern countries. Egypt is the most extreme example of this, with more than 95 per cent of its water coming from countries upstream on the Nile. But Egypt is not alone. Syria, Iraq, Israel and Jordan are in a similar position, being vulnerable to developments in upstream countries with which they share water resources. For example, Jordan will suffer reduced flows in the Yarmouk River if Syrian agriculture recovers to pre-conflict levels. One study estimates that the effect of that development would be twice as great as reduced precipitation as a result of climate change (Rajsekhar and Gorelick, 2017).

Lack of coordinated basin-wide management plans (there are none in the region to date) will lead to poorer outcomes in terms of MENA countries' security of water supplies than might otherwise be the case. Such outcomes have already been observed with respect to the Euphrates–Tigris and Nile basins (Mueller et al., 2021). The waters of the Euphrates and Tigris rivers, on which the food-growing regions of Syria and Iraq depend, have depleted and degraded over the last 50 years owing to a combination of hydroelectric infrastructure, diversion for urban use, flood irrigation and chemical practices in agriculture (Shamout and Lahn, 2015). Although there is little evidence that overall water levels in the Nile basin have reduced in recent years, climate change is causing more variation in the Nile's flow, which increases the risk of flooding and extended droughts (Wheeler et al., 2018).

Groundwater is still available to MENA countries but is rapidly depleting and poorly regulated. In most cases there is little effective effort to manage it as use is defined by land ownership and ability to afford and use pumps. In Yemen, for example, the water table is declining in places by as much as 7 metres annually due to groundwater over-abstraction (Mohamed, 2017). In Gaza, the water supply is contaminated by sewage with 80 per cent exceeding the maximum salinity standard of the World Health Organization (Bromberg et al., 2018). In Algeria, the discovery and production of shale gas, seen as a way to respond to growing domestic demand and retain export markets, has raised serious environmental concerns over the destruction of fragile desert aquifers and water demands in southern parts of the country (Desmidt, 2021).

Given that 22 aquifers across the region (ESCWA and Federal Institute for Geosciences and Natural Resources, 2013) are shared between one or more states, lack of cooperation presents a further obstacle to sustainable management. An ESCWA study shows there are relatively few working shared aquifer agreements in the region. Some have successfully begun the first steps in cooperation (see Box 5).

Box 5. Shared aquifer agreements

Agreements on shared aquifers include the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer System (NSAS) between Chad, Egypt, Libya and Sudan; a steering committee of representatives from Algeria, Libya and Tunisia guiding an observatory for the North-Western Sahara Aquifer System (NWSAS), and the agreement between Jordan and Saudi Arabia over the Al-Saq/Al-Disi aquifer.

For the time being, these remain largely communication mechanisms. The NSAS agreement would come closest to full cooperation were it operational (ESCWA, 2018). A Global Environment Facility-funded, UN-implemented project has helped the joint authority to form a Strategic Action Plan, the long-term goal of which is 'to achieve an "equitable and reasonable" management of the aquifer, for socio-economic development and for the protection of biodiversity and of natural resources' (Quadri, 2017). This provides the groundwork for workable management once there is a stable government in Libya.

The Observatoire du Sahara et du Sahel (OSS) which covers NWSAS, carries out technical and scientific studies related to the management of the shared waters and is a data repository shared between the three states. It also assumes a wider remit concerning implementation of international biodiversity and climate agreements in the region.

After years of low-level tension between Saudi Arabia and Jordan over the Al-Saq/Al-Disi aquifer, in 2014 Jordan began pumping water from it 350 kilometres to the capital city, Amman). The two governments then signed an agreement in 2015 and later set up a Joint Technical Committee. This set out regulations for limited drilling and defined a protected area.

With the notable exceptions of the as yet unrealized Nile Basin Initiative and the NSAS Strategic Action Programme, existing transboundary water agreements tend to focus on allocations of quotas between riparians rather than effective, sustainable cross-border water management. For example, while the Al-Saq/Al-Disi agreement does have an emphasis on quality, it is based on shared use. The aquifer became part of a 'pumping race' that had begun in the 1980s (Ferragina and Greco, 2008). The agreement provides for high-quality fossil water for municipal and limited irrigation use. However, as the source is non-renewable, some Jordanian experts argue that this water should instead be treated as a 'strategic reserve' with recourse to other sources for irrigation (Salameh et al., 2014; Jasem et al., 2011).

For the most part, transboundary cooperation over water can be understood in the context of broader security and economic relations between states (Hussein, 2019). The Nile Basin Initiative, for example, has remained hamstrung by the reluctance of politicians to cede control to regional scientists and engineers who could create the joint understanding of the basin that is needed to generate cooperative action in the future. Progress on cooperation has tended to happen when leaders recognize mutual security interests, as they have done sporadically and bilaterally among countries sharing the Euphrates (Shamout and Lahn, 2015), even during periods of 'imperfect peace' (Mueller et al., 2021).

4.3 Governance: non-state and local empowerment

In interviews, regional experts repeatedly drew attention to three sub-state-level factors that will be critical in addressing climate change effectively in future:

1. the capability for decentralized decision-making and implementation by local authorities;
2. public awareness, capability and knowledge of climate and environmental issues and space for civil society organizations (CSOs) to operate effectively; and
3. private sector innovation and ability to deliver green and resilient solutions through the market.

Although conditions vary, these areas were considered as requiring improvement in the majority of MENA countries. Behind these issues lie deep and historical political economy structures, and attendant weaknesses in the rule of law, particularly in protecting human rights. Several experts also drew attention to cultural, colonial, and educational legacies that have stymied creativity and critical thinking in the region.

Local governance

Local authorities are generally not empowered in the region, relying on centrally allocated budgets only, and with little devolution of power, for example over public buildings, infrastructure or basic services. Access to finance and resources to enable long-term municipal planning and investment, for example, could enable much more effective and less expensive approaches for urban resilience. The work of the Greater Amman Municipality in developing a climate action plan for Amman (Jordanian Ministry of Environment and Greater Amman Municipality, 2019), with support from international financiers, is exemplary. As the Municipality has an unusual level of independence and the capability to take on financial risk, it can engage directly with international partners and was also able to join knowledge-sharing networks such as the 100 Resilient Cities and the C40 Cities. United Cities Lebanon/Bureau Technique des Villes Libanaises manages a network of local authorities helping them to access funding and strengthen capacity, including in environmental management and renewable energy. Another example is the past work of regional environmental peacebuilding organization Ecopeace with mayors of towns sharing the Jordan River on reducing river pollution and treating sewage (Djernaes et al., 2015). Such cooperation on shared natural resources suggests greater possibility for aligned cross-border remedial and adaptive action at the local level.

Civil society

Civil society is essential for preparedness and resilience. CSOs and community groupings can act in a way that is much more nimble and close to the ground than the government to educate, raise awareness, create networks of assistance and help with disaster response. The nature, capacity and level of enablement of CSOs vary widely across the MENA region. Communities throughout the Middle East have mobilized to achieve improved outcomes in education, health and numerous other areas, despite prevailing conditions of poverty and marginalization (Brixi et al., 2015). Following various disasters, including the Jeddah floods, citizens have self-organized to provide assistance for affected people.



Groups focused on conservation and heritage have often been on the front line in securing environmental services in MENA countries.

Groups focused on conservation and heritage have often been on the front line in securing environmental services in MENA countries, often linked to SDG objectives. For example, in Egypt, the Hurghada Environmental Protection and Conservation Association, which focuses on conservation in the tourism-dependent Red Sea governorate, made notable progress in improving waste management policies and preserving coral reefs. It was able to do this through formal relationships with the local authorities 'and has benefited from embedding itself as a localized effort supporting an economic lynchpin in the area' (Halawa, 2020). Nature Iraq, which played a role in restoring the Iraqi marshes, helps to raise the voices of local people relying on the marshes in view of their livelihood and local economy concerns. In the UAE, the Emirates Wildlife Society – now Emirates Nature – has worked in association with the global WWF to research and embed new approaches to environmental

conservation, climate and energy sustainability, from large-scale awareness-raising campaigns to work with local authorities to restore traditional ‘aflaj’ irrigation systems. In several countries, predominantly business-focused associations such as country chapters of the Green Building Council and EDAMA (the sustainability business association in Jordan) have been able to advance progressive regulation and standards regarding buildings and energy.

The majority of the population of the MENA region live in jurisdictions where CSOs are either heavily circumscribed by restrictions or essentially illegal, rather than being allowed to play an active role in organizing people, investigating potential abuses of power and making recommendations to the government (CIVICUS Monitor, 2019).

To help understand the current landscape for civic action on climate change and climate justice, the International Centre for Not-for-profit Law has mapped regulations in five countries in the region (International Centre for Not-for-profit Law, 2021). This shows that groups focused on environmental protection, which were few in the region a decade ago, are a growing force. While generally tolerated, these too can risk overstepping invisible and often moving lines, which has happened in Egypt, Turkey and Iran in recent years. For example, the Iranian government has imprisoned environmental activists under charges of spying (Iran International, 2020). Those who speak out against environmental crimes are often also calling attention to high-level corruption or irresponsible government decisions, which may be considered a threat to regimes.

Local civil society could help in gaining international attention and support for the region’s climate and environmental issues. Yet at present it is poorly represented. It has been difficult to mobilize MENA CSOs (as well as those from several other regions) for the UN Environment Assembly (UNEA), for example. To facilitate access, a proposal from the UN Environment Programme (UNEP) suggested altering the accreditation rule requiring two years of operations for an NGO/CSO. Many governments in the MENA region (and others globally) objected, instead requesting to specify five years of operations, stating the need to make sure organizations were genuinely active. ‘The real reason was to make sure they are not against the governments, even though these are environmental, not human rights organizations,’ said one regional expert. In the end, the existing rule was maintained but the episode illustrates the suspicion with which governments in the region view CSOs, unless they are backed by a royal family or government authority.

Private sector responses to sustainability

With the exception of Israel, the market in MENA countries remains dominated by the state and/or business elites with political connections. A state-led economy can bring a number of benefits with respect to climate resilience that might involve large-scale infrastructure, planned agriculture and national companies with technical expertise that can be deployed in a crisis. However, in practice, this model – coupled with and encouraged by subsidized, untaxed inputs such as energy and water – has tended to crowd out entrepreneurship and encourage inefficiency, as exemplified by Kuwait and Algeria. Lebanon, meanwhile, demonstrates the way that an ostensibly privatized business space can be dominated by politically-connected cartels. This system can inhibit reconstruction and basic services in a way that strongly impedes resilience (Boswall and Wood, 2020).

Market instruments to encourage private sector responses to climate risks are still lacking in the region. A number of instruments, including the use of green bonds, green catalyst funds and de-risking mechanisms, can be deployed to encourage the private sector to invest in areas such as green construction, climate-smart food production, weatherization and water conservation. Some of these instruments, including from the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD), have helped grow private sector activity in renewable energy in, for example, Morocco, Egypt and Jordan. The issuance of green debt (sukuk and traditional bonds) in the region has risen rapidly since 2015, while still representing a small fraction of the global total (Clean Energy Business Council, 2021). These can provide opportunities for economic diversification; however, it is unclear to what extent all projects financed in this way will have a net positive environmental gain. To optimize their effectiveness, it is important that domestic fiscal and legal improvements provide long-term reassurance for markets and that projects and financiers deliver on transparency.

Different sizes and types of business (e.g. large corporations, small and medium-sized enterprises (SMEs), start-ups, social enterprises, micro, home-based and informal) need different approaches and strategies. In many countries in the region, lack of support,



Only 8 per cent of bank lending in the MENA is available to SMEs. And, in spite of recent insolvency law reforms, fear of bankruptcy and indebtedness leading to imprisonment creates a disincentive for start-ups and small business expansion

information and market regulation in favour of large companies is prohibitive for smaller businesses. Only 8 per cent of bank lending in the MENA is available to SMEs (Ahamed, 2021). And, in spite of recent insolvency law reforms, fear of bankruptcy and indebtedness leading to imprisonment creates a disincentive for start-ups and small business expansion (Kilborn, 2020). These are often the businesses that can be best placed to nimbly respond to local resilience challenges.

Experiences of and potential for private sector actors in adaptive solutions vary across the region and must be understood within the context of the political economy of the country in question. In Morocco, for example, the financial interest of elites has also created a strong incentive for renewable energy development and, once regulation was in place, it opened up space for a growing number of local companies. This contrasts with Tunisia, where the regulatory environment for renewables is weak. Although lots of technical support is being given (including from the German development agency GIZ), there are few incentives to expand the sector for the moment. The UAE has encouraged companies to compete on sustainability measures through increasing the introduction of standards and regulations for buildings' sustainability, for example, and there are a few large conglomerates seeking to excel in this area. In Lebanon, a number

of social enterprises and small businesses dealing with composting and recycling have sprung up in response to the state's failure to deal with a waste crisis in recent years (Aoun and Abou Moussa, 2019).

4.4 Economic structure and well-being

Poverty levels

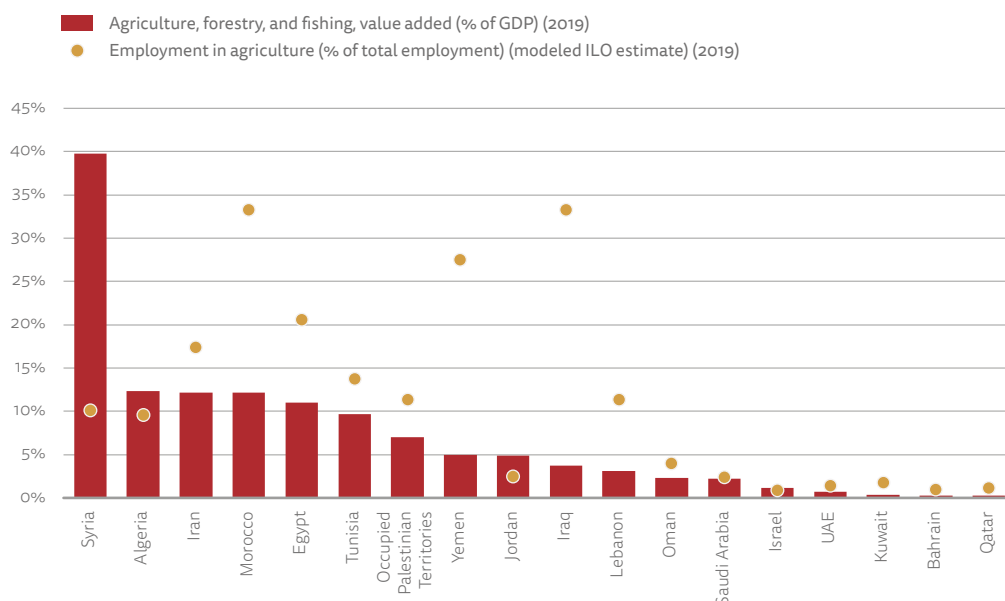
Within each country, the poorer sectors of society will be least able to cope with climate impacts (Waha et al., 2017). Among the problems facing them are the following: food prices may go up; poorer farming families may not be able to afford to drill deep wells to access groundwater; the areas in which they live may be more at risk of flooding than those in which the better-off live. There are already very low levels of investment in rural areas across the MENA region and governments may not be as interested in helping them following extreme weather events as they are in helping better-connected sectors of the population (World Bank, 2020b). Where governments are unable to help or are dilatory in doing so, poorer people will not have the resources to help themselves.

In wealthier MENA countries, where energy is cheap and/or heavily subsidized, people will be able to use air-conditioning to cope with extreme temperatures. However, numerous groups including low-income households, migrant workers, internally displaced people and refugees lack access to temperature-regulated housing or air-conditioning.

Economic and social dependence on agriculture

A society's high dependence on agriculture need not necessarily indicate vulnerability but current agricultural practices in the MENA region highlight its exposure to drought and seasonal changes. However, less easy-to-measure values such as local food self-sufficiency and stable rural communities also play a critical role in food security and stemming internal migration. Well-managed agriculture will be increasingly important to the resilience of most MENA countries.

Dependence can be considered in terms of contribution to the economy and employment. According to the World Bank, agriculture, forests and fishing contribute 5.1 per cent to the region's GDP (excluding Syria and Libya), versus a global average of 4 per cent in 2018 (World Bank, 2020a). However, if the whole agricultural value chain is accounted for, then this percentage more than doubles (Valdés and Foster, 2010; World Bank Group, 2014, p. 117). Agriculture is more important in terms of jobs and rural incomes as it employs an average of 10.7 per cent of the total labour force in the region, although the share ranges from less than 1 per cent in Israel to more than 33 per cent in Morocco (according to figures modelled by the International Labour Organization).

Figure 8. Agriculture's role in the economy

Source: World Bank World Development Indicators, 2021.

Climate threats to agriculture will affect certain groups more immediately and severely than others. Agriculture is the sector with the highest rate of informality in the world. In the Arab world, 95.6 per cent of agricultural employment falls within the informal sector (International Labour Office, 2018). Many of the workers relied upon in Jordan, Lebanon and the Gulf countries are expatriates, including refugees. Agricultural work is a vital contribution to refugee income in the region, and to family remittances in Egypt and Yemen (Tsukamoto, Leighton and Staermose, 2020). In the Middle East, a significant number of agricultural smallholders and labourers are women (Abdelali-Martini and Dey de Pryck, 2015). Box 6 shows the vulnerability of these groups in the olive sector to climate change, given the current business model and gender conditions.

Box 6. Worsening inequalities in the Tunisian olive sector

Olive oil is Tunisia's key export commodity. Nearly a million Tunisians derive at least part of their income from olive growing. The olive sector is essentially in the hands of big companies that, aided by the state, worked towards higher production levels via mechanization and intensive growth. The current business model does not provide good access to financial capital, including loans and credits to smallholder producers or encourage environmental replenishment.

