Overview of disaster risk in the Arab region

1.

A. Introduction

Understanding disaster risk has been acknowledged by decision-makers and policymakers as a key priority. Over the past two decades, countries in the Arab region have improved their knowledge on the frequency and severity of natural hazards, and the current exposure captured by the number of people living in certain areas, the total constructed area of a region and the economic value of the built infrastructure within a given city or country. To a lesser extent, countries also performed vulnerability analyses (for one or more dimensions) yielding qualitative and/or quantitative results of the damage susceptibility to an individual external shock, natural or human-made, of a community, a system or the built environment. However, with the increasing complexity and interaction of human, economic and political systems (for example, the international financial system, communications and information technology, trade and supply chains, megacities and urbanization) and natural systems (marine, land and air), risk becomes increasingly systemic.[1] While the era of hazard-by-hazard risk reduction is over, few countries are directing attention to understanding and addressing the large-scale dynamic risks that cut across the economic, social and environmental dimensions of sustainable development.

This chapter presents a regional context of disaster risk, with an analysis of the risk trends, based on available data from global and national disaster loss databases. The emerging regional systemic risks are also reviewed.

1 UNDRR, 2019a.

1. From disaster management to disaster risk management

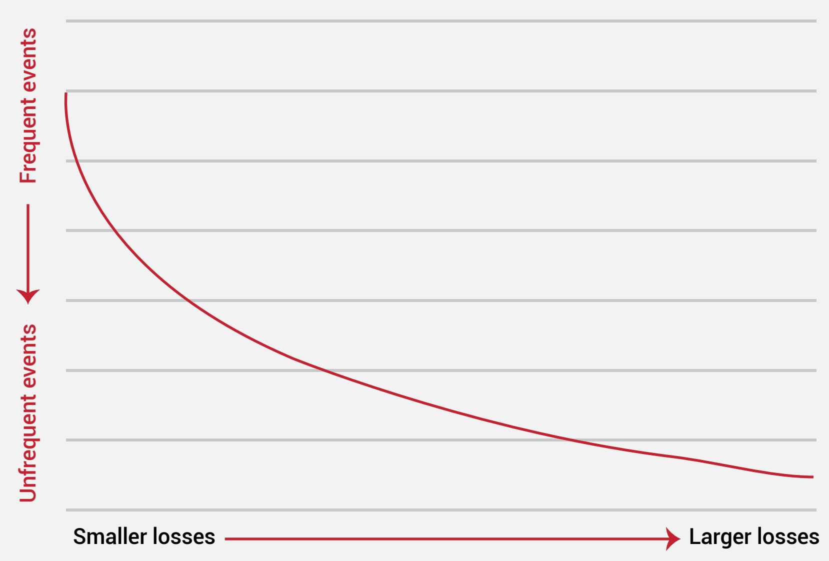
A balanced portfolio of DRM consists of: (i) prospective risk management strategies to prevent risk from accumulating during new investment and development projects, including through land use and urban planning, and to build codes for new structures, networks and systems; (ii) corrective risk management strategies to reduce existing risk, including through resilience building and retrofitting for existing structures, networks and systems; and (iii) compensatory risk management strategies to secure the funds necessary for the recovery and reconstruction phases, as in the case of the insurance instruments. The three approaches face considerable challenges in the region.

In the past two decades, a paradigm shift in DRM has occurred at global level, from managing disasters to managing disaster risk using balanced DRM portfolios. Through the design and implementation of interventions, retrofitting plans and financial disaster planning, certain types of losses have been avoided, and the costs of residual ones reduced. While the region has fallen behind in effecting this shift, it now faces the additional challenge of managing increasingly complex system risks,[2] which require a stepped-up effort to reduce risk before disasters occur.

2. Hazard by hazard disaster loss functions

Stakeholders recognize that new investments have better rates of return if they account for climate and disaster risks; existing investments, however, did not necessarily do this. For these to be effectively managed, disaster losses need to be quantified to contribute to the prioritization of DRR efforts.[3] Determining the consequences in terms of fatalities, internally displaced people and/or economic loss, is not sufficient for managing disaster risk. The outcomes of probabilistic comprehensive risk assessments are usually loss exceedance curves that relate expected losses in one or more dimensions, such as economic losses, fatalities or affected people, with their likelihood (for example, in terms of the return period) in order to inform stakeholders and decision-makers (see figure 1.1 for a schematic representation for one such relationship). These types of analyses are yet to be carried out in the region.

Figure 1.1 Example of a loss exceedance curve



2 UNDRR defines a complex system as one exhibiting emergent properties that arise from interactions among its constituent parts in which relational information is of critical importance to integrate the system. To understand a complex system, it is necessary to understand the dynamic nature of the relationships between each of the parts. In a complex system, it is impossible to know all the parts at any point in time. See UNDRR, 2019a.

3 Ordaz. 2000; Velásquez. and others, 2014; UNDRR, 2017a.

The above models that describe single system vulnerabilities on a hazard-by-hazard basis do not help decision-makers understand and prepare for systemic risks. Indeed, across the world, policymakers face this with the COVID-19 pandemic.[4] By contrast, we do not have models that are able to describe the degree of risk expansion within interrelated complex systems, even at global level.[5]

3. Disaster risk reduction and acceptable risk

Acceptable risk levels are defined in a range of sectors, such as the nuclear and oil industries, and air and terrestrial transport networks. However, whether there should be an explicit acceptable risk threshold is a question that still has no answer. If a threshold is to be set, a multidisciplinary approach is required, one that addresses social, economic and moral issues. Most decisions about risk thresholds are made implicitly by, for instance, choosing a return period for the earthquake design forces in building codes, or defining the height of a defence wall based on the return period of the wave height. While there is consensus that current risk levels are unsustainable, acceptable risk thresholds are not universally agreed. The emergence of complex systems further complicates risk governance, due to: (i) difficulty in attributing accountability; (ii) deep uncertainty surrounding triggers and cascading consequences; and (iii) limited understanding of the systemic nature of many risk contexts.[6]

4. Disasters as a development failure

Disasters are socially constructed and represent a development failure. According to the Intergovernmental Panel on Climate Change (IPCC),[7] the frequency and intensity of climatic events is set to increase, and hence, consideration of climate change in development and DRM agendas is mandatory. An intersecting point between current and future risk is that mitigation of existing vulnerability can be considered an effective CCA measure. Addressing the increased severity and frequency of weather-related events is now believed to be a political responsibility. This highlights the need for risk-informed development, based on transparent assessment of trade-offs, that considers the costs and benefits of preventing, reducing and managing disaster risks.

5. Emerging systemic risks

In our hyperconnected world, triggering events can simultaneously affect multiple, complex systems and geographical regions. The breakdown of entire systems, not only their individual components, must now be considered. The COVID-19 pandemic has provided strong evidence of how a biological hazard, in a short time, may affect, directly and indirectly, all countries around the world. From health to transport, and agriculture to tourism sectors, the virus has had a significant impact in the Arab region, with more than 8 million people potentially pushed back into poverty and food insecurity.[8]

Against this background, the Sendai Framework has expanded the list of hazards that need to be considered, from natural ones to those with biological, technological and anthropogenic causes. The GRAF[9] aims to provide for a systems-based approach to DRR, integrating expertise from multiple disciplines and contributing to the development of risk-informed decision-making based on an understanding of the multidimensional nature and dynamic interactions of disaster risk.