Small-scale farmers and women are particularly vulnerable. The mechanization of large corporate farms has come at the cost of smallholders' dispossession and debt. While many olive farmers with small and medium-sized plots used to have various sources of income, most of them now only harvest olives. Ninety per cent of harvest workers are women, working as seasonal agricultural labourers. According to research by Gender Concerns International: '40 per cent of women in rural areas are not well integrated into the economic and political life; they are illiterate and have no access to free healthcare' (Gender Concerns International, no date). They carry out the same workload as their male counterparts yet earn a daily salary that is typically less.

Mass production for export is draining the land, exhausting the soil of nutrients and reducing its fertility and water availability. In recent years, a new Spanish olive tree variety has been introduced in certain areas in Tunisia. While these trees produce greater yields, they require increasing amounts of irrigated groundwater, which will put extreme pressure on already over-pumped aquifers. Due to reduced water availability and increased droughts, yields from olive trees will further diminish in the near future.

The climate risks of the olive sector in Tunisia could further reduce production, especially in monoculture systems that are draining the soil. In the long run, reduced olive yields can cause supply losses and business disruptions for Europe. Moreover, social frustrations are rising due to inequality in the olive sector, where smallholders have limited opportunities (including due to the lack of access to credit and loans) in a sector that is in the hands of large-scale agribusiness. This could further trigger social unrest in rural Tunisia.

At the same time, there is fear that the Deep and Comprehensive Free Trade Area (DCFTA) with Tunisia, if eventually agreed, could further stimulate an export-oriented trade model, thereby undermining smallholder producers. Several factors that led to the 2011 Freedom and Dignity Revolution still prevail in Tunisian society. Without prospects, many young Tunisians are joining militant jihadist groups, which could form a direct threat to Europe. In addition, large groups of young Tunisians are migrating by boat to Europe, looking for better opportunities.

Source: Adapted from Knaepen, H. (2021).

Balance of trade and food imports

With the exception of the 2017–2021 blockade in Qatar, import dependence has not been a problem in the MENA region to date provided three conditions are in place: i) food producers are willing to export their products; ii) there are means of transportation and supply routes available to transport the food; and iii) a country has enough foreign exchange to pay for food imports (including in times of elevated prices) (Shapland, 2018). Countries with low volumes of water per capita and access to foreign ‘rents’, for example, from oil exports, security arrangements and humanitarian aid, have long pulled off this feat. However, there are several reasons that much greater economic diversification will be needed to sustain growing imports in the future (Pouran and Hakimian, 2019).

Countries with larger export revenues per capita (namely the GCC, Israel, Morocco and Tunisia), or those with steady streams of other forms of international rent (Jordan and Morocco) are better equipped to make investments to prepare for climate impacts. The region’s wealthier countries can afford to make investments that can help them cope with climate risks. Stockpiling food is one possible stratagem. Several countries keep high food stocks. For example, Qatar has developed its capacity to store food: its Strategic Food Security Facilities Project, a food storage and processing facility at Hamad Port, has the capacity to stockpile enough rice, sugar and edible oils for 3 million people (more than its current population) for two and a half years (Alagos, 2018). Such strategies can carry a heavy climate cost, as well as a financial one (Wellesley, 2019).

As freshwater sources dwindle, the Gulf countries have put restrictions on the growing of fodder for animals, such as alfalfa, choosing instead to import growing volumes from North Africa and South America. Following the 2007–08 food price crisis, various state investment instruments and commercial agribusinesses in the GCC countries have invested in agricultural land in North Africa, Pakistan and the Americas. The jury is out on how effective these investments will prove to be, and

they may increase risks for other water-stressed countries (see the example in Box 7). More recent agricultural investments have tended to be in food-trade value chains (Woertz, 2020) and in existing key trade partners in Europe and the Americas: for example, an Emirati company has invested heavily in Serbia and Saudi companies have invested in Poland, Ukraine and the US (Bailey and Willoughby, 2013; Cooke, 2016) while Qatar has invested massively in self-sufficiency (Wellesley, 2019).

Box 7. Unintended consequences of foreign land investments

MENA countries with substantial foreign reserves resulting from incomes from hydrocarbons exports, such as Saudi Arabia, the UAE and Qatar, have, since the global food price spike of 2007–08, sought to improve their food security by investing in agriculture abroad. GCC countries made significant investments in land-rich but famine-prone African countries – particularly Sudan (Abdelaziz, Saeed Atallah and Eltahir, 2021). These investments have often faced poor security and political controversy (Lons, 2021). The UAE's investment in the Toshka project in Egypt is one such example (Jägerskog and Kim, 2016). This began in 1997 as an initiative to reclaim 540,000 feddans (2,268 square kilometres) of the Western Desert and shift the population from the Nile Valley.

Despite ambitious targets, the Toshka project has not improved food security in Egypt. Neither has it brought many other benefits to the country, as the farms owned by foreign UAE investors require high amounts of energy while not delivering on the promise of generating many new jobs for Egyptian citizens. The two biggest Gulf companies invested in the project are now controlling almost half the 60,000 feddan (252 kilometres) of cultivated land, drawing water for irrigation from Lake Nasser at remarkably low prices. Despite the government's promises of wheat production, the area is mostly being used for export products (dates and grapes) and highly water-intensive animal feed crops like alfalfa (Masr, 2020).

Such strategies are generally beyond the reach of low- and middle-income countries with much lower capacity to prepare for and adapt to the direct and indirect effects of climate change (Borghesi & Ticci, 2019).

Looking to 2050, simulations suggest that dependence on agricultural imports is likely to continue to increase in the MENA region, especially in the event of stronger climate change (Tull, 2020). Current forms of agriculture and dietary patterns, as well as the lack of scope for expanding land use in the region, further support this trend. (Razzaz et al., 2017). Countries that do not have large quantities of foreign exchange at their disposal (especially those with large populations, such as Egypt) may struggle to feed their citizens if they are to meet other needs as well. Providing for twice the number of people without rationing or dietary substitution will mean using twice the amount of foreign exchange, even in years of plentiful supply on the global market. In years of supply-side shocks, such as poor harvests in grain-exporting countries, the forex bill will rise. So will the cost of any food subsidies. If climate change brings widespread crop failure in supplier countries, it may even prove difficult for the majority of people to provide an adequate diet for their families. MENA regimes may find themselves having to choose between spending a large chunk of their national budgets on subsidizing food or risking popular discontent by not doing so.

However, across the region, policy interventions encouraging dietary changes, different methods and types of food production, and a reduction in food waste could enable an increase in locally produced food (or at least stem its decline) while increasing nutritional intake and therefore robustness to disease (Bahn, EL Labban and Hwalla, 2019; Woertz, 2020).

Dependence on revenues from high-carbon industries

The transition to a decarbonized energy system globally will entail a contraction in the markets for fossil fuels. While the timing of this is uncertain, the International Energy Agency's 1.5°C scenario demonstrates the dramatic fall in coal, oil and gas demand needed to meet the goals of the Paris Agreement and avoid dangerous climate change. Even if the actual trajectory is more chaotic, the falling costs of alternative ways of meeting energy needs and declining economic capacities to purchase fossil fuels on the international market as a result of climate change impacts will constrain oil and gas markets.

This presents a challenge for countries of the MENA region whose economies are dependent on oil and gas exports, such as Algeria. Trajectories aligned with the Paris Agreement targets tend to consider oil prices over the next two decades averaging within the \$30–\$60/barrel range, although volatility is likely to be high with the average price declining. Many of the MENA countries, given rigid government budgets including subsidy, defense and civil services salary payments, rely on more than \$80/barrel oil to break even. Iran, Algeria, Bahrain and Saudi Arabia fall into this category (see Figure 9) with Algeria estimated to need over \$100/barrel and Iran almost \$200. Gas prices are usually forecast to stay more buoyant for longer, but begin to tail off with demand declines in the 2040s.

The chart below gives some idea of the vulnerability of countries to falls in hydrocarbons prices.

Figure 9. Oil and gas dependence in selected MENA exporter countries



All the countries on the chart are exposed (and Yemen and Syria perhaps more so but no data was available), but the larger bubbles give an indication of which countries have higher standards of living and capacity to invest. The further to the right the country, the more it relies on hydrocarbons exports for the foreign exchange needed to pay for food imports and other foreign goods. Three countries – Algeria, Libya and Iraq – appear the most exposed of all to falls in oil price, with almost total dependence on hydrocarbons for foreign exchange and relatively low GDP per capita.

The ability to sustain standards of living while diversifying during a period of declining hydrocarbons prices is diverse, even among the GCC countries. Sovereign wealth minus government debt indicates the wealth cushion on which a country can draw. Here, Kuwait, Qatar and UAE feature positive balances of over 100 per cent of their GDP. By the beginning of 2021, following the oil price fall related to COVID-19, Saudi Arabia, Oman and Bahrain were negative, suggesting the need for these countries to move faster on economic transition (Augustine, 2021).

There are several other important considerations regarding potential resilience. One is the capacity a country has to diversify its economy – which would include its human resources and skills potential, its land fertility, other natural resources, tourist attractions and national capacity for innovation. The less able a country is to diversify, the more vulnerable its economy will be to shifts in demand trends. For countries such as Algeria, low oil prices, difficulties in attracting investment partners, infrastructure gaps and technical problems have meant that investments in renewable energies are lagging behind considerably. Although it is not facing (potentially) high-level conflict such as Libya and Iraq, much-needed and anticipated political and economic reforms have stalled in recent years. This has hampered efforts to diversify Algeria's economy and energy markets, fuelling popular protests.

Most oil export-dependent countries have overarching national 'visions', to 2030, 2035 or 2040, that aim at economic diversification to reduce dependence on hydrocarbons and energy diversification domestically, in part to help free up export capacity. In 2020, the government of Iraq launched a White Paper for Economic Reform, which recognizes the urgency of moving away from dependence on fossil fuel revenue and broadening its tax revenues (Government of Iraq, 2020).

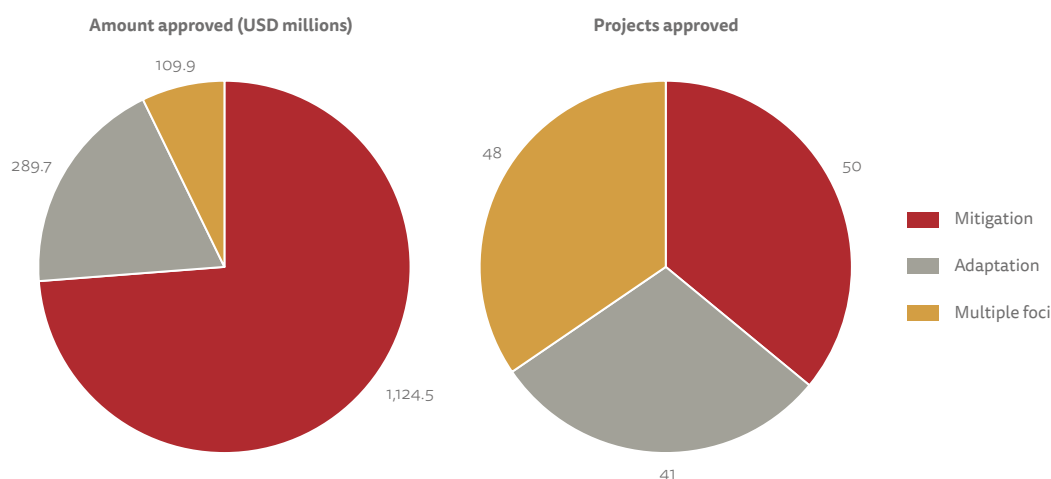
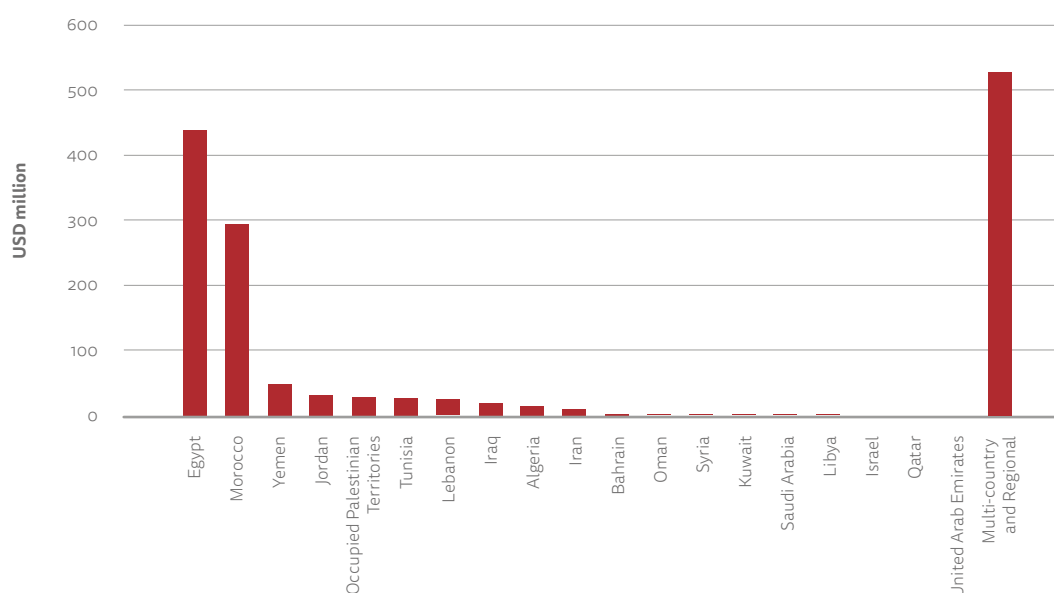
4.5 Access to finance and technology

Access to finance will be essential for resilience and adaptation, particularly in the lower- to middle-income countries in the MENA region. Each country will have different options given its particular context and relations with development finance and investors. Regional experts drew attention to specific needs for finance to enable the introduction of efficient and circular technology in the water and agricultural sectors, as well as for nature-based solutions and remediation of land and rivers. Water production through desalination, increased deployment of solar power, and hydroponic agriculture are examples of capacities that higher income countries are well placed to implement but where lower to middle income countries require support. Finance for weatherizing and protecting built infrastructure, as well as for climate resilient regeneration (including retrofitting and rehabilitation of infrastructure and reconstruction in conflict-affected areas) is urgently needed. Many of the necessary measures are not currently commercially profitable so will rely on a mix of public funds, national and international.

To attract and optimize the benefits of climate finance (as with other types of finance that could support resilience and adaptation investments), proposals will need to show the potential to scale, which will mean enabling national public and/or private capital to flow in. As Egypt, Jordan and Morocco have shown through their success in scaling up renewables, the regulatory environment is key to attracting finance and deploying technology. Developing project pipelines can show how initial finance will help to mobilize other forms of capital and lead to transformative results on the ground.

The challenges of access to climate finance in developing regions are well documented and some reports detail specific issues for the MENA region (ESCWA, 2019a; UNFCCC, 2021; UNEP Finance Initiative, 2021). These strongly relate to the governance issues noted in sections 4.1 and 4.2 but also the way international climate finance remains fixated on donor priorities, fragmented and still lacking a firm footing for measuring adaptation gains. To date, Egypt and Morocco have been the recipients of the largest share of climate finance to the region in the form of grants plus finance from the Clean Technology Fund. Energy and transport have received the majority of climate finance to date (ESCWA, 2019). Projects have been largely under the category of ‘mitigation’ – chiefly for renewable energy – but a small but increasing amount in the region is focusing on ‘adaptation’ and ‘multiple foci’ (Watson and Schalatek, 2021). For example, in 2020, Jordan and Lebanon attracted \$14 million through the Adaptation Fund ‘to increase the resilience of displaced persons and host communities to climate-change-related water challenges in urban host settlements’ (UNEP Finance Initiative, 2021).

Figure 10. Amount of climate finance approved for MENA recipient countries from the 12 climate funds active in the region (2003–2020)



Source: Climate Funds Update (n.d.).

The EU and European development banks are investing heavily in climate resilience strategies and various water–energy–food related infrastructure in the Jordan Valley area. For example, the European Investment Bank set up a framework loan of €260 million to support investments in Jordan’s water sector in 2020 (Elnimr, 2020). The EBRD invested €87 million in Jordan in 2019 and €73 million in 2020, 73 per cent of which was invested in sustainable infrastructure (EBRD, no date). Yet the success of such investments depends on political factors.

As Figure 10 shows, several countries in urgent need of support for mitigation and adaptation have received relatively little, and some, namely Syria and Iran where private finance flows are heavily constrained by international sanctions, are missing from this picture (although they have recently accessed Green Climate Fund funding through the UN Food and Agriculture Organization to build their capacity for attracting and deploying climate finance).

4.6 Demography and migration

Quite apart from any impact of climate change, countries in the region will be confronted by challenging levels of population growth. This means increasing pressure on national and municipal services, including water, energy and waste, and, on current food consumption trends, increased import demand. However, with almost half the people in the region aged under 25 years old, demographics also present tremendous potential for prosperity and innovation, compared with the ageing populations of Europe.

The population of the region as a whole is projected to increase by around 45 per cent by 2050 compared to 2020 (UNICEF, 2021). There are, however, wide variations in rates of growth among individual countries, with the highest rates projected to be in Egypt, Iraq, Israel and the Occupied Palestinian Territories (UN DESA, 2019). Egypt is the most populous country in the region and Iraq the third, so the absolute additional numbers would be high, too.

However, fertility rates have been gradually declining regionally as more women go through higher education, get jobs and delay having families (Roudi-Fahimi and Kent, 2008). This trend may speed up, meaning lower-than-expected rates of growth.