6. Systemic risk and the global development agendas

Global development agendas now explicitly incorporate DRM and disaster reduction considerations. Further, these agendas recognize that services that come from nature are neither free, nor infinite, and that scientific and technological progress, without the political will to bring about a paradigm change, will not achieve sustainable development.[10] Achieving the SDGs requires a transparent and inclusive assessment of the risks, costs and benefits of the development choices to be made. Progress in the Arab Region varies; countries like the United Arab Emirates, Algeria and Morocco

4 UNDRR, 2019a.
5 Ibid.
6 Ibid.
7 Seneviratne and others, 2012.
8 ESCWA, "New ESCWA brief: 8.3 million people will fall into poverty in the Arab region due to COVID-19", 1 April 2020.
9 https://www.preventionweb.net/disaster-risk/graf#tab-1.
10 IDB and Acclimatise, 2020.

report a good performance, achieving up to two thirds of the SDGs, but less developed countries affected by conflict, such as Yemen, Iraq and the Syrian Arab Republic, lag behind.[11]

Eradicating poverty and promoting resilience are common goals across the three main global agendas, with direct links with disaster risk. The urban and rural poor form the group disproportionately affected by disaster losses, especially for small and medium scale disasters that are proven to have, cumulatively, the same – or a larger – impact as extreme events.[12] In the Arab region, these types of events also act as main intensive risk drivers. While development gains have been made at regional level in terms of health, education and poverty eradication, these have not always been risk-informed and hence remain fragile. A single external shock can cause a setback affecting a large share of the population as the COVID-19 pandemic has shown.

B. Natural, environmental, biological, chemical and technological hazards in the Arab region

1. Introduction

The region is prone to natural hazards,[13] some amplified and affected by climate variability and change. Small and medium impact localized events such as flash floods and landslides are seldom recorded in a systematic manner despite having mid- to long-term adverse impacts on affected populations. Other events, including earthquakes, sand and dust storms, droughts, locust infestations and tropical cyclones, affect larger, often transnational regions. The high-impact events tend to remain in the collective memory for a couple of generations.

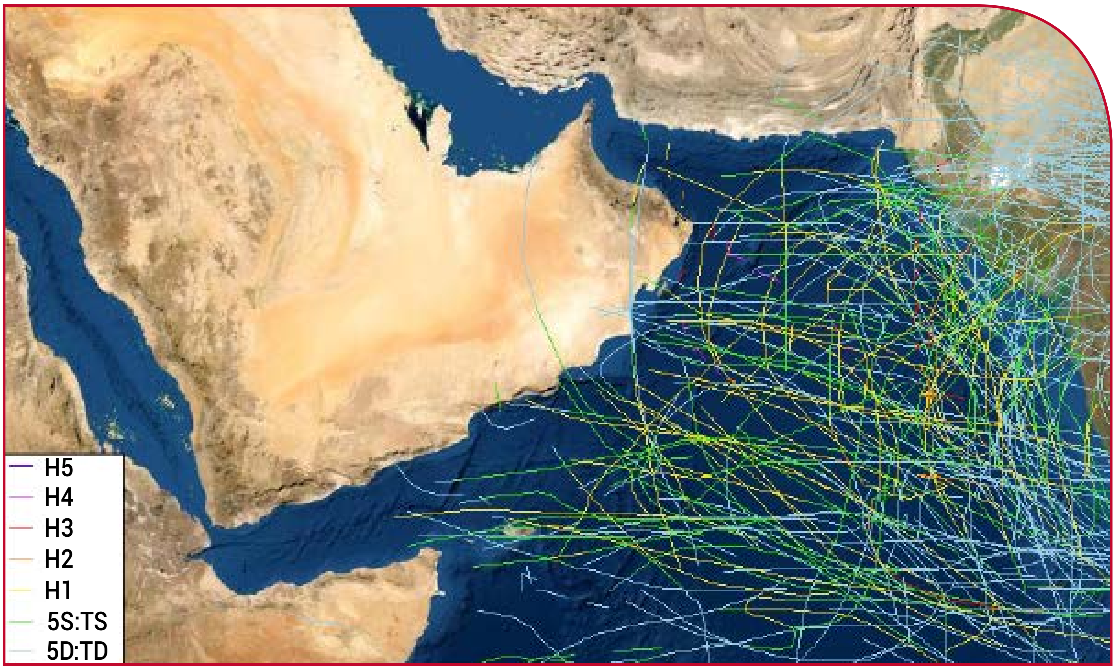
2. Hydrometeorological and climatic hazards

In the Middle East, less than 15 per cent of the population is exposed to medium and high levels of flood hazard;[14] however, the large concentration of people and assets within limited areas makes it a risk that requires attention. From 1970 to date, the total exposed value to floods has increased by a factor of three, while residential buildings, transport and communications infrastructure have accumulated.[15] Continuous urban expansion has required rapid changes in land use. More areas are covered with concrete and pavements, thereby reducing the natural absorption capacity of rainfall in many locations. This is reflected in an increasing number of flash floods in urban areas. A typical example is the 2009 Jeddah flooding, where accumulated precipitation exceeding 90 mm was recorded in less than four hours, equivalent to twice the annual average. This resulted in approximately 150 fatalities, and more than 8,000 houses damaged or affected in a southern zone of the city where most inhabitants were poor immigrant workers.[16]

Tropical cyclones generated in the North Indian Ocean basin can also make landfall in Arab countries such as Oman, Yemen, Somalia and Djibouti, with strong winds, storm surges and floods of varying degree. The 2007 Tropical Cyclone Gonu, for instance, affected some 20,000 people in Oman, causing more than $4 billion in losses.[17] In 2018, Cyclone Sagar made landfall in Somalia, causing large economic losses, with damage to crops and livestock and the displacement of thousands of people.[18] Cyclone Kyarr in 2019 was the most intense storm recorded in the past 12 years. High waves and the storm surge disrupted road networks in the United Arab Emirates, highlighting the need to account for damages and disruptions in infrastructure systems that have a critical role in emergencies, acting as evacuation routes, and ensure a prompt response by primary agencies. Coastal locations in Yemen and Oman were also affected by strong winds and moderate storm surge[19] (figure 1.2 for historical tropical cyclones that have affected Oman).

11 Luomi and others, 2019.
12 Marulanda, Cardona and Barbat, 2011; Velásquez and others, 2014.
13 DRR terms in this report adopt the open-ended intergovernmental expert working group on indicators and terminology, see United Nations General Assembly, 2016a.
14 Dabbeek and Silva, 2019.
15 De Bono and Chatenoux, 2015.
16 Youssef and others, 2016.
17 Fritz and others, 2010.
18 ACAPS, 2018.
19 Global Weather and Climate Centre, 2019.

Figure 1.2 Historical tropical cyclones in the region on the Saffir-Simpson scale (1881–2019)



Source: National Oceanic and Atmospheric Administration, 2020; NHC HURDAT data, see at http://www.nhc.noaa.gov/pastall.shtml; and IBTrACS data, see http://www.ncdc.noaa.gov/oa/ibtracs. Earthstar Geographics.