Large-scale migration is likely to continue within national borders, across borders in the region and from outside the region. As of 2019, the region had an estimated 12.4 million internally displaced people and 9.1 million refugees, chiefly from conflicts in Syria, Iraq, Yemen and Libya, as well as the historically unsettled matter of the Palestinian refugee population. The MENA region is also a transit route. As Desmidt (2021) points out, the sub-Saharan Africa to North Africa route is well established in spite of its many risks. With the effects of both climate change and conflict being felt most acutely in sub-Saharan Africa, it is likely that migration will continue in this direction (Barnes-Dacey and Dworkin, 2020; Idemudia and Boehnke, 2020). It is also possible that new routes will emerge as political dynamics shift, as described in section 5.

Whether migration increases or decreases, vulnerability depends on several factors, including the capacity for reception and integration in the receiving community, the level of existing social ties, the legal rights of migrants, and the state of their living conditions. One probable result of the projected decline in the agricultural sector in MENA countries (see section 2) is migration from the countryside to urban areas (Wodon et al., 2014). Regional experts strongly emphasized this trend during the

interviews and workshops. Observation of this sort of movement, already much in evidence over the last two decades in Egypt, Iraq and Syria, suggests that the majority of migrants from rural areas will establish themselves in marginal areas of towns and cities, which often lack adequate access to services (Waha et al., 2017).



Unplanned migration has tended to add to environmental stresses on receiving areas, while displaced people living in temporary shelters and without community support networks are among the most vulnerable to climate and weather extremes

Unplanned migration has tended to add to environmental stresses on receiving areas, while displaced people living in temporary shelters and without community support networks are among the most vulnerable to climate and weather extremes (Lahn and Grafham, 2015). This is due to the way in which migrants are received and the conditions in the receiving country. Informal settlements, as with internally displaced people's and refugee settlements, are often built in haste and lack infrastructure (or legal provision) for sewerage, waste, water treatment and energy. This is also the case with many ageing, degrading urban 'camps' and cities housing internally displaced peoples and refugees in the region, namely the Palestinian ones in Gaza, Jordan and southern Lebanon, for example. Restrictive policies and lack of access to housing, jobs markets and services play a critical role in these conditions. Coping mechanisms in the event of not being able to keep warm or cook food, for example, may involve burning waste or cutting trees. This may in turn increase hostility towards new groups from local inhabitants. Such issues present growing humanitarian and equitable development concerns.

5. The likely effects of climate impacts on human societies and systems in the MENA region

The intersection of climate impacts and the above-mentioned vulnerabilities, if unaddressed, will have consequences for human lives, livelihoods, economies and security.

The shape and severity of outcomes will depend on the context for response and resilience measures. This context, both regional and international, will evolve and change over the next few decades. Selected variables, identified in Table A1 in Appendix 1 as the most important in affecting the severity of climate impacts in the expert interviews, form the parameters for three simple, non-exhaustive scenarios: 'Stagnation', 'Fragmentation' and 'Cooperation'. These were tested at an intensive workshop in March 2021 and improved upon. Each scenario (set out in Figure 11 and summarized in Box 8) plots a different version of those parameters.



The shape and severity of outcomes will depend on the context for response and resilience measures. This context, both regional and international, will evolve and change over the next few decades

Given the pace of technological change and difficulty of predicting this, and the increasing influence that climate change will have on international and regional trends, **the scenarios are imagined as broad characterizations of trends from 2025 to 2035**. They are not dependent on the level of rising temperatures but are rather focused on political and economic factors. We can then imagine these evolving until 2050, combined with climate change impacts. It is also possible to imagine each scenario applying to a different subregion at the same time or one scenario leading to another. For example, seeing greater fragmentation in the Levant leading to increasingly securitized responses in the GCC.

The purpose of the scenario and cascades exercise was twofold:

- to help think through the way that climate impacts might play out in the MENA region under different conditions, and what the implications for Europe might be; and
- to understand priorities for resilience-building and adaptation and, in particular, the way that international partners like the EU might support it.

The five risk cascades consider what might happen in certain subregions under the 'Stagnation' scenario. A box under each one suggests how things might play out differently under the 'Fragmentation' and 'Cooperation' scenarios.

Box 8. Future scenarios

Scenario 1: 'Stagnation' is marked by increasing ethno-religious tensions in the region. States remain militarily strong with centralized bureaucracies. Authoritarian rule inhibits civil society and reduces inclusion, accountability and transparency. Economies remain undiversified and rent-based. In the absence of defined rights and laws, antagonistic relations stymie attempts at greater regional trade integration. Food import dependency increases. Economic and educational inequality grows. High population growth drives urbanization and crime; underemployment is common. Balances of trade worsen and debt rises. Climate change is addressed through technical fixes, reactive action and vanity projects in richer countries, rather than regional, long-term, inclusive strategic planning. Securitization tightens borders in wealthier countries, restricting inward migration.

The US withdraws from the region with the exception of trade and strategic aid. Russia and China strengthen influence. Global finance is limited although uncoordinated ad hoc aid and security packages are available. Food prices in the region are higher, with sporadic price shocks. Oil prices are volatile to lower.

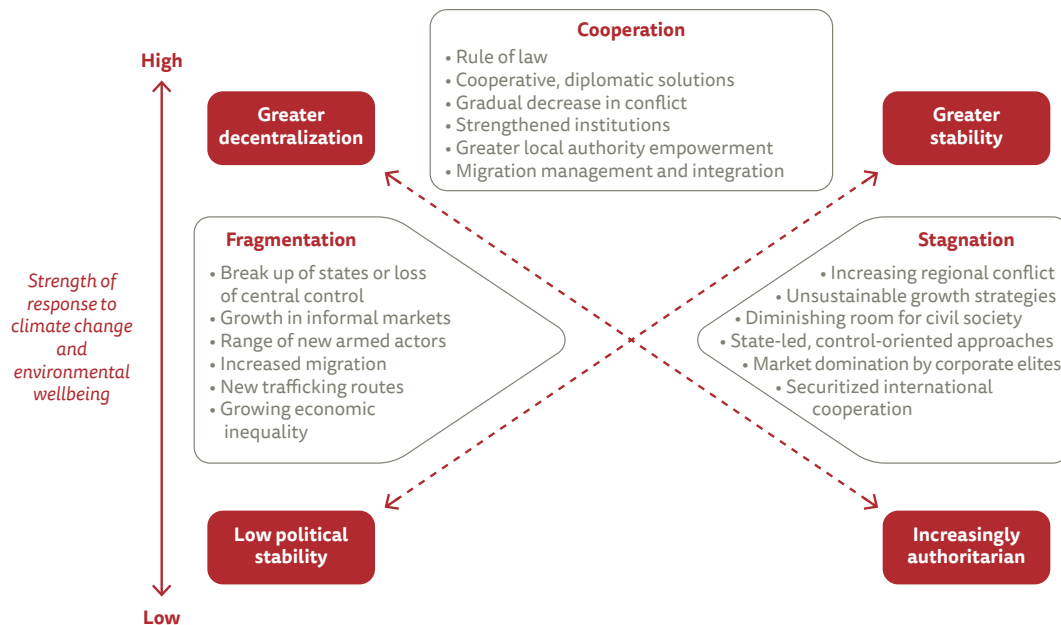
Scenario 2: 'Fragmentation' is marked by greater fragmentation of states, the rise of new actors and uncoordinated decentralization of power. Simmering regional tensions prevent greater integration of trade. Food import dependency remains high. Governance is uneven: some breakaway regions are supported to improve capacities while others become more feudal. Porous borders enable increased smuggling and human trafficking. The private sector expands in some areas but not in others. An imperfect peace exists between riparians. Population growth is unevenly distributed, driven by conflict and migration. Economic inequality grows while formal job growth is weak. Tensions and fragmentation inhibit effective, long-term implementation of climate adaptation strategies.

Major powers pursue tactical diplomacy in the region. Other powers provide increased strategic investment, responsive aid and modest climate resilience finance. Food prices are volatile, with some price spikes. Oil prices are volatile to medium.

Scenario 3: 'Cooperation' is marked by a gradual decrease in conflict and greater attention to cooperative, diplomatic solutions in the region, enabling increased investment, finance and technology innovation and adoption. Institutions are strengthened and there is greater decentralization of authority to local governments. Rule of law, regulation and clear market incentives foster improved land and water management as well as a vibrant private sector, helping hydrocarbons exporters to manage the transition to renewable energy. Food import dependency is sustainably reduced by increasing regional cooperation in trade and water management, coupled with nationally diversified food production and healthier diets. Population growth slows and there is greater planning for and acceptance of migration flows. Educational quality and equality improve. Jobs are increasingly generated by the private sector, while forms of tax reform and universal income assist the transition away from high carbon export dependence in countries exposed to volatile/decreasing oil and gas prices. Balance of trade improves and debt falls.

The international community is strengthened by enhanced cooperation on development and security, and coordination of aid and finance including climate finance. Food prices remain volatile to high, with some shocks. Oil prices rise and then fall as alternative technologies and regulations take hold.

Figure 11. Meta scenarios for 2025–2035 which would affect countries' ability to respond and adapt to climate change



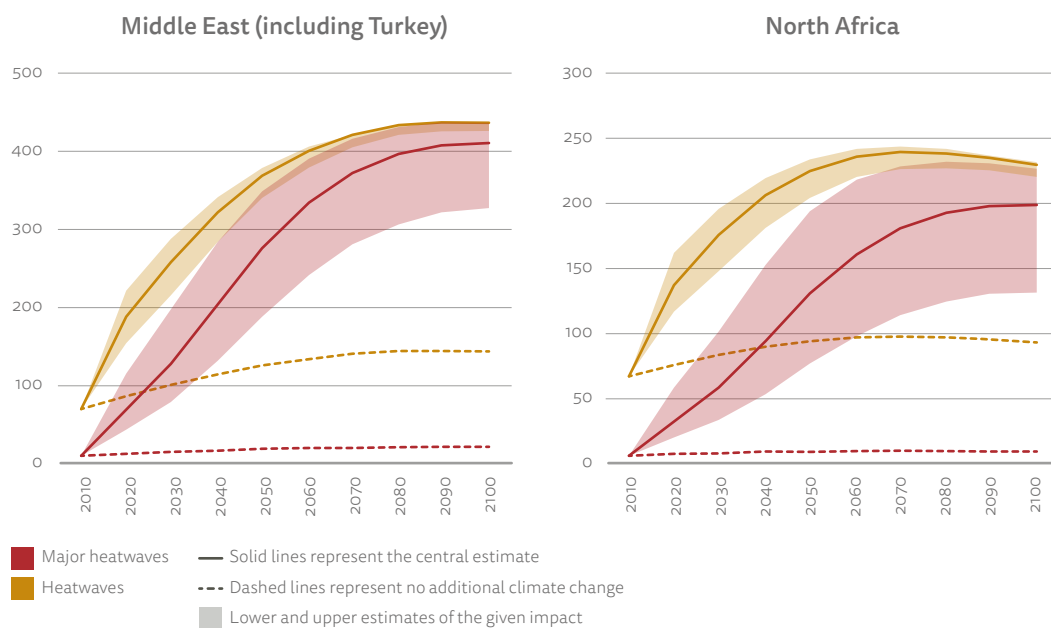
In this section we discuss how climate change is likely to affect the region in four areas: human health, livelihoods and economic opportunities, inter- and intra-communal relations and regional security, based on available studies, and use examples of five risk cascades (based on expert consultations and workshop dialogue) to show how **compound risks with cross-border effects** could play out. These cases apply the scenarios, suggesting how key dynamics and choices could cause them to play out differently.

5.1 Human health

Environmental degradation, whether driven by climate change or other factors, can have a wide range of negative health consequences, both direct and indirect (Green et al., 2013). Heat stress from more severe and longer lasting heatwaves may be the most serious threat to human health caused by climate change in the MENA region (Zittis et al., 2021). Assuming a moderate trend in population (SSP2), Figure 12 gives an idea of the scale of social impact under an RCP4.5 trajectory. This shows the number of people experiencing major heatwaves quadrupling between 2010 and 2050.

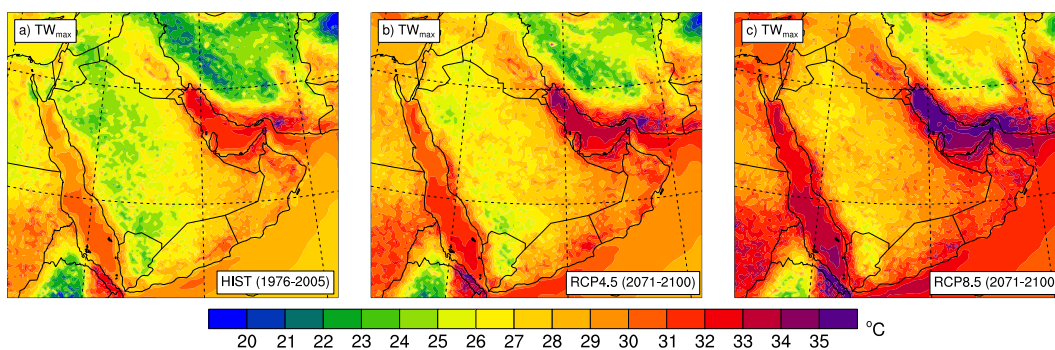
Humidity is projected to present a serious challenge to health, especially for coastal cities. A wet-bulb temperature of 35°C, which is an air temperature of 46°C with humidity of 50 per cent, can kill a person as their body will not be able to cool itself through sweating. As Figure 13 shows, the wet-bulb temperature has come close to this in several locations in the Arabian Gulf including Dhahran, Ras Al Khaimah and Muscat. Bolleter et al. (2021) explain how this will be worsened by sea-level rise and the concentration of buildings in areas of the UAE coastline. Pal and Eltahir (2016) argue that this could severely affect life in the region, including the international pilgrimages (Hajj) to Mecca.

Figure 12. Populations within the Middle East and North Africa experiencing heatwaves and major heatwaves under RCP4.5 (millions of people each year)

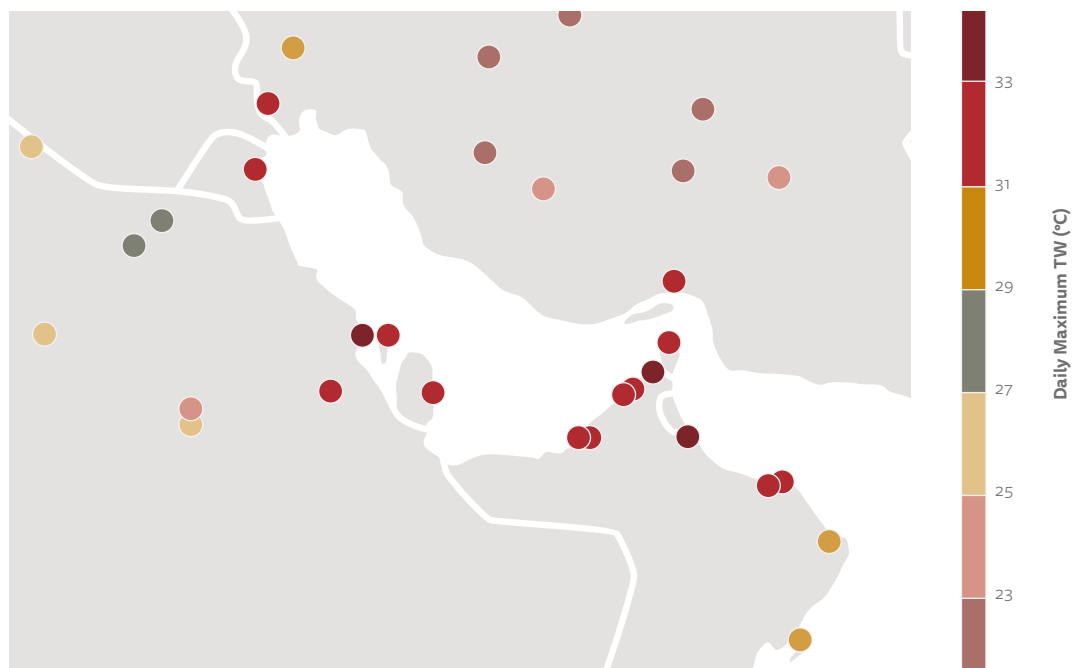


Source: Quiggin et al. (2021), based on data from Arnell et al. (2019).

Figure 13. Historical and projected wet-bulb temperature extremes in the Arabian Gulf



Source: Pal and Eltahir, 2016, updated and supplied by Jeremy Pal, 2022.

Figure 14. Observed extreme humid heat in the Gulf region, maximum for 1979–2017

Source: Adapted from Raymond et al. (2020).

High temperatures (especially when combined with flooding) may result in increased outbreaks of diseases, for instance, salmonellosis, cholera and giardiasis (Wu et al., 2016). Floods also increase the opportunities for standing water in which malaria-carrying mosquitoes can breed and create conditions for diseases such as West Nile virus, Ebola and Zika (El-Zein et al., 2014). Rare outbreaks of West Nile fever occurred, for example, during heatwaves in Israel in 2006 and 2010 (Paz, 2015; Efron, 2021) and in Iran in 2008 and 2009 (Sayed-Ahmed, 2016).

Certain groups will be more vulnerable to the health impacts of climate change than others, as detailed by Waha et. al. (2017). For the elderly, the wet-bulb temperature threshold may be lower, while both old and very young people are more susceptible to heatstroke. One academic study estimates that the mortality risk to those over 65 will be three to seven times higher in 2100 (compared to 1951–2005), even if warming is kept to 2°C (Ahmadalipour, Moradkhani and Kumar, 2019).