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

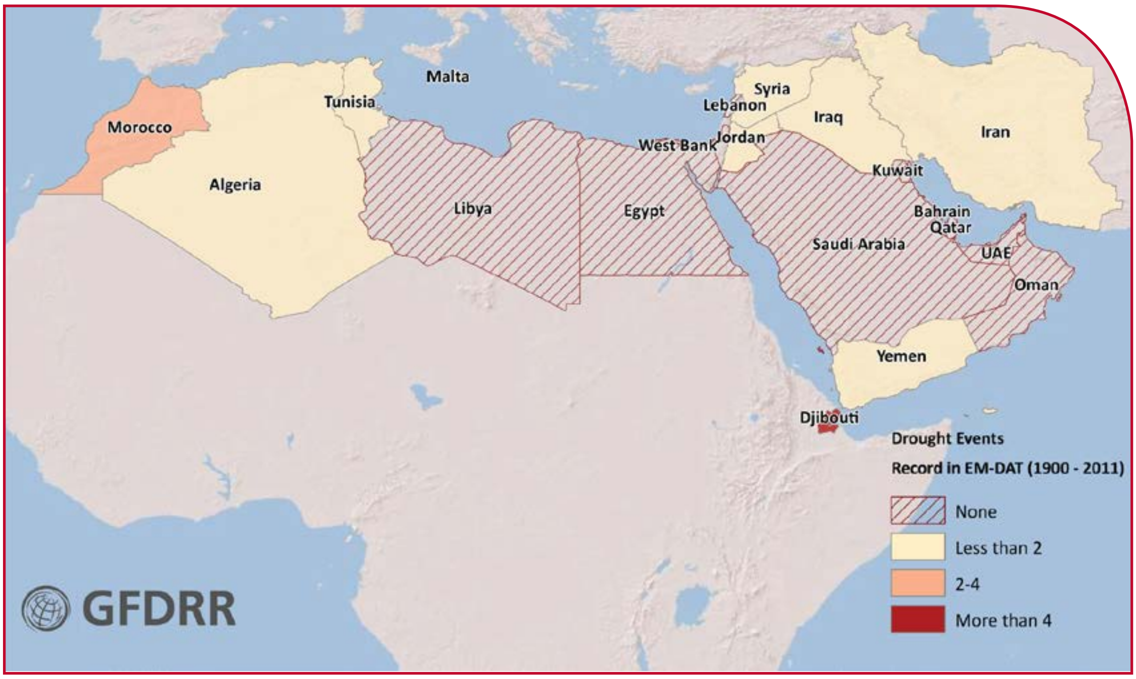
Two of the 22 Arab countries, the Comoros and Bahrain, are Small Island Developing States (SIDS) and, as such, are recognized as facing considerable challenges related to DRM and disaster reduction. Climate change, mostly rising sea levels and droughts, is a permanent threat to their people and infrastructure, with most countries having limited space for relocation to reduce exposure. Simultaneously, increasingly severe and frequent storms impact large zones of the SIDS, pushing the response capabilities of local and national services beyond their limits.

Over the past 50 years, droughts in the region have had the largest cumulative impact in terms of death, affected people and economic losses, their frequency and severity shaped by climate variability.[20] They have caused considerable losses among the rural poor in Iraq, Morocco, the Syrian Arab Republic and Jordan, reflected in the decrease in land fertility, agricultural production and the loss of livestock and biodiversity.[21]The arid and semi-arid conditions in many parts of the region, combined with natural and anthropogenic causes, also lead to sand encroachment. Sand accumulation in coastal areas, along streams and on cultivated and uncultivated land, has caused damage to infrastructure, mostly roads and buildings, the loss of plantations, and a decrease in crop yields in countries such as Algeria.[22] Wildfires are a problem in Mediterranean countries; in Lebanon more than 1,200 wildfires have been recorded since 1981.[23]

From 1900 to 2011, 28 drought events were recorded across nine countries in the region, affecting 44 million people. Drought hazard data remain limited given the slow onset nature of the hazard, lack of a solid definition and insufficient measurement systems (figure 1.3).[24]

20 CRED, 2020.
21 Van de Steeg and Tibbo, 2012; FAO, 2019a.
22 Boulghobra, Saifi and Fattoum, 2015.
23 CRED, 2020.
24 World Bank, 2014.

Figure 1.3 Drought hotspots in the Arab region



Source: World Bank, 2014.

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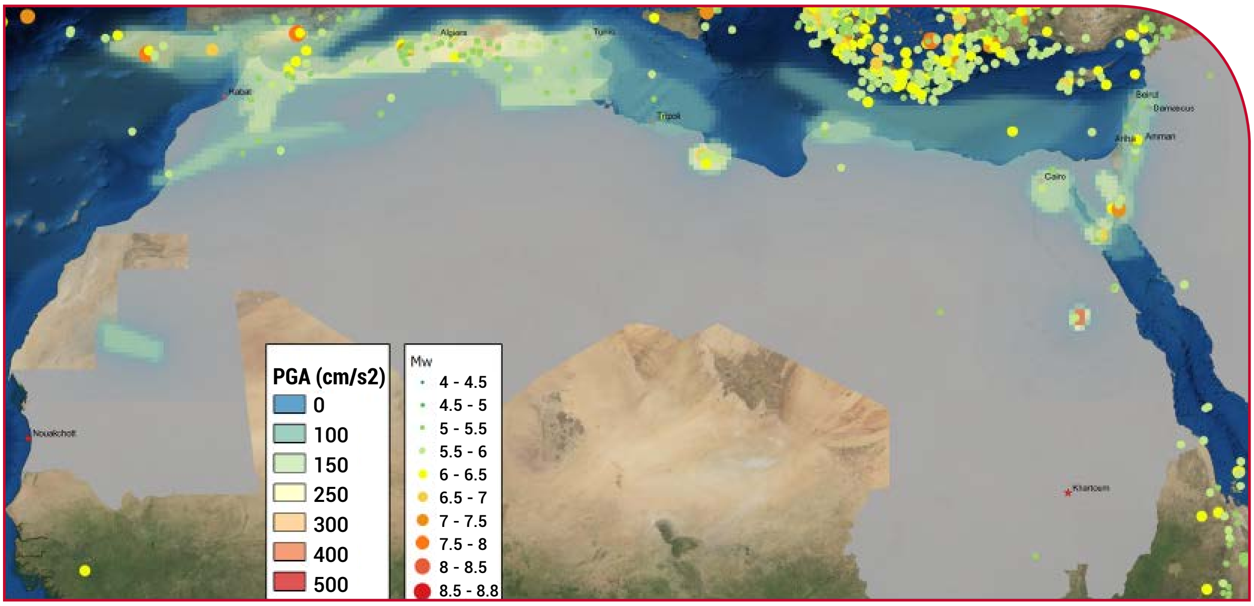
3. Geological hazards

The region is prone to geological hazards such as earthquakes, landslides and tsunamis. Studies have indicated that more than 30 per cent of the Arab population live in areas with medium and high earthquake hazard;[25] most urban centres and settlements within the Maghreb and Mashreq[26] regions lie close to seismically active areas. In the past 60 years, moderate and large earthquakes have destroyed urban areas in Algeria, Egypt and Morocco, and there are recordings of vast destruction caused by the ground shaking in Lebanon, the State of Palestine and the Syrian Arab Republic during the past 2,000 years. In highly urbanized contexts, managing earthquake risk must be a priority; a single event lasting a few seconds can transform the latent accumulated risk into fatalities, injuries, displacement and economic losses. Figure 1.4 shows the instrumental seismicity recorded in North Africa and Eastern Mediterranean, together with an earthquake hazard map depicting the peak ground acceleration (which is equal to the maximum ground acceleration occurring during earthquake shaking at a location) for the 500-year return period. Earthquake hazard for the region as a whole is defined as intermediate and high, despite several locations not recording seismic activity in the past 100 years.

25 Ordaz and others, 2014.
26 UNESCWA Maghreb countries are Algeria, Libya, Morocco and Tunisia; Mashreq countries are Egypt, Iraq, Jordan, Lebanon, the State of Palestine and the Syrian Arab Republic.

Figure 1.4 *Historical seismicity and earthquake hazard map for the Arab region*



Source: Evaluación de Riesgos Naturales, 2020.