Other groups at risk will be: ‘The rural poor, unskilled workers and internally displaced people – all large populations in the region ...’ (Benzie, Davis and Hoff, 2012). Many refugees and displaced people live in temporary shelter and conditions even less adapted to extreme conditions. Even today it is not unusual for temperatures to reach into the mid-40s in camps like Azraq and Zaatari in Jordan (Albadra et al., 2017). People who work outdoors or who cannot afford additional air conditioning (e.g. the poor in urban heat islands such as Cairo and migrant construction workers in the Gulf countries) will also suffer. Soldiers undergoing training or in combat may be affected, too (Stoltenberg, 2020).

Nutrition plays a vital role in the immune system and physical robustness and levels vary vastly across the region (Ghattas, 2020). Largely due to political conflict, well over half of Yemen’s population are food insecure and one in five children suffers from malnourishment. Meanwhile, in Kuwait, Jordan, Saudi Arabia and Qatar more than

a third of adults are classed as obese, due in part to 'Western' influences on diets in the last half century (ALAbdulKader 2019, citing WHO 2016 data, Nahhas, 2017; Alnohair, 2014). Obesity can also go hand in hand with undernourishment, cause chronic inflammation and increase the risk of a number of illnesses including cardiovascular, diabetes and respiratory diseases.

Increased concentrations of pollutants in water supplies, including salts, will occur as a result of a decline in flow in rivers and streams and reduced rates of aquifer recharge. This effect can already be observed in the Euphrates and in the Gaza Strip, for example. If treatment to remove these pollutants is not of a sufficiently high standard, diseases will become more prevalent. This may happen directly (when people drink the water, as has occurred with mass hospitalizations in Iraq) or indirectly (when people consume food crops irrigated with polluted water or fish from polluted rivers).

Air pollution resulting from dust storms (potentially combining with other forms of pollution such as that from traffic and heavy industry) brings other forms of health hazard, including respiratory diseases (El-Zein et al., 2014; Soleimani et al., 2020; Khanjani, 2018). Given the levels of toxic conflict waste strewn across damaged areas of Syria and Iraq, a serious risk involves the potential transfer of particles via dust storms to populous areas and potentially across borders. **Storm damage to critical infrastructure (hospitals, transport networks, etc.) can have secondary health impacts, for example, if patients are unable to access medical treatment or medicines.** Secondary health impacts may also result from food poverty consequent to the non-availability of food at affordable prices.

5.2 Livelihoods and economic opportunities

According to the UN Food and Agriculture Organization, climate change and increasing water demands mean that 'the region is expected to experience economic losses estimated at 6–14% of GDP by 2050' (UN Food and Agriculture Organization, 2020).

Agriculture

In most MENA countries, agriculture is the sector likely to be affected most severely by climate change. This is not only due to reduced or erratic precipitation but also higher temperatures, which will bring higher rates of evapotranspiration (evaporation from the land surface plus transpiration from plants), changing the quality of produce. For example, Tunisia is likely to experience a 14 per cent increase in evapotranspiration by the 2050s (Mirzabaev et al., 2019). In addition, higher temperatures will reduce the productivity of agricultural workers (Jobbins and Henley, 2015) (as well as other people who have to work outdoors, such as construction workers).

Projections are hard to make as they depend on precipitation patterns, water management, crop varieties and farming techniques. Some sources declare that longer droughts will mean a reduction in the area within which rainfed cropping is possible (as well as reduced rates of recharge of non-fossil aquifers used as a source of water for irrigation) (e.g. Verner, 2012). Under current practices, the World Bank Group (2014) points out significant differences in reductions in crop productivity between a 1.5–2°C scenario versus a 3–4°C scenario: from 1.5–24 per cent for the western Maghreb (western North Africa) and 4–30 per cent in parts of the Mashrek (Levant), by mid-century.

Sea level rise will reduce the area of cultivable land in MENA (through effects such as seawater intrusion into coastal aquifers and flooding resulting from storm surges), thus reducing agricultural production. The areas likely to be affected include some of the region's most productive farmland, e.g. the Nile Delta, the Atlantic coast of Morocco and the coastal plains of Oman (Shammas and Jacks, 2007; Al-Maktoumi et al., 2018). Potential compound effects of drought, poor domestic and transboundary water management and resulting soil salinization are shown in Figure 15. Seawater intrusion is accelerated by over-abstraction from coastal aquifers or declining river flows, mainly for irrigation or to supply cities (ESCWA et al., 2017).

Effects on animal health and ecosystems will also increasingly affect rural and oasis livelihoods. Salinization resulting from reduced river flows and seawater intrusion has already led to animal deaths in southern Iraq, driving farmers into greater poverty (Elia, 2018). In the region's oases, reduced rainfall and other drivers such as poor water-management practices may also lead to increasing salinization. Higher temperatures may limit the range of crops that can be grown in oases (Mirzabaev et al., 2019). The nature of farming has already been changing for some years. A 2013 study of farmers north of Muscat in (the next most populous) Al-Batinah governorate noted that they were active in adaptive practices from crop changes to water conservation in response to seasonal changes and were also 'diversifying from farm to non-farm activities' (Choudri, Al-Busaidi and Ahmed, 2013). High levels of rural-to-urban migration as people abandon farms altogether are expected in many of the MENA countries.

Box 9. Food insecurity and job losses in the Maghreb

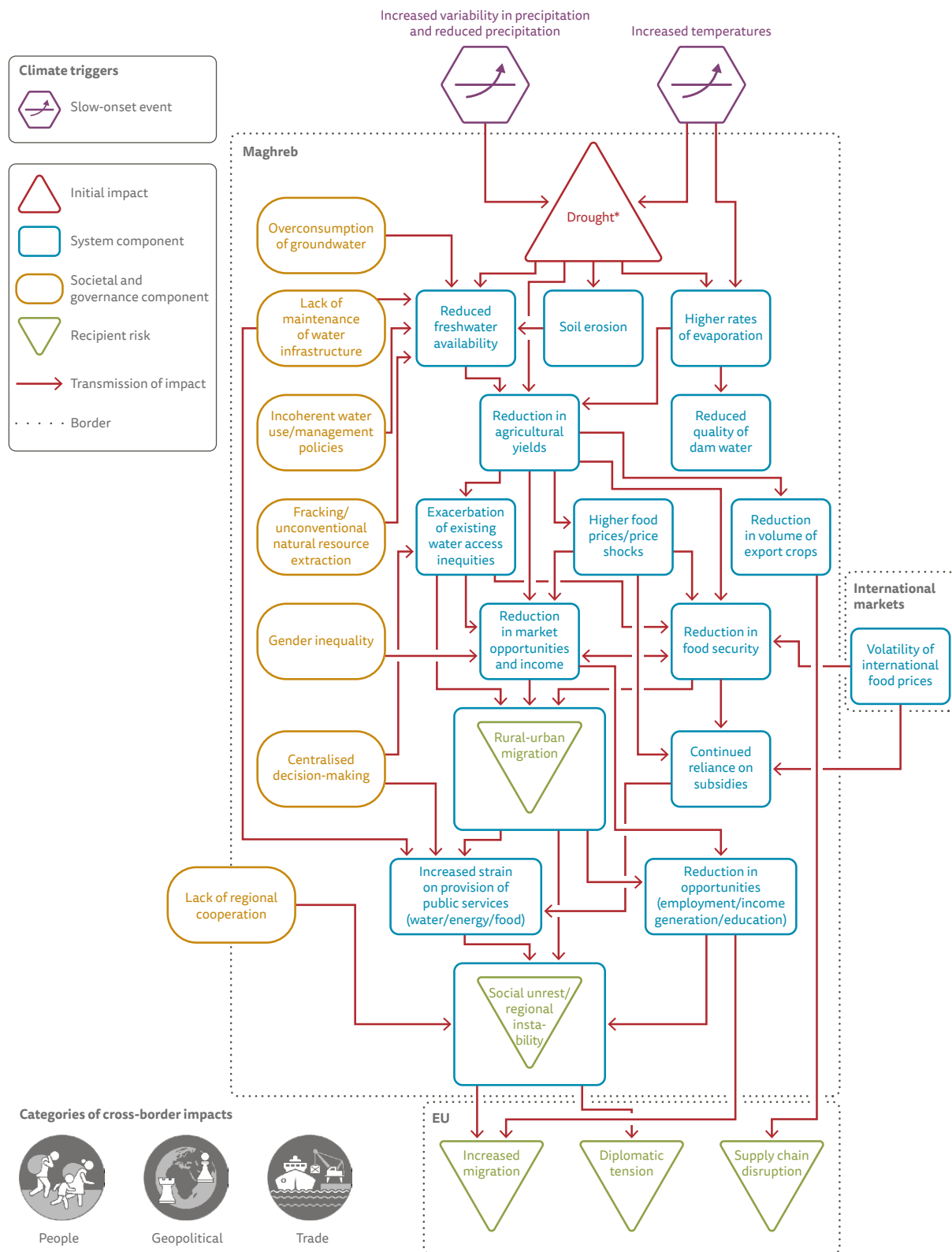
Figure 15 shows the potential ramifications of such conditions that might be felt across Algeria, Morocco and Tunisia under the **Stagnation** scenario. The risk cascades here are common to several other MENA countries but with notable impacts for the EU in terms of:

- A combination of higher temperatures and water shortages reduce volumes of export crops, causing disruption in food supply chains in the EU;
- Increased migration to the EU as opportunities for education and income generation decrease; and
- Pressure on diplomatic relations as heavy state repression of protests and/or instability spread across borders.

Under the Stagnation case, these outcomes are also fostered by:

- heavily centralized decision-making;
- incoherent water management policies and strategies, lack of maintenance of water infrastructure and unsustainable use of water for industry (e.g. gas fracking in Algeria, phosphate industry expansion in Tunisia and Morocco) and export-oriented agriculture and energy (water use in cooling power plants and solar facilities);
- continued and rising reliance on subsidies;
- gender inequalities; and
- lack of regional cooperation.

Figure 15. Climate risk cascade: Maghreb food security



How might this play out differently?

Fragmentation: Where power becomes much more fluid and decentralized, foreign-backed corporate agribusinesses assume greater power in certain places, challenging democracies. More porous borders and militia-led local economies foster black markets, making trade more difficult, and increase people and drug trafficking to the EU. Socio-economic inequalities widen, with some groups benefiting from greater investments by agribusiness while others are further excluded.

Cooperation: Increased regional trade – including with sub-Saharan Africa but also between countries in North Africa – strengthens the economic position of Maghreb countries; foreign assistance supporting a timeline for phase-down of oil and gas production and growth of renewable energy and alternative revenue streams in Algeria helps to alleviate water and economic pressures. Greater decentralization offers opportunities to respond to local challenges in more responsive ways. Financing for and increased access to climate-resistant crop varieties, weather insurance and regenerative and gender-inclusive farming coupled with improved EU market access revives rural communities and stems rural-to-urban migration.

While quantification of the impact of climate change on agriculture in the region is challenging, some trends seem certain to materialize in the absence of radical change in food production methods:

- MENA countries will have to spend more foreign exchange on importing food. For countries that already depend heavily on food from abroad and have limited foreign exchange income, such as Egypt, Lebanon and Jordan, this will be an additional burden.
- The urban poor will face increased food prices (Waha et al., 2017), unless governments increase subsidies (which will add to budgetary pressures).
- MENA countries will become more vulnerable to any disruption of global food supplies, for example as a result of crop failures in supplier countries.
- The contribution of agriculture to GDP in individual MENA countries will fall. For example, Iran's INDC estimates that the national economy would lose \$3.7 billion each year in damages from 2015 to 2030 compared to 2010 'due to the changing trends of climate change and hydrological parameters' (Department of Environment of the Islamic Republic of Iran, 2015). In some countries (especially those where the sector is negligible in terms of GDP, such as the Arab states of the Gulf), this effect will be barely noticeable; in others, such as Morocco, Tunisia and Egypt, it will be substantial.
- Employment in agriculture will fall. Although agriculture is often only a small part of MENA economies, it is in some countries a major (informal) employer. The social consequences of any decline in the sector will therefore be greater than the impact on the economy of individual countries. Many of those who cannot find jobs there will move to cities or try to emigrate (Farajalla, no date).

Competition for water among different sectors (agriculture, industry and commerce, domestic, etc.) will continue to grow, as demonstrated in the Maghreb cascade (Figure 15). This is underpinned by a lack of policy coherence. Greater coordination between ministries and integrated policies and incentives relating to water are needed alongside innovation in farming practices. Different sectors can be complementary. Irrigated agriculture can make use of treated

wastewater from domestic and industrial uses (as can golf courses and other tourist facilities, such as hotel gardens). Treating and reusing wastewater does, however, require the construction of additional infrastructure and a high degree of organizational efficiency and regulation, to ensure the water has been treated to a safe standard. So far, Israel is the only country in the MENA region that has used wastewater for irrigation on a large scale (Water Scarcity Solutions, 2016). Other countries in the region have mostly not managed to overcome the obstacles involved, which include proper regulation and safety precautions as well as farmer awareness (Fanack Water, 2017). This could change if what are at present pilot projects in the region are demonstrably successful.

Damage to urban businesses and assets

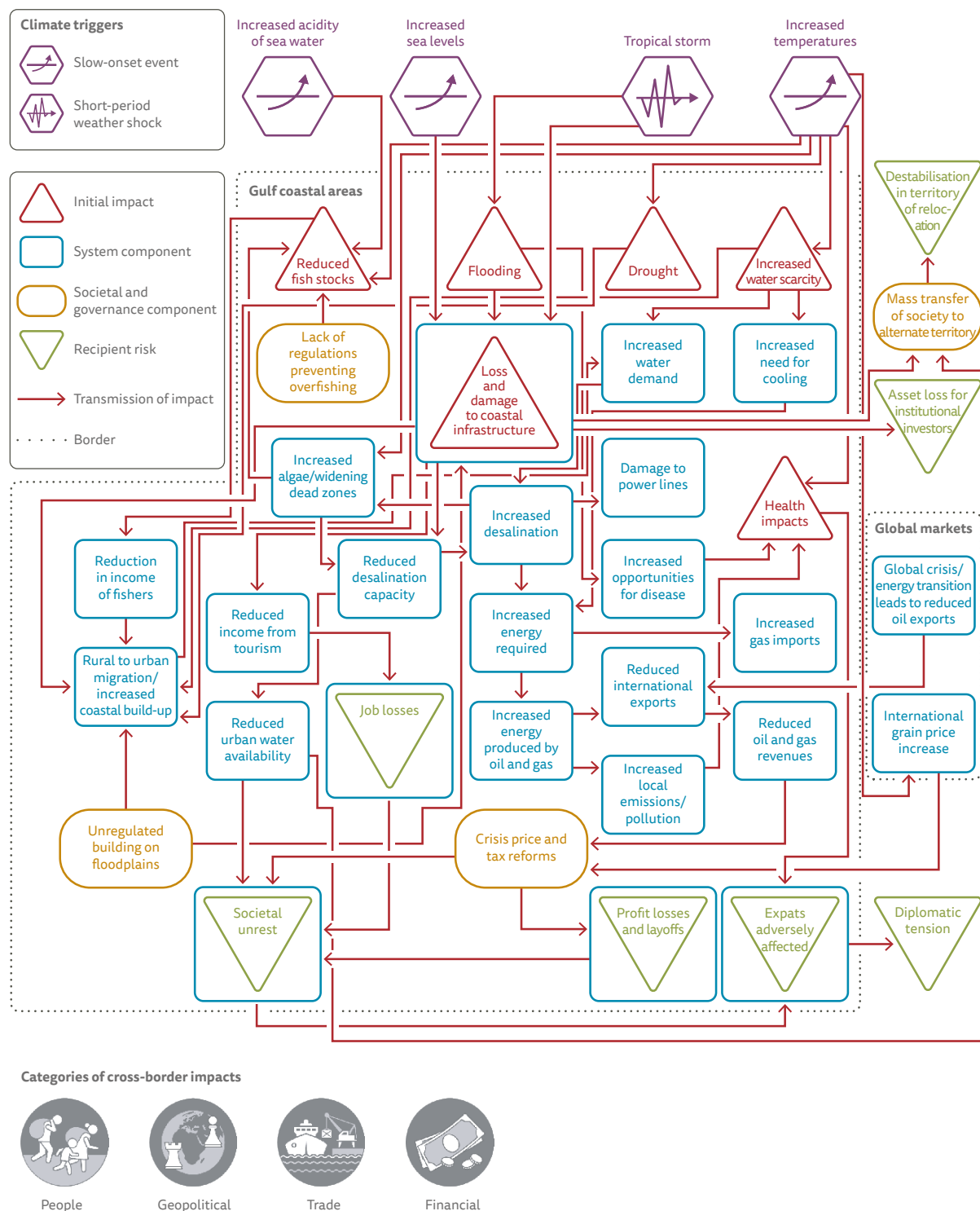
Along with population rise and unresilient urban expansion, the impacts of flooding are likely to intensify. With little experience with floods and flood prevention, parts of the region are especially exposed (Loudyi and Kantoush, 2020). Longer dry periods followed by heavy rainfall can increase the risk of flooding given that dry soils will become more impermeable (Vaghefi et al., 2019). More frequent and/or more intense storms could cause damage to infrastructure (electricity distribution, transportation, etc.). This could have a devastating impact on the business and tourism economies in the GCC with global ramifications (see Box 11).

The lack of drainage in cities means that flooding increases hazardous conditions for driving, with roads quickly becoming submerged. The collapsed buildings and bridges suggest that rapid development and poorly constructed infrastructure compounds the problem. This has already played out in parts of Amman, Jeddah and Muscat in the last few years. In each place, building in harmony with local ecology and an adequate drainage system would have reduced the damage (Gharaibeh et. al., 2019; Daoudi and Niang, 2019; Al-Naamani, 2016).