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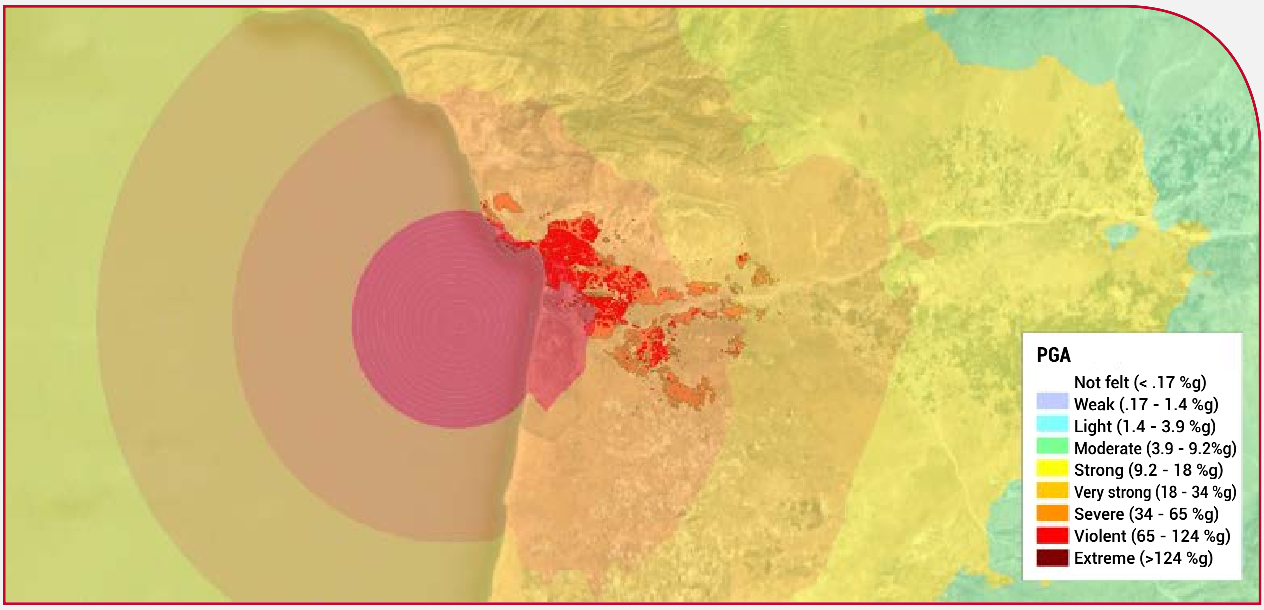
Box 1.1 *The 1960 Agadir earthquake, Morocco*

Agadir is the capital city of a prosperous region, and in 1960 was home to 36,000 people. Minutes before midnight on 29 February, a ground shaking lasting less than 20 seconds caused by an earthquake with moderate magnitude (Mw 5.8) led to the deaths of 15,000 and injured 12,000 more. Some 3,500 houses were destroyed and 20,000 people rendered homeless, with economic losses of about 60 per cent of the total exposed value. Although the city lies in an intermediate earthquake hazard zone, no recorded earthquakes since 1731 had resulted in low earthquake risk perception and a risk accumulation in the form of poorly built homes.[a]

Today, Agadir has a population of more than 400,000, and is normally an active domestic and international tourist destination. It has an important fishing industry and a port for exporting Moroccan goods. A seismic building code was utilized in the city's reconstruction for the design of new structures and the retrofitting of existing ones, under comprehensive urban planning that included abandoning the most affected areas. Despite this, unsound construction practices that pose a risk to inhabitants and the built environment remain.

Although another earthquake with a similar or larger magnitude could occur in Agadir, now a more highly populated city, a low risk perception remains among many of its inhabitants. Figure 1.5 shows the ground acceleration values of the 1960 quake superimposed on the built environment in the urban area. There are currently some 55,000 buildings and houses, and a simulation considering similar ground shaking intensities as in 1960 indicates that approximately 35 per cent of those would suffer moderate to severe damages, and more than 5 per cent would collapse. If these results are not comparable to the earlier losses in relative terms, in absolute terms the impact could be considerably larger. Although disaster risk is usually quantified in terms of losses, intangible effects such as human suffering should not be overlooked.[b]

Figure 1.5 Current exposure and PGA of the 1960 M5.8 earthquake in Agadir, Morocco



Source: United States Geological Survey (USGS), 2020.

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a Plufke, 1960.
b Paradise, 2005.