While sea level rise is a slow onset impact not generally thought to have significant impact in the MENA region until the latter part of this century, it is likely to increase the damage from storm surges before mid-century. This trend threatens coastal areas in many MENA countries, where a great deal of infrastructure (ports, factories, cities, etc.), the most productive farmland and large numbers of people are located (ESCWA, 2017). Various studies identify Alexandria, Benghazi, Algiers, Casablanca, Dubai and Kuwait City as areas at risk from sea level rise. Even at 0.2 metre sea level rise by 2050, urban infrastructure on the North African and Gulf coastlines would be highly exposed. Alexandria is particularly at risk because the area is sinking. It is ranked fifth among global cities in terms of potential losses relative to GDP (Abadie et al, 2020). For example, one study mentioned by the World Bank Group (2014) estimates that sea level rise of 0.3 metres (in 2025) would flood 30 per cent of metropolitan Alexandria, forcing about 545,000 people to abandon their homes and land, and leading to the loss of 70,500 jobs.

The deltas of important rivers may feel earlier effects of sea level rise. In locations such as the Nile Delta and Shatt Al-Arab, sea-level rise could exacerbate existing problems of subsidence, salt intrusion and poor drainage, with local consequences for housing, employment, and food production by 2030 (Jobbins and Henley, 2015, Khamis, 2020).

Figure 16. Climate risk cascade: Gulf Coastal Areas



Box 10. Infrastructure loss and damage in the GCC

In this risk cascade, damage to coastal infrastructure in the GCC combines with system vulnerabilities such as reliance on desalinated water to create negative economic cycles and service crises, which weaken the social contract. Figure 16 shows the GCC quite generically, but there would be specific risks for each country.

Risks that could transmit beyond borders under the **Stagnation scenario** include:

1. **Massive damage to coastal infrastructure** in freak weather events and large-scale flooding causing direct and indirect deaths; business losses and insurance pay-outs.
2. **Opportunities for diversification beyond oil and gas – notably tourism and fishing – are reduced** through climate events. This has impacts on international investments and assets in the region, particularly property.
3. **Internationally invested sovereign funds diverted for domestic reconstruction**, potentially affecting on international financial flows.
4. **Expatriate communities are adversely affected, causing diplomatic tension.**
5. **Mass movement of people.** For some countries the situation could become so dire that the government attempts to relocate the entire nation to another country – at least temporarily – with legal and political ramifications. For example, Qatar, with its small native population, could in theory afford to buy a temporary home in a less populated part of Asia.

How might this play out differently?

Fragmentation: This would signal a momentous change in the GCC, where the fall or contraction of monarchies could give way initially to a chaotic grab for infrastructure and worsening states of disrepair, further endangering human life. Loss of control over major oil installations and nuclear power (UAE) could result in catastrophic outcomes but, more likely, increased international intervention would give rise to corporate-led security and patch-up solutions. Ad hoc technological fixes such as cloud-seeding and genetic modification may be unacceptable to religious groupings and become a point of conflict with corporations or governments.

Cooperation: Increased deployment of disaster risk reduction measures, early warning systems and local infrastructure measures would strengthen resilience to storms. Empowerment of local municipal governments and civil society would enhance proactive mitigation and response strategies. Increased enforcement of regulations and by-laws and improved urban design would help protect people and businesses from the worst effects of heat, storms and flooding. GCC countries' technical expertise and innovation would enable growing business in renewable energy trade, carbon management and sustainable solutions, helping to diversify as oil revenues decrease.

Those MENA countries that are economically resilient may be able to afford the cost of relocation of infrastructure and people from affected areas. Qatar and the UAE for example, will consider this. Poorer countries may not.

5.3 Inter- and intra-communal relations

If the impact of climate change on agriculture is severe (as seems quite probable, in anything but the RCP2.6 scenario), many rural communities may well disappear or radically change their demography. Those most likely to leave first will be the young and enterprising, particularly (initially) men; this will change the demographics – as has happened in many Sahel villages, with women gaining greater agency but also overburdened by familial and agricultural responsibilities. Cities to which rural people move may find it difficult to cope with the new arrivals who, like the existing population, need jobs, infrastructure and services (housing, education, health, etc.).

Internal migration of this kind can cause clashes between established residents and newcomers, if the informal and formal mediation and legal structures are not able to deal with such problems. Such tension could result if, for example, the newcomers put an additional strain on services. They may be discriminated against based on ethnicity (Waha et al., 2017) and conflict with local communities may arise due to differences in cultural norms and practices. A rise in the number of young males moving to the city may increase the likelihood of outbreaks of violence and repressive police measures. There is already an extensive literature on the consequences of rural-to-urban migration but far less that relates this phenomenon specifically to climate change. The article by Waha et al. (2017) is a notable exception.

Migration into the MENA region from sub-Saharan Africa is already on the rise – especially to North African countries – with climate change likely to become an increasing driver. The vulnerability of such migrants tends to be high, with police brutality, racism and exploitation widespread. Migrant women are particularly at risk of sexual harassment, assault and trafficking.



Situations in which one group uses its superior wealth, power or political connections to gain unequal access to a dwindling resource will fuel animosity

Unrest could result if a government favours one social group or geographical area over others. This could be the case, for instance, if the authorities draw on groundwater in rural areas to supply cities, where reduced rainfall has curtailed the resource. A similar phenomenon has already been seen in Yemen, although not as a result of climate change (Hales, 2010). Service failure in the context of inequalities has already proven a trigger for unrest. Violent protests erupted in Basra in 2018 after more than 100,000 people were hospitalized as a result of drinking local water supplies. This demonstrates how a failure of basic services can be a trigger for outrage over a host of popular frustrations.

In Basra, frustrations arose over the growing wealth gap, unemployment and corruption; all thrown into sharper relief in the context of Basra's status as an 'oil rich' province where there are also wealthy enclaves not exposed to the polluted water. The pollution itself is likely to have been a result of a number of factors including upstream damming and poor transboundary river cooperation, poor national water

management, climatic variability, corruption and governance failures that meant that existing treatment plants were not working (Lahn and Shamout, 2018; Human Rights Watch, 2019).

Climate change could also trigger pathways to internal tension or conflict between social groups that do not directly or at least initially involve the authorities. Reduced precipitation as a result of climate change may exacerbate existing inequalities and tensions in farming communities. Water tables may sink because of reduced recharge, with the consequence that only better-off farmers who can afford the equipment and the diesel for pumps will have access to groundwater. This has already happened in Yemen, although factors other than climate change are responsible (Lackner, 2019). **Situations in which one group uses its superior wealth, power or political connections to gain unequal access to a dwindling resource will fuel animosity.**

In the Occupied Palestinian Territories, constrained and unequal access to water is a point of tension between Palestinian and Israeli settler communities but also increasingly among Palestinian households. Inter-tribal armed conflict in southern Iraq provides a precedent of what can happen when there is not adequate recourse to methods of resolution as communities vie for shrinking resources.

In areas already affected by conflict and/or political injustice, climate factors could worsen the status quo. However, **in many places, political injustices and the daily experience of oppression are the overriding concerns.** These tend to inhibit the implementation of resilience measures, leaving communities and economies more vulnerable to climate impacts.

Box 11 illustrates how climate change could play into a developmental decline in Jordan and increasing instability in the West Bank in the context of these non-climate dynamics.

Box 11. West Bank de-development and intercommunal tensions

The area of the Jordan Valley is politically contested and highly securitized. In places, it runs through the state border between Israel and the Hashemite Kingdom of Jordan and contains part of the Occupied Palestine Territories, known as the West Bank.

The West Bank is fragmented in terms of authority. Following the Oslo Agreement, the area became subject to complex political categorizations that determine usage and access. According to the human rights organization B'Tselem, almost 60 per cent of the West Bank is under full Israeli control, known as Area C under the Oslo Agreement. The remaining 40 per cent – home to Palestinian communities, including the city of Jericho – is divided between Area A (full civil and security control by the Palestinian Authority) and Area B (Palestinian civil control and joint Israeli–Palestinian security control) (B'Tselem, 2017). Forty-six per cent of the Jordan Valley in the West Bank has been declared military firing zones, although this overlaps with the state lands allocated to Israeli settlements. Israel has also declared one-fifth of the area as nature reserves with the vast majority of it overlapping with the two categories above (B'Tselem 2017; Etkes and Mishirqi-Assad, 2013).

Israel's militarization of the Jordan Valley region, various forms of land and water control and settlement building have already forced many farmers to give up their rural livelihoods and seek other sources of income in cities or even as wage labour in settlements (Mason and Mimi, 2014). This pattern of rural-to-urban migration weakens community cohesion and usually leads to increased urban poverty and inequality.

Under the **Stagnation scenario**, increased water stress and reduced agricultural productivity are likely to push already marginalized groups of Palestinians living in the Jordan Valley to breaking point. Continued expansionist policies in which Israel encourages, subsidizes and protects illegal settlements that consume significantly more water resources – and enjoy a higher standard of living – than their Palestinian neighbours – would only exacerbate the unequal resource distribution and the latter's sense of injustice. Migration to urban areas and wage labour into Israeli settlements will effectively depopulate rural areas, further reducing the potential for a future Palestinian state since abandoned land is more easily appropriated.

Increased water stress and reduced food security could also raise the stakes of returning or retaining the West Bank land and water resources to Palestinians. While there is no fair means of representative engagement in water governance or resource to just resolution for resource conflict, violent attacks between Palestinian communities and settler communities over areas using water resources (such as olive groves and orchards) may intensify.

Ultimately, continued oppression by Israeli military and authorities coupled with rural-to-urban migration by Palestinian farmers and extreme economic inequality can create the conditions for a new economic intifada. This would in turn affect Israeli farmers, increase food prices, could increase the sense of crisis in Israel and result in increased polarization and possible domestic unrest, further weakening Israel's ability to govern.

Jordan, meanwhile, governs the eastern bank. This forms an important part of the Jordanian economy, both in terms of agricultural products for export and the domestic market, and for tourism. But water insecurity mars the prospects for rural livelihoods and development in the area. Given the precarious nature of the Jordanian economy and potential for increased securitization of development policies, rural areas could become neglected or suffer from failing crops, uncoordinated export and agricultural policies, and increased competition for water. Meanwhile, increasing military oppression from the Israeli side is likely to worsen relations with neighbouring states including Jordan, whose leadership will come under greater public pressure to withdraw from cooperative and diplomatic agreements with Israel.

Figure 17 demonstrates the extent to which sociopolitical factors exacerbate and compound natural resource stresses and climate change in the region and how in future these could undermine the effectiveness of international – including EU – investments in climate resilience in both areas and further damage the prospects for peaceful development.

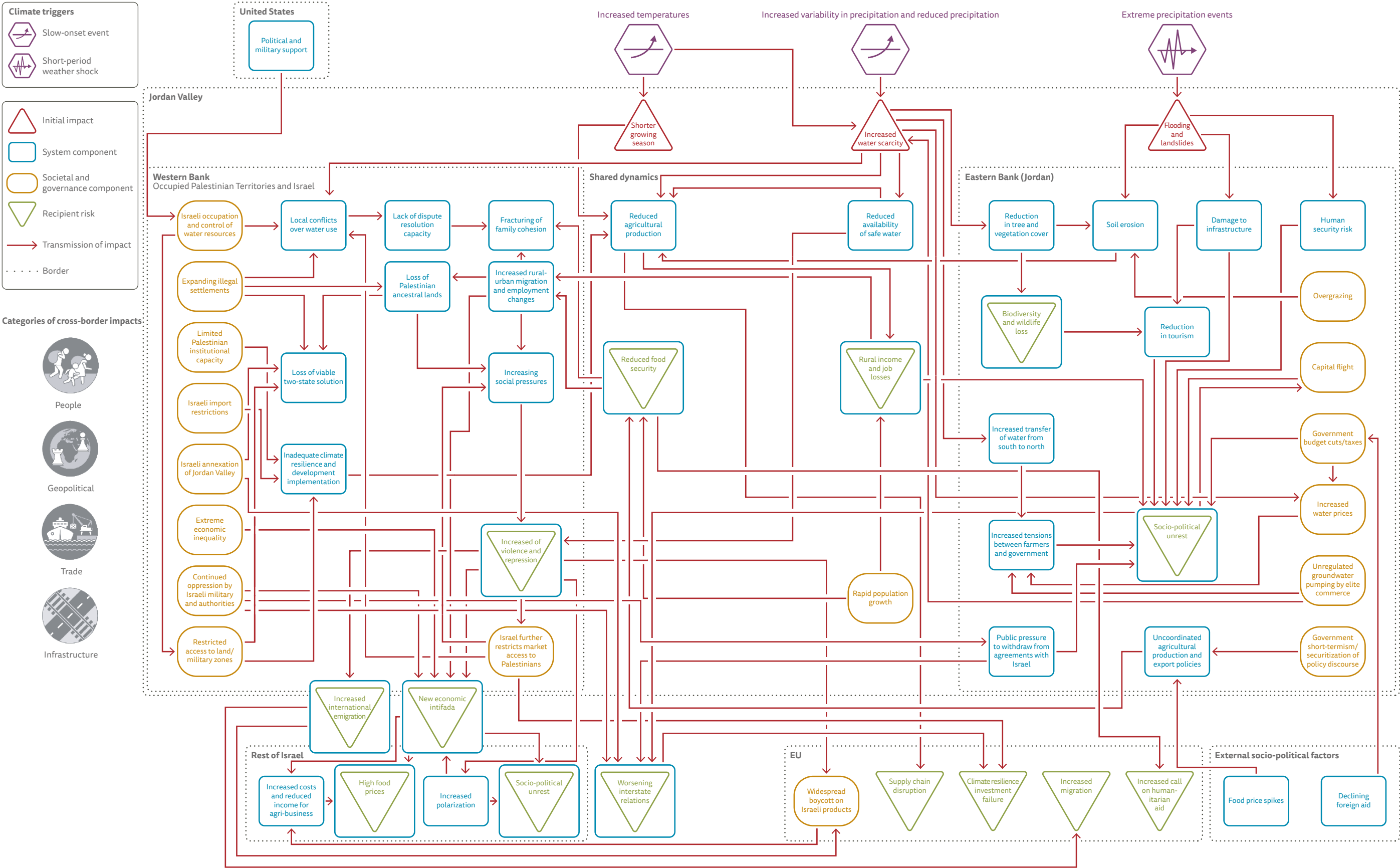
How might this play out differently?

Fragmentation: Humanitarian crisis in Gaza and the West Bank affects Israeli communities in the form of water pollution and disease; civil disobedience and popular unrest follow. Hit by more waves of migration without sufficient aid, Jordan's ability to function as a state decreases, with reducing ability to service debt. Some opportunities arise for joint civil society action on land regeneration as military control of the West Bank recedes. However, getting goods in and out remains problematic. International agencies increase their humanitarian role in the region while these operations are endangered by vigilante security.

Cooperation: Greater international and regional pressure and engagement forces resumption of peace talks. Occupation ends and recognition of shared environmental resources and a commitment to environmental justice emerge as the basis for a new pathway to peace between Israelis and Palestinians – either as a one- or two-state solution. Innovation and technological capacity grow through sharing knowledge and cross investment. Equitable management of the Jordan River basin and replication of best available sustainable agricultural techniques enables increased food production, while agricultural planning makes sure that the region can produce the right quantities for export and domestic sales.

Source: Drawing on Jordan Valley Case Study, CASCADES, Lahn and Elgendy, forthcoming 2022.

Figure 17. Climate risk cascade: Jordan Valley



5.4 Insecurity, conflict and cross-border migration

Socio-political instability

Political responses to the effects of climate change will be the key variable in any risk scenario. Regimes in the region may be very different in 2050 or 2100 from their current character: for example, further rounds of uprisings in Iran and the Arab states may bring transformations that previous rounds failed to do. There could be greater fluidity and fragmentation or new territorial boundaries with different ideological leanings and alliances. Some of the broad possibilities are discussed in the scenarios (see Appendix 1).

The impacts of climate change will not be the sole cause of unrest. It is possible, however, to see pathways to political instability in which climate change plays some part. Such pathways are laid out in another paper in this series on security in North Africa (Desmidt, 2021).

The severity of climate change as a factor in instability depends on the extent to which there is already distrust and frustration with governments and on whether they are seen to prepare for and respond effectively to climate change impacts. It also depends on how the authorities respond to any dissent related to or triggered by climate impacts, with repression possibly more likely to lead to instability (at least in the long run) than softer measures such as dialogue (Ghabra, 2018). An extreme weather event that is badly handled by the authorities, for example, might combine with factors such as unemployment, high food prices and the absence of freedom of expression to cause mass protests. For example, the October 2019 forest fires in Lebanon sparked public outcry over the lack of resources and equipment for the Civil Defence Forces. Coupled with the government's announcement of new taxes amid economic crisis, this triggered a mass uprising which brought down the government (Maksad, 2019). Such compound events can also strengthen grassroots movements who fill the needs gap and alter power dynamics in the country, much as the Muslim Brotherhood did in Egypt earlier this century.

Box 12 gives the example of how compound agricultural and urban climate-related stresses could exacerbate insecurity and migration from Iraq.

Box 12. Service failures combined with political discontent in Iraq

The risk cascade illustrated in Figure 18 shows how several dynamics could combine with climate change impacts both within and outside the region, exacerbating violence, loss of life and health, and food insecurity. This could result in outward migration, reduced oil exports and inability to service debt. These risks have to some extent already played out in the region, although environmental factors have often been ignored or marginalized given the impacts of invasion and 'regime change' in 2003, ongoing political and militarized conflict, and ethno-religious dynamics.

Electricity is also a potential source of increased cross-border tension. Dust storms in Iraq have already caused electricity outages in Iran, affecting oil production in Khuzestan Province and provoking accusations against Iraqi authorities (Alarabiya News, 2017).

Under the **Stagnation** scenario described in Box 8, suboptimal reconstruction efforts with little or no consideration for climate change or sustainability and ongoing elite land capture would further weaken trust in government. Reductions in services such as sudden electricity outages would result in protests and increasingly repressive state

countermeasures. A further ‘securitized’ measure might be that Iraq comes more fully under the hegemony of Iran in a protectorate model with increasing backing from China and Russia for finance, security and debt.

Climate-related factors that could affect this are:

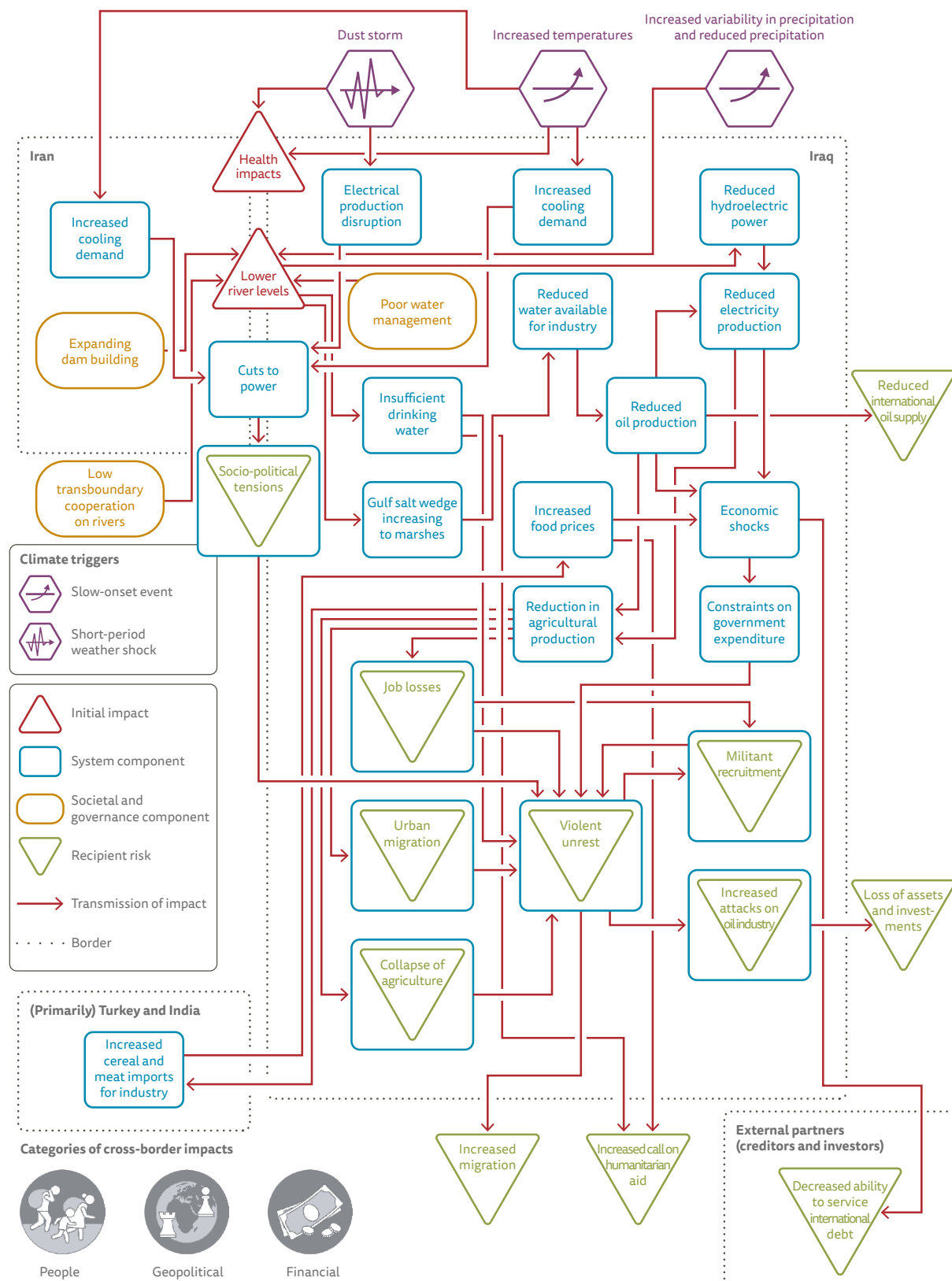
- **Increased rural–urban migration** without sufficient investment in municipal services in rural areas and deteriorating living conditions in Iran and Iraq;
- **Reducing international oil prices** as the global energy system decarbonizes. As a country where oil receipts fund around 90 per cent of government revenue, and which requires a rising oil price (over \$70/barrel in 2021) to meet budget requirements, Iraq faces severe economic consequences if unable to diversify its economy fast enough;
- **Sporadic reduced production of oil**, affected by water and electricity declines;
- **Declining domestic agriculture combined with international food price rises**, presenting a serious current account imbalance; and
- **Increasing dust storms affecting neighbouring countries, increasing securitized responses.** For example, climate stresses combined with sanctions on Iran could also increase opportunities to securitize events such as electricity outages.

How might this play out differently?

Fragmentation: As state control is increasingly ceded to militias backed by different external forces, assets such as oil and electricity infrastructure fall into different hands. Resource stresses would force groups into undertaking more ad hoc decentralized solutions; artisanal refining would become rampant in some places, further worsening local pollution; but cooperative solutions over water use and solar power might also be able to take root out of necessity. This scenario is likely to promote increased migration and trafficking routes from South and Central Asia through Iran and Iraq. Turkey is on the front line of increased migration. As it struggles to cope with an even greater burden of immigrants, Turkey turns to the EU for help – with the prospect of lower border controls if aid is not forthcoming. A number of ‘narco states’ could arise as a result of a lack of law and order and receding alternative income-generating opportunities.

Cooperation: Mutual recognition of shared climate and environmental challenges fosters closer relations over water and ecology as the international community makes more nature-based financing available. Greater decentralization of power would encourage a race to the top in terms of local municipal resource efficiency and service provision, with circular measures increasing urban agriculture. Greater equality and quality in education and rule of law would enable a multiplicity of businesses and social enterprises to thrive, decreasing dependence on oil revenue as that declined. Regional trade (including food for electricity trade linked to cooperative water management between Turkey and Iraq) would also improve. However, a recalibration of the balance of trade would still be needed and international food price spikes would present a challenge that some level of regional storage-sharing might help meet.

Figure 18. Climate risk cascade: Iraq



Extremist groups

Extremist groups in the MENA region are not known to have engaged explicitly with climate change to gain support and recruit members. However, there is some anecdotal evidence of such groups taking advantage of the impacts of climate stresses. In Iraq, for example, drought and lack of water for irrigation, which has driven thousands to migrate from rural areas and has also led to tribal conflict (Al Hasan, 2020), can also be seen as a critical factor in increasing the vulnerability of men from farming communities to Islamic State of Iraq and Syria recruitment (Schwartzstein, 2017). In future, government inability to deal with climate events could become a touchpoint for insurgency, especially if there is a strong popular reaction to extreme weather events that extremist groups could exploit.

The likelihood that contracting employment opportunities in agriculture will cause migration from rural areas to the cities to accelerate has already been mentioned. In countries affected by sea level rise, there may also be migration from coastal cities such as Alexandria or Basra to other cities. If the region's economies and governments prove able to generate jobs, infrastructure and services to cater for these new arrivals, the process need not be especially disruptive. In many cities at present, however, planning, administration and implementation capacity is lacking. In those circumstances, those who find themselves without jobs and services could be prone to take their discontent to the streets or be attractive targets for recruitment by extremist groups. Bourekba (2021) provides an insightful study of the ways in which climate change could affect violent extremism, particularly in North Africa.

Conflict between states

A number of issues combining environmental mismanagement and climate change, the effects of which cross borders, could exacerbate low-level conflict.

Issues include dust storms and their effects on cross-border electricity flows, famine or disaster-driven migration, and reduced river flows. In the case of reduced river flows, whether conflict does or does not occur in such situations depends more on the overall relationships between states than on the availability of the resource.

In terms of relationships between MENA states sharing rivers, climate change may be an exacerbating factor or the trigger for the escalation of an existing dispute (as described in Box 13). Globally, internationally shared rivers have served as much to promote cooperation between states as they have to promote conflict (Wolf, Yoffe and Giordano, 2003). This has not been the case so far in the MENA region and the future might possibly even bring more cooperative relations, perhaps including comprehensive treaties among all states that share a river basin.

Securitized state responses

Some governments in the MENA may choose to 'securitize' climate change, that is, to treat it as an existential threat above normal politics that requires extraordinary measures. This could enable counter and adaptation measures to be fast-streamed. Climate change could be used to justify policies such as the hard closure of borders, restrictions on mobility, land seizures and alliances with neighbouring countries to secure preferential access to goods. This is not difficult to imagine given the high level of centralization in most MENA governments and the recent experience of COVID-19.

Box 13. The Grand Ethiopian Renaissance Dam and cascading climate risks

The Nile is the longest river in the world and the lifeblood of the 550 million inhabitants (Lashitew and Gebeyehu, 2020) of its 11 riparian countries. Of those, 75 per cent live in rural areas, where their livelihoods depend on the cycles of nature and the availability of water and land (Tront and Jägerskog, 2020). Across the basin, agriculture irrigated by the river contributes to about one-third of GDP and employs an estimated 75 per cent of the populations, with the majority of those concentrated in Egypt and Sudan (Awulachew, 2012). It is also essential for national food security. Egypt, Ethiopia and Sudan are already dealing with significant food insecurity and nutrition challenges and populations are set to increase significantly in the coming decades.

At the heart of increasing tensions in the Nile basin is the Grand Ethiopian Renaissance Dam (GERD), which will become Africa's biggest hydroelectric dam when complete. Egypt and Sudan, who lie downstream, fear that Ethiopia, as the dam owner, will effectively gain control of the flow of the Nile, a turn of events that could radically change the way that water resources have been utilised in the region. For its part Egypt has declared the project a major threat, against which 'all options are open'. As the diplomatic dispute endures, however, Ethiopia has carried on with the construction of the dam, and began filling its reservoir in July 2020, aiming to have the 74 billion cubic metre project fully operational by 2023.

While it is possible that the GERD could benefit the two downstream countries in some respects by evening out the flow of the Blue Nile, there is a danger that further phases of the dam's operation could coincide with much lower flows, requiring Egypt to implement emergency plans. Any change in water quality would have a huge impact on the vast majority of Egyptian and Sudanese farm holdings that are considered 'small' – the majority of which are on the banks of the Nile. And changes in water volumes might increase desertification and loss of livelihoods, potentially causing civil unrest if not addressed properly. The environmental impact of the GERD on the complex Nile River system also raises concerns about the river's ecosystem, the surrounding environment and the river's downstream course.

Figure 19 shows a potential scenario in which the construction and operation of the dam without adequate cooperation exacerbates existing trends already negatively impacting soil salinity and the ability of smallholder farmers to make a living through rainfed agriculture. These impacts in turn worsen the effects of drought and food insecurity, increasing rural-to-urban migration and domestic unrest while national governments also earn less revenue from agricultural exports. In this 'stagnation' scenario, governments throughout the region react by doubling down on agricultural 'mega-projects' as a means of generating revenue for the state, and deflect attention from domestic governance failures by upping the rhetoric and actions against riparian states. This undermines the options for cooperative water agreements and pushes external partners – such as the EU – into defensive strategies around migration management.

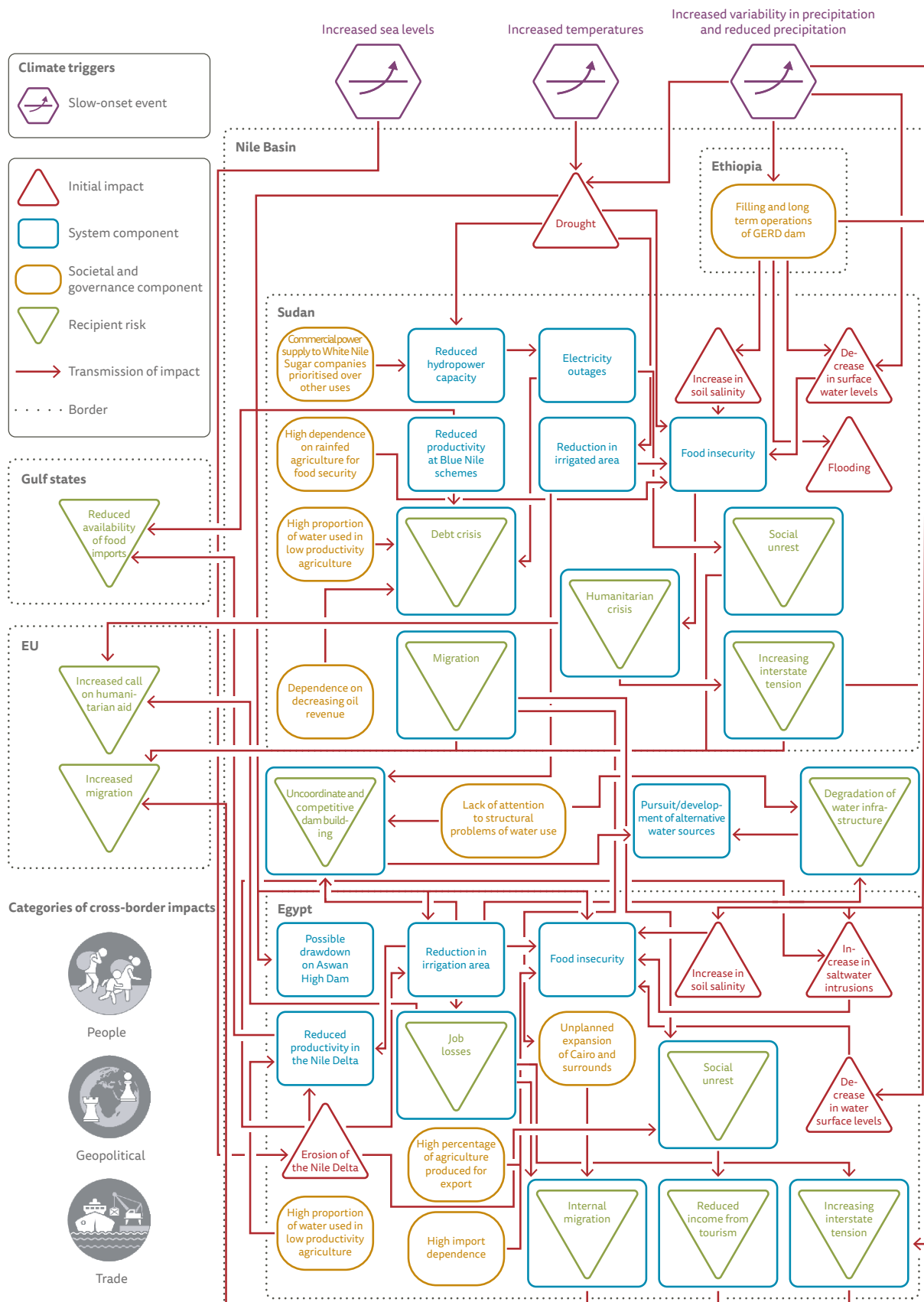
How might this play out differently?

Fragmentation: Nile basin states continue along a trajectory of tense rivalry and fiercely nationalistic development planning. This focus neglects existing water infrastructure, leading to increasing risks of damage or breach. At the same time, individual states aggressively pursue the development of alternative water sources – for example, the Western Nubian Sandstone aquifer – and replicate the same structural problems of water consumption and use already in existence throughout the region. The role of the EU in disaster response and humanitarian assistance increases.

Cooperation: Increasing pressure, and resource-backed commitments to diplomatic and technical cooperation initiatives such as the Nile Basin Initiative, finally lead the riparian states to undertake a coordinated approach to regionally-focused water management, which maximizes environmental and social benefits of the water available. Long-term cooperation agreements create, over time, a new generation of environmentally-minded technical experts (and politicians) who recognize the importance of regional water management for the future economic prosperity of the region. At the same time, early warning systems implemented across the region, proactive strategies for climate-conscious land management systems, and large-scale investments in national adaptive capacity help to avert the worst of the impacts from future climate impacts.

Source: Nile case study, Dahshan and Grafham, forthcoming 2022.

Figure 19. Climate risk cascade: Nile Basin



6. Considerations for MENA country stakeholders and their international partners

Adapting to climate change has not been a government priority in the MENA countries, but this is changing. The upcoming United Nations climate summits planned to take place in Egypt in 2022 and the UAE in 2023 shine a spotlight on the region and create momentum for joining up high-level strategies with local capabilities and international support. Based on the research presented in this report and regional expert views, this section sums up broad considerations for approaches to resilience in the region. This is followed by practical recommendations for stakeholders in the region and their international partners, and specifically for the EU.

6.1 Broad considerations

Aligning resilience with local priorities and capacities

For MENA country governments, climate change still falls below many other concerns linked to security and economic stability. State failure in these areas will also damage the prospects for implementing resilience. Therefore, it is important that climate resilience and adaptation projects are designed to include immediate co-benefits that meet country needs and align with national aspirations.