Some countries are exposed to tsunamis triggered by earthquakes, even if they have not occurred in the recent past. Regional and global studies[27] indicate events in the Indian Ocean can cause tsunamis capable of reaching the Horn of Africa. For example, in December 2004, tsunami waves from the Sumatra earthquake reached the coast of Somalia, more than 10,000 km away, causing approximately 300 deaths, displacing 50,000 people[28] and damaging many fishing boats.

The tsunami hazard map for the 500-year return period in the region indicates coastal locations in Oman and Somalia are expected to have tsunami waves of up to 5 metres (figure 1.6). Countries with Mediterranean coasts, such as Egypt, Morocco and Libya, are also exposed to tsunami hazards. In addition, there are records of historical tsunamis in Beirut (551), and the destruction of ships and large recorded waves in Tripoli[29]. Along the Syrian coast, there are records of the withdrawal of the sea shoreline, or drawdown, after the 859 and 1202[30] earthquakes.

Active volcanoes in the region are mostly located in western Saudi Arabia and Somalia. The eruption of Jabal Yar Volcano in Saudi Arabia, close to the border with Yemen, was recorded in about 1810, with a relatively small Volcanic Explosivity Index (VEI2) but with lava flows. Landslides are small-scale disasters that occur in localized areas with particular geological and topographical characteristics.[31] Between 1981 and 2019 in Lebanon there were at least 75 landslides, and although they had a small to moderate impact, their cumulative effects may have been significant;[32] a lack of consistent records on landslides losses contributes to underestimation of disaster risk at regional level.

27 Norwegian Geotechnical Institute and Geoscience Australia, 2015; Kumar, 2008.
28 Tsunami Inter Agency Assessment Mission, 2005.
29 Darawcheh, 2000.
30 Sbeinati, Darawcheh and Mouty, 2005.
31 Centre for the Observation and Modelling of Earthquakes, Volcanoes and Tectonics, 2020.
32 CRED, 2020.

Figure 1.6 Tsunami run-up height for 500-year return period

Source: Norwegian Geotechnical Institute, Australia, Department of Industry,/and Geoscience Australia, 2015.

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4. Biological hazards

In the region, biological hazards of different types have been present. It has been affected by epidemics, mostly related to cholera and yellow fever. More recently, the COVID-19 pandemic has highlighted the complex systemic risks latent across health, social, economic and environmental systems. In addition, rainfall variations and increased vegetation can lead to locust infestations. Morocco, Libya and Tunisia are exposed to this hazard, with significant social and economic impacts. Heavy rains in Saudi Arabia in 2018 gave rise to several locust swarms in 2019. They remain an ongoing problem, affecting more than 20 countries and raising fears of food shortages. These countries are experiencing high levels of food insecurity, potentially impacting on more than 20 million people.[33]

Box 1.2 COVID-19 pandemic in the Arab region

All 22 Arab region countries have reported COVID-19 cases, the latest being Yemen, whose first case was confirmed on 9 April 2020.[a] Most have taken measures to minimize the impact of the coronavirus, such as closing borders, public places, schools and religious sites. However, the lack of universal health service coverage in many countries, together with the prevailing social fragility and high population density that is said to facilitate contagion, make the region in general ill-prepared for such an event.

Preliminary estimates by UNESCWA quantify the direct economic impact of the pandemic in the region as a contraction of $42 billion of gross domestic product (GDP). Although countries such as the United Arab Emirates, Qatar, Saudi Arabia and Egypt have secured billions of dollars to boost their economies and encourage activity in critical sectors, most do not have the means to apply similar measures. Further, the enforced closure of sectors such as tourism in Tunisia, Morocco, Jordan and Egypt, where it accounts for about 10 per cent of their GDP, will be reflected in the loss of more than 1.5 million jobs. Many Arab countries in the Mediterranean region also have close geopolitical and commercial relationships with other European countries heavily affected by the pandemic, including Italy, France and Spain. For most countries in the region, COVID-19 has become an exacerbating factor for existing development challenges, thereby highlighting the importance of integrating biological hazards in DRR strategies