Capacity to plan and implement varies widely across the region, and among our expert respondents, governance was the most oft-cited impediment to greater resilience. Mismanagement and corruption, constraints on civil society, loss of expertise, insecure land tenure and lack of access to justice present major obstacles to effectiveness and are often responsible for making things worse on the ground (Cofman Wittes, 2016). This reinforces the views on major constraints on effective cooperation with the EU presented in a 2021 survey of views in the Southern Neighbourhood (EuroMeSCo, 2021). For example, one regional expert said that EU funds pooled into a system for the Lebanese government had 'led to more corruption'. Work on resilience should therefore also strengthen governance and accountability, while acknowledging the imperfection of working conditions, especially in conflict-affected areas with complex 'conflict economies' (Eaton et. al., 2019).

Special conditions pertain in countries which depend on fossil fuel export revenues and have grown economies based around low-priced fuel and water inputs. Some of these, such as the GCC countries, Iran, Iraq and Algeria, also face the strongest physical climate impacts in the region in terms of heat and humidity extremes, dust storms and coastal flooding. Climate-related changes in energy demand pose 'transition risks' for these economies and there is growing interest from leaders in addressing both physical and transition risks as part of larger economic diversification agendas. Some of these countries also have influence and capital

availability to drive regional resilience agendas – as suggested by the Saudi-led Middle East Green Initiative Summit and the UAE-US-led Agriculture Innovation Mission for Climate launch in 2021.

Insecurity was high on the list of impediments to resilience noted by regional experts. For some MENA countries (Yemen, Libya, Syria and to a lesser extent Iraq) continuing internal conflict means that many measures that could be taken in more stable circumstances cannot be taken for the time being. For the Occupied Palestinian Territories, Israeli occupation has a similar effect. In terms of investment, it would be a waste of resources to build a state-of-the-art wastewater treatment unit were it to be bombed a few months later. Likewise, imperatives for providing shelter for people in conflict zones and those fleeing or returning from conflict will override the best laid plans for smart, net zero carbon cities. These situations currently severely inhibit the steps that need to be taken now, in terms of adapting to present and future changes in the climate.



For some MENA countries continuing internal conflict means that many measures that could be taken in more stable circumstances cannot be taken for the time being

However, a body of experience is emerging on the ‘relief to resilience’ approach whereby meeting immediate humanitarian needs can also contribute to longer-term development and resilience objectives (German Federal Ministry for Economic Cooperation and Development, 2021).¹⁹ There have been some successful projects, for example, deploying community-level solar solutions through women-led businesses in Yemen (UNDP with EU funding) and innovative green home-improvement projects in Jordan (Norwegian Refugee Council, Jordan Green Building Council).²⁰ The international ‘build back better’ agenda is also embracing the concept of ‘sustainable reconstruction’ in post-conflict zones to try to make sure that communities coming out of war are not left more vulnerable to resource stress and climate change. The Arab region has only recently received attention on this front (UN-Habitat, webpage).

Can environmental cooperation promote peace?

In situations of conflict and oppression, the environment continues to be weaponized in various ways, often through the control of water and access to land (e.g. Israel/OPTs, Syria, Libya, Yemen). This worsens the prospects for future peace as well as vulnerability to climate change. There are already growing social tensions over diminishing natural resources between and within communities and between rural and urban populations.

¹⁹ The EU, its member states and its partners have therefore launched the Resilience and Humanitarian–Development–Peace Nexus, introduced at the 2017 Council conclusions (European Commission 2021c).

²⁰ For more information on these initiatives, funded by the EU, IKEA Foundation and UK Aid respectively, see UNDP (2020), Practical Action (2021) and Dupire (2018).

The question of how environmental cooperation and resilience projects could be instrumental in restoring or maintaining peaceful relations between parties remains highly relevant. To be successful, initiatives will need to be backed by serious external brokerage and diplomacy and a strong awareness of historical iniquities and complementary interests.

Given the transboundary nature of many of the climate risks highlighted in this report, planners and financiers should consider how measures might promote greater cooperation. For example, how might initiatives promote knowledge sharing and technical exchanges, infrastructure that benefits more than one country, cross-border community land restoration and joint early warning systems or DRR cooperation?

Financing and scaling up adaptation measures

The literature on adaptation reflects the wide range of measures that governments, subnational authorities and individuals could adopt to adapt to climate change. The IPCC's 2015 Summary for Policymakers, for example, suggests a range of measures across physical, institutional and social areas, many of which will need to be pursued simultaneously (IPCC, 2015). For the foreseeable future, most MENA leaders are likely to prefer the 'structural/physical' responses, particularly those in the 'Engineering and built-environment' category. Such responses are less complicated politically (vested interests are not threatened and may well be able to benefit) and are easier to finance directly or through soft loans. However, the view among experts, civil society and even policymakers appears to differ; in the 2021 EuroMeSCo survey, a majority expressed the view that the EU should concentrate on smaller scale and more decentralized projects which attract less attention but generate more co-benefits at community level.

Access to finance for adaptation is hampered on the domestic side by the lack of coordinated strategic planning for climate change; the lack of mapping of the areas and groups most vulnerable to its impacts; the lack of capacity to draw up viable projects; and a market and regulatory structure with impediments to scale up. However, it is also inhibited by fragmented international conditions for climate finance, donor-led priorities in mitigation and the lack of metrics to assess and price adaptation progress. A combination of sanctions against regimes and lack of international recognition for de facto authorities (e.g. in Gaza, parts of Yemen and Northeast and Northwest Syria) also limits adaptation finance flows.

Fostering nimble, creative responses through diversification and the business environment

In terms of reducing overall economic vulnerability in the context of rising food prices and the global energy transition, countries will need to address their balance of trade and economic diversification. **The process of economic diversification as part of the transition to a green economy must be a political priority.** This process cannot be effected at speed; a country will usually need a timeline of decades to reduce its dependence on hydrocarbon rents, for example. Addressing the balance of trade will be particularly important for countries heavily dependent on export revenue to cover their product imports.

Reforms to encourage a multiplicity of private sector and social enterprise actors will foster innovation and rapid responses to climate challenges.

With rising populations and uncertain government rents, MENA governments need non-state businesses to play an increasing role in providing jobs, generating revenue and improving services. In many countries in the region, modes of state capitalism or rentier capitalism predominate, reducing opportunities for nimble responses to local problems such as those posed by climate change. A more level playing field and appropriate regulation for small- and medium-sized companies and social enterprises, progressive environmental regulation, greater financial inclusion (including both access to credit and appropriate taxation), and fairer competition and bankruptcy laws would bring multiple benefits. These would encourage companies to offer the kind of creative responses needed in the case of climate response, resilience and adaptation and foster more sustainable economic diversification for those countries threatened by future decline in oil and gas demand.

Localizing resilience

Raising awareness of and addressing climate risks in the MENA region will stand most chance of success if pursued from the perspective of local challenges.

Issues that resonate with local people can be a rallying point: the International Centre for Not-for-profit Law (ICNL) report, for example, points to the restoration of the marshlands and gas flaring as two such areas in Iraq that are suitable for environmental engagement (ICNL, 2021). Adaptation and resilience activities must focus on contributing to local needs such as sustainable job creation, agricultural productivity, clean water, waste treatment and sanitation, air quality improvement and housing. They should pay close attention to accountability: how projects might be designed to improve accountability and rule of law, and should be sensitive to gender dynamics and disparities in the region, noting in particular how projects might affect the security and well-being of women and girls and where the engagement of women can enhance effectiveness of resilience work. Likewise, there is huge potential to integrate climate resilience thinking and implementation through existing work on SDGs and humanitarian relief in the region (Blind, 2019).²¹

The UNDP carried out an assessment of adaptation projects in the MENA region (including countries further south that we do not include in this assessment) and identified a number of lessons learned including the importance of working on enabling policy and governance environments, promoting participative project design, decentralizing management and facilitating community involvement; making sure projects can be operated and maintained sustainably and putting in place cost recovery and finance recycling mechanisms (Twining-Ward et al., 2018).

These lessons raise the importance of taking the local context into account. According to the IPCC, it is ‘... essential for the approaches to be based on an understanding of local community structures’ (Field et al., 2014). Where this

21 This report for the United Nations Department of Economic and Social Affairs points out that several SDGs, including those relating to climate change, can provide useful ‘connectors’ between the humanitarian and development spaces. For example, the humanitarian agenda has obvious synergies with SDG 11.b on increasing the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and developing and implementing, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management. SDG 13.b on promoting mechanisms for raising capacity for effective climate change-related planning and management in Least Developed Countries and Small Island Developing States, including focusing on women, youth and local and marginalized communities.

has not happened (in the field of development generally, not just in respect of climate change), the results have been disappointing or even the opposite of those intended (Lackner, 2020). As the history of urban reconstruction in Lebanon and Iraq shows, certain large infrastructure or real estate projects, while favoured by national governments, may divert resources away from the most urgent community needs, generating discontent (Sirri, 2021; Boswall and Wood, 2020).

In the same vein, **it is essential that more materials and scientific evidence related to climate change are produced in or translated into Arabic and Farsi.**

One expert said: 'Availability of data in the region is so hard and gets harder when you go looking for reporting in Arabic.' This can prevent the progress of legal actions and therefore accountability in cases of environmental transgressions.



While the language of adaptation and resilience to climate change is new in translation in the MENA, the concepts are ancient

While the language of adaptation and resilience to climate change is new in translation in the MENA, the concepts are ancient. **There is rich past experience in architecture, water management and land conservation which seeks harmony with the environment**, for example. Some recent initiatives, such as the work of the NGO Humat Dijla in Iraq, has revived the idea of ecological connectedness around river basin communities (see also Tinti, 2020). Such organizations seek to revive local heritage and eco-sensitive practices and livelihoods. There is also a growing discourse on religious understanding of environmental protection and climate action (see for instance the UN Faith for Earth and Mizan initiatives).²² Such dialogues provide a rich seam that could be used to strengthen and deepen international partnerships as well as enhancing knowledge on both sides.

Making use of multilateral resources

The various UN funding facilities aimed at assisting countries to adapt to climate change could be more widely tapped. One think tank report argues that Arab governments have underutilized these facilities (Lambert and D'Alessandro, 2019). The work of the League of Arab States and ESCWA encourages country governments to take advantage of opportunities for climate finance and a range of green technologies. The new ESCWA Arab Centre for Climate Change Policies may be able to go further in connecting the dots.²³ There are also growing collaborative efforts in which MENA countries and the EU share a common interest; for example, on transboundary sand and dust storms. The United Nations World Meteorological Organization launched the Sand and Dust Storm Warning Advisory and Assessment System in 2007, which has accurately predicted the effects of storms reaching Europe in the last few years (World Meteorological Organization, 2021). In 2020,

22 www.unep.org/about-un-environment/faith-earth-initiative and www.unep.org/al-mizan-covenant-earth.

23 <https://archive.unescwa.org/arab-centre-climate-change-policies>.

the UN launched a UN Coalition on Combatting Sand and Dust Storms, acknowledging the massive transboundary impacts on socio-economic well-being their increase will have.²⁴

6.2 Priorities for reducing the risks of initial impacts and enabling adaptation

The initial impacts of climate change defined by this project focus on three areas: food insecurity, loss and damage as a result of storms, and impaired landscapes unable to support populations. In terms of needed resilience measures, improved **water management** is a theme that runs through each of these, followed by **regeneration of landscapes** and **built infrastructure resilience**. These are far from comprehensive but provide a priority list.

Water management

The countries of the MENA region are frequently characterized as water-scarce, which is why desalination has been a popular solution to the shortage of natural water per capita. This characterization can, however, detract from opportunities for far greater efficiency and resourcefulness than desalination, especially given its impacts on sensitive coastal regions and emissions if powered by fossil fuels.

Demand-side management requires fair and efficient water pricing and regulation. The pricing of water is politically sensitive, as sudden rises in tariffs in Saudi Arabia in 2016 demonstrated. However, pricing water at the cost of supplying it (allowing for constant reinvestment) with higher volume tariffs for industry, and subsidies for those who cannot afford to pay the economic cost, is possible for national supplies of water (Lahn, 2016).

Groundwater is more difficult to control and price. Moreover, there is limited knowledge of groundwater resources although satellite and remote-sensing technologies offer potential. ESCWA commissioned the most comprehensive study to date in which the Arab countries participated (ESCWA et al., 2013). This demonstrated the limits of data and while there are some bilateral agreements between countries over groundwater, few are operationalized (often hindered by conflict) (ESCWA, 2018). Even relative successes such as the Al-Saq/Al-Disi agreement between Jordan and Saudi Arabia in 2015 have not fully resolved tensions.

Priorities for adaptation to future challenges in water management are:

- **Scaling back or abandoning projects and industrial plans that are wasteful or polluting of water** (e.g. the Toshka project in Egypt).
- **Reducing wasteful consumption – particularly by targeting high users such as agribusiness, industry, the commercial sector and large villas.** Fixing leakages in distribution networks and at consumption sites is a priority. Economic pricing of water will be the most important tool in achieving this goal but other steps such as the repair of distribution networks, education and public information campaigns are also essential. Improving water delivery infrastructure and irrigation efficiency are obvious areas that still have much potential. Exchanging practices between countries on industrial and behaviour change holds much potential.

24 <https://unemg.org/our-work/emerging-issues/sand-and-dust-storms>.

■ **Strengthening national institutional frameworks to address conflicting water interests among different users and improving cooperation and coordination domestically between institutions affecting water resources.**

As Mueller et al. (2021) recommend with respect to the countries sharing the Euphrates and Tigris rivers, this will require strengthening the capacity of national institutions relevant to water to enable them to prepare for future conditions and making domestic environmental and water legislation and enforcement much more robust.

■ **Transboundary cooperation among countries and communities in the management of shared rivers and aquifers.** This would require a change in attitudes from zero-sum game to win-win approaches (Shamout and Lahn, 2015). Regional cooperation is challenging, given the weakness of regional institutions. Ideally river management would be conducted at the basin level but in the absence of basin-level organizations, cooperation at subregional and technical level should be pursued where possible. The potential for climate threats may also be an impetus for regional cooperation, for example, between the GCC and Iran and between the countries sharing the River Nile. Climate adaptation measures that strengthen water security for all (Mueller et al. 2021) may be able to be co-designed to increase joint benefits and future cooperation.

■ **Increasing the use of non-conventional water resources such as wastewater reuse and investigating infrastructure that could capture heavy rainfall.**

In Oman, for example, there are experiments with using storm water for groundwater recharge. This will need to be balanced with natural run-off that brings nutrients to the coast, but offers several co-benefits. Wastewater reuse is not a simple matter. It requires additional infrastructure, a high level of organization and effective regulation and monitoring to prevent disease, among both farm workers and consumers. A successful example is As-Samra wastewater treatment plant (currently receiving expansion financing from the EBRD). This treats 100 million cubic metres annually, meeting 80 per cent of its energy demand through its own biogas digester and hydraulic turbines. This is reported to cover almost 10 per cent of farming requirements in Jordan, equivalent to 10,000 hectares irrigated (Millennium Challenge Corporation, 2018).

At the international level, the Glasgow Declaration for Fair Water Footprints for Climate Resilient, Inclusive and Sustainable Development provides a collaborative forum for trading partners to commit to and drive forward action on transformative water management.

Food security and rural livelihoods

Food security must be understood in a much broader light than keeping the shelves stocked. In a time of climate change, planning for food security becomes more complex. It needs to be tackled in a comprehensive way, taking into account the type of agricultural crops and practices, unsustainable water withdrawal and deteriorating water quality on the one hand, and the potential for international food price spikes on the other.

The strongest recommendations from expert interviews were: 'Strengthen preparedness of the agriculture sector' and 'coordinate food export policies and agricultural planning'. Planning requires greater awareness among food producers,

meteorological agencies and early warning systems, as well as insurance to help protect against drought. Shifting away from water-intensive crops as well as to drought-resistant varieties is part of the picture, alongside regenerative practices that are likely to be context specific. These require a long-term outlook and strong farmer engagement.

For example, an option for wheat-growing countries like Tunisia could be to introduce more barley that has lower water requirements (Knaepen, 2021). Shifting to the use of organic fertilizer (which has better water retention properties) and permaculture techniques (which reduce water and chemical inputs and replenish soils through mixed planting) would benefit many farmers. Heatwaves will also affect animals, so protective measures such as growing indigenous trees and adding solar cooling systems in barns and shade netting may be needed (as a UNFCCC report on adaptation to climate change in the Occupied Palestinian Territories suggests) (Smithers et al., 2016). All of the above would require some form of financial support, awareness raising and extension services.



The strongest recommendations from expert interviews were: ‘Strengthen preparedness of the agriculture sector’ and ‘coordinate food export policies and agricultural planning’

National planning would also benefit from cross-border cooperation, especially between riparians, to make sure, for example, that dams are not filled while farmers are planting their crops – particularly important for Iraq and Egypt.

Food security policies should make provision for:

- **nutrition for all**, which means tackling malnutrition and obesity and thus dietary habits. This will have added macroeconomic benefits in relieving pressure on health systems and increasing robustness to disease;
- **affordability** – the cost of food relative to people’s incomes;
- **welfare and social safety nets** that enable the poorest to have access to food staples;
- **raising awareness and promoting the benefits of traditional food diversity** – the traditional cuisines of the region, which are rich in diversity, could be revived, increasing local resilience to shortages in current staples;
- **invigorating rural livelihoods** and thus limiting rural-to-urban migration;
- **assessing the value and environmental costs of agricultural inputs** such as water and fuel;
- **achieving resilience through the right balance of locally produced and imported foodstuffs** (which will involve taking into account how foreign exchange can be generated to cover the necessary imports);
- **establishing reliable regional supply chains and storage**; and
- **reducing and limiting food waste** and, where possible, turning discarded food into compost to return nutrients to the soil.

Regeneration and remediation of landscapes

Much stronger environmental regulation and/or enforcement of that regulation are urgently needed in most of the region. This may be impossible in countries undergoing conflict, while in countries lacking recourse to justice, elite land confiscation and projects that go ahead without proper environmental impact assessments are serious impediments to natural capital.

Ecosystem restoration is at an early stage in the region, although national conservation areas in Lebanon and Jordan show how this can be effective in nurturing threatened species and in encouraging tourism. There are also a range of experiences from across the Mediterranean region, from ecological restoration of rivers in Spain to restoring natural pastures in Egypt (International Union for Conservation of Nature, 2019). Ambitious plans for larger scale tree-planting projects in Jordan and the Arabian peninsula also pose entry points for work on landscape and ecosystem restoration (Kayed, 2020).

Nature-based solutions, such as the use of reedbeds for treating water in Oman and restoring natural coastal barriers like mangroves in eastern Saudi Arabia, will have economic benefits. The UAE is planning a major initiative to do use drones to plant mangroves along coastlines, for example. Restoring indigenous vegetation will also be critical in reducing the escalating damage expected from sand and dust storms. However, currently governments will not always understand such projects as sound economic sense.

Once the international spotlight turns away from nature-based solutions, interest may wane. **There are a number of areas in which the EU could engage to help institutionalize incentives in line with its own focus on mainstreaming natural capital accounting** (European Commission, 2021b). The EU helped to develop, and currently supports the UN's System of Economic Environmental Accounting, launched in March 2021. This aims to enable the contributions of forests, oceans and other ecosystems to complement existing economic accounts (UN Statistical Commission, 2021). This would be a rich area to explore with countries in the MENA region, especially those transitioning from dependence on oil rents and wanting to attract investment in green growth and eco-tourism.

Built infrastructure resilience

All countries, especially those planning major expansions of urban and industrial areas, will need to rapidly adopt a 'systems of systems' approach to planning new developments, resource use and management (land use, mobility, water, energy, waste, etc.) that takes both sustainability of resources and climate resilience into consideration in line with projections to 2100. **In particular, the following are needed:**

- **More stringent regulation and enforcement of building restrictions on low-lying land and natural floodplains** (wadis) and changing practices and mindset in the local planning and construction industry on how to build in harmony with the natural environment.
- **Drainage and sewerage for urban areas.** With more frequent extreme precipitation events, there is the opportunity to benefit from widespread drainage both to increase safety and to enable rainwater harvesting.

- **Buildings retrofitting for adequate weatherization, with particular attention to low income and dilapidated housing and public buildings such as schools and hospitals.** Upgrading using, for example, Trombe walls (passive design elements which store and deliver solar heat for a building), reflective and green roofs, sloping roofs (where heavy flooding is expected), rainwater collection, window shading, solar water heaters, solar cooling and solar PV and can generate a range of co-benefits for immediate well-being while improving long-term resilience to climate change.²⁵
- **Long-term planning to protect utilities given the vulnerability of energy and water supplies** (particularly to address problems with water connection for people suffering from a lack of water connection for several weeks in some regions after cyclones).
- **Improving capacity building and development of skills, from local informal construction to national civil engineering levels, through sharing experiences.** Networks of technical expertise on these issues will enable learning from countries that have suffered similar challenges, particularly in terms of watercourse and disaster management.

6.3 Adapting to much higher temperatures

Many urban areas in the region have grown in a rapid and unplanned way – Dammam in Saudi Arabia provides an example (Abou-Korin, 2011). **Regeneration of these towns and cities – which will be necessary in coming decades for reasons of growing populations, dilapidating infrastructure and weatherization** – should involve the retrofitting and reconfiguration (and in some cases reconstruction) of existing urban infrastructure to increase shading and make it easier to protect residents and workers from much higher temperatures.

Humidity (wet bulb) is a greater threat than temperature rises, given the effects on the human body; projections and early warning systems can help to advise people when to stay inside.

At the same time, regeneration should be used to sensitively shift infrastructure and residential areas away from coastal zones that are threatened by sea-level rise and rising wet-bulb temperatures. Bolleter et al. (2021) make a strong case for this regarding urban areas in the UAE. In exposed coastal areas, incentives for people to move inland over a longer period of time will be cheaper and less destabilizing than sudden mass relocation.

6.4 Perspectives on the EU's role

During the 25 years since the Barcelona Process, the EU has strengthened its relationships with several countries in the MENA region and intends to increase its interaction on climate resilience and sustainability issues in line with the EU Green Deal. Clean energy and energy efficiency, sustainable agriculture, food–water–energy nexus models, circular economy and nature conservation and the use of digitalization as a tool of achieving these ends are all on the agenda.

²⁵ Evidence of the co-benefits of such interventions was revealed through two housing and sustainable energy projects focused on the humanitarian situation in Jordan – the Green Affordable Homes project, a UK Aid-funded Moving Energy Initiative project implemented by Jordan Green Building Council, and Habitat4Humanity and Norwegian Refugee Council's shelter upgrades as part of the IKEA-funded Practical Action-led Renewable Energy for Refugees project.

While experts consulted for this report generally felt that the EU was focusing on some important areas for resilience building in the region, some felt that more could be done to join up and coordinate the EU's planning with other UN initiatives in the region. The EU 'being in it for the long term' was valued. 'The consistency and follow up – this has been really dramatic in making sure you have a lasting change instead of just jumping in and giving money', said one respondent.²⁶

Experts were keen for the climate challenges facing the MENA region to be understood as integrated with those of Europe, given the issue of migration to the north. 'Europe will be on the receiving end of what happens in the region in terms of food, resources, supplies,' said one participant. CASCADES MENA expert workshop participants generally felt that the EU's work related to climate resilience in the region was constructive. However, relating to the corruption concerns mentioned in 6.1, some emphasized the need for greater attention to local transparency and accountability.

The EU's work and projects were well known among experts in the Levant; North African participants were more aware of its activities through the Union for the Mediterranean partnership. In these places, people felt that the EU carried diplomatic leverage as a major player and could therefore encourage governments to give higher priority to climate change and adaptation while also supporting an enabling environment.

6.5 Recommended approaches for the EU

1. **There are strong opportunities for the EU as a major trading partner to the region to promote regional peace and cooperation through alignment with its Green Deal.** The New Agenda for the Mediterranean frames this intention and aligning policies at the EU and member levels will be critical to its achievement. Actions could include financing instruments to support businesses and build the necessary infrastructure, and the geopolitical-level support to foster the diplomatic political will of parties to come to the table. Even where political will is absent, there may be opportunities to enable shared management of natural resources, for example between communities sharing the Jordan River and the Euphrates and Tigris rivers. Joining the Glasgow Declaration for Fair Water Footprints could assist both EU and MENA trading partners in the management of water for productive use.
2. **The EU can provide climate change modelling tools for national and local scenario building and hazard planning.** Early warning systems for all natural hazards is another area that others are already engaging in but there is much to do. The EU is funding 'living labs' for the co-production of meteorological data and services in Africa, which might be able to be scaled.²⁷ The EU has the capacity to help countries in the region to improve knowledge production on climate to inform decision-making and policymaking. The use of Copernicus, the EU's Earth observation programme, could, for instance, enable countries to monitor climate change impacts, especially on land cover and land use (Abdelraouf, 2019). Another recommendation from a workshop participant was to support farmer field schools that support people-centred learning and research to join up local observation and enhance the national picture of climate and environmental change.

²⁶ Expert interviews, March 2021.

²⁷ This programme is called Innovating Climate Services through Integrating Scientific and local Knowledge (I-CISK). (IHE Delft Institute for Water Education, 2021).

3. **Pursuing remedial and post-conflict rehabilitation work that addresses humanitarian needs while fostering long-term environmental resilience is urgently needed.** Increasing humanitarian crises in which degraded environment and climate change worsen life prospects are already a reality in the region. The environment has tended to be a neglected part of the response to the Syria crisis. Work could include, for example, leading a full environmental assessment of conditions in northeastern Syria and parts of Iraq and supporting local action to clean up soil and water (Zwijnenberg et al, 2021).
4. **Building climate resilience in cities and subnational areas of the MENA region by developing technical capacity to address climate-related issues and manage the water–energy–food nexus.** A CASCADES study on urban climate resilience in the MENA (Abdullah et al., 2021) recommended that regional partners such as the EU adopt whole systems thinking at the urban scale rather than ad hoc projects. This requires supporting local capacity building and inclusive governance – especially at the municipal and community levels, increasing EU climate funding for the water–energy–food sectors in cities, and including city networks to support peer-to-peer climate action knowledge exchange as part of the EU’s Green Deal diplomacy in the Southern Neighbourhood. As one regional expert put it: ‘Work with municipalities can become a successful entry point if it can be sustained and supported and solution oriented.’
5. **The way that funds are disbursed must take into account the effectiveness of centralized bureaucracies versus local agencies and other actors in the area concerned.** Value for money requires close attention to good governance and the mechanisms to scale up sustainable finance. Greater inclusion of civil society, youth and vulnerable groups can help increase accountability. There are cases, particularly in conflict-affected areas with reconstruction needs, where a pragmatic, imperfect approach will be needed to do anything at all.
6. **Financial instruments used to build climate resilience can also help to empower local actors and build better national-to-subnational linkages.** The EU could, for example, help to scale up successful projects whereby NGOs have accessed small grants by linking them up with the necessary authorities for continued support or making follow-up funding conditional on effective implementation of a co-created plan. Encouraging moves to enable municipalities to take on and manage capital to pursue resilience and adaptation strategies (as the Greater Amman Municipality does) could also enable effective decentralization.

Appendix

Future scenarios

Given the difficulty of factoring in both technological advances that might change the picture beyond 2035 and the multiple international responses to climate change itself, these scenarios are imagined to run through from 2025 to 2035 and then evolve from there on to 2050. They are based on factors that interviewees expected to be most important in affecting the severity of climate impacts. However, they are not exhaustive. Climate change itself will, of course, interact with these factors but the idea is to consider factors generally external to climate change at this point.

Scenario 1: 'Stagnation'

- **Worsening – Authoritarianism and conflicts**
- **Regional dynamics in the Middle East and North Africa**

Tensions are rising

This scenario is marked by increasing ethno-religious tensions across the region in a context of long-running conflicts.

States remain militarily strong with centralized bureaucracies

Lack of strategy to address long-term issues like border security, food and water security, or climate change. Governance is marked in general by centralized government control with increased authoritarian rule. This allows little room for civil society and reduces inclusion, accountability and transparency. Although moderate bureaucratic efficacy is achieved, economies remain generally rent-based, dominated by state-backed business and large foreign corporate investments. Climate change questions are addressed rhetorically with reactive action and vanity projects rather than long-term planning for climate change impacts in most countries. In most cases, climate change (adaptation) plans and strategies are limited to a country level rather than a regional level. Moreover, end users are not well engaged in the development of climate change plans.

Antagonistic relations and competition inhibit greater integration

Some regional cooperation exists, for instance, through the East-Med Energy Forum, but generally antagonistic relations stymie attempts at greater integration of trade. High food import dependence continues and increases overall. No real cooperation is achieved between riparians and relations are marked by lack of trust and blame without concrete and defined rights and laws.

The wealth gap is rising and education stagnates

Some pockets of affluence remain and increase but there is a rising wealth gap alongside high population growth. With urbanization, new types of crime and violence also emerge in cities. With little attention to education, there is a rising

gap between state and private education. Awareness of climate change strengthens in some parts of the society but conspiracy theories are rife. Economic well-being: balances of trade worsen, debt is rising and jobs are created but underemployment is common.

International context

Internationally, a jolting energy transition and increased energy security policies in major importing countries create volatile to lower oil rents over time. The US retracts from the region and it and other powers provide some uncoordinated and ad hoc aid and security packages. Food price shocks occur sporadically globally with overall higher food costs for the region. Lower than expected global finance is available due to failing international economic systems.

Scenario 2: 'Fragmentation'

- **Porous borders, with new actors and competitive relations**
- **Regional dynamics**

States are fragmenting

This scenario is marked by greater fragmentation of states, the rise of new actors (e.g. brokers/middlemen, military and paramilitary groups, elite groups) and uncoordinated decentralization of power, where transfer of power to local authorities does not happen. Simmering tensions do not allow much greater integration of trade. Food import dependence remains high.

Governance is a mixed picture

Some breakaway regions are supported to improve capacities while others become more feudal. There is greater power for the elite and for the private sector in some areas such as in the energy and agri-food sectors, but less room for the private sector in others.

An imperfect peace with sporadic migration

An 'imperfect peace' exists between groups and countries sharing rivers. There is mixed population growth with some countries' populations reducing due to conflict and migration and others increasing. Black markets are growing in some places and more porous borders mean increased illegal transfer of goods, and trafficking of humans and drugs.

Increasing divides in economic well-being

Awareness of climate change is stronger and some climate adaptation strategies take shape but intergroup tensions and fragmentation inhibit effective and long-term implementation. Increasing divide between private, religious and state-educated groups in society. Balance of trade is similar but mixed. Jobs are created mainly in the informal economy and black market.

International context

Internationally, the US exhibits increased interest in tactical diplomacy in the region, vying with other powers, China and Russia. Energy transition coupled with constraints on production in some places create volatile to medium oil prices. Increased strategic investment by other powers and responsive aid; climate-resilience focused finance and packages make possible some projects. Food prices are volatile with some price spikes.

Scenario 3: 'Cooperation'

- **Gradual peacemaking, sustainability, stability and equality**
- **Regional dynamics**

Gradual peacemaking and stability

This scenario is marked by a gradual decrease in conflict and greater attention to cooperative, diplomatic solutions in the region. This in turn enables increased investment, finance and technology innovation and adoption.

Strengthening institutions and decentralization

There is stronger commitment to institutional governance and diversification pathways. The state system continues but with greater decentralization of authority to local governments, one of the conditions to effective local adaptation. A vibrant private sector and greater flourishing of entrepreneurship is enabled by increased rule of law, regulation and clear market incentives.

Increasing cooperation

Basin management between riparians is more cooperative, with more focus on the needs and capacities of communities and ecosystem restoration. Food import dependence reduces as greater regional trade integration coupled with cooperative water management, and more investment in national diversified food production, increase sustainability.

An educational dividend

There is strong public awareness of climate change and environmental issues that find channels of expression through civil society groupings and are represented in political systems. Population growth reduces and there is greater attention to increasing educational quality and equality, and investment. Balance of trade improves, debt reduces and jobs are increasingly provided by the private sector. Forms of taxation and universal income assist with subsidy reform and the transition away from high carbon export dependence in countries exposed to volatile/decreasing oil and gas prices.

International context

The international community strengthens with greater engagement of multiple parties cooperating over development and security, with coordinated aid and finance, including climate finance. Oil prices rise and then fall – a boom to bust period, as alternative technologies and regulations take hold. Food prices remain volatile to high with some shocks.

Table A1. Regional parameters

Parameter	Scenario 1 – Stagnation	Scenario 2 – Fragmentation	Scenario 3 – Cooperation
Stability level	Worsening – increasing tensions and ongoing armed conflict	Low-level but unresolved conflicts	Gradual peacemaking
Governance	Medium efficacy bureaucratically but rigid and lacking in accountability and rule of law	Less efficacy at national level but with some areas evolving new models of governance	Improving levels of accountability, competency and rule of law
Ecological state	Worsening	Similar to today overall – better in some places, worsening in others	Improving
Economic well-being (trade balance, debt, employment)	Worsening trade balances, rising levels of indebtedness, high unemployment	Similar trade balances but with some areas failing, increase in black markets, trafficking and militarized economy	Improved trade balances, rising employment/universal basic income in some places, reducing debt
Local empowerment (the extent to which power is distributed and ability to make decisions)	Lower	High but uncoordinated	Increasing
Transboundary cooperation	Little – lower than today	Greater, with new actors joining forces around specific ecosystems but with more parties involved and less ability for national coordination	Greater, with moves towards cooperative basin-wide management strategies
Regional trade integration	Similar to today	Small scale – a little more than today but increased through black and grey markets	Greater regional integration of food and materials trade
Population growth	High – similar to today	Medium/mixed – lower than today in some countries, higher in others due to movement of peoples and continuing fertility rates	Reducing, with more girls staying longer in education and delaying marriage
Migration	High rural-to-urban migration, high urbanization, low cross-border migration	Similar urban-to-rural migration, high cross-border migration	Lower rural-to-urban and cross-border migration
Public awareness (and activism) of environment and climate change	Similar	Stronger, but confused	Stronger, well informed

Parameter	Scenario 1 – Stagnation	Scenario 2 – Fragmentation	Scenario 3 – Cooperation
Quality and equality of education	Little attention to educational reform, increasing pressure on state schools – rising gap between private and state educated	More fragmented education system with rise of different types of institution as state schools decline (religious, elite private and NGO-run schools)	Rising, with increased investment and attention to education at all levels. Reduced gap between state and private education
International parameters			
Geopolitical relations – especially US interest (but could be other major power)	Reduced interest from major powers	Tactical major power diplomacy, multipower interests	Strengthened and more aligned engagement of multiple parties
International engagement including on aid and finance (all powers)	Reduced investment; ad hoc, uncoordinated aid and finance efforts	Responsive aid efforts; increased strategic efforts but lack of coordination	Increased investment in and cooperation over development and security
International food prices	Volatile food prices with some shocks and generally higher prices	Volatile food prices with some shocks and generally higher prices	Volatile food prices with some shocks and generally higher prices
International oil prices	Volatile to lower oil rents (average lower than 2010–2020)	Volatile to medium oil prices (similar to 2010–2020)	Boom period followed by terminal decline of oil prices

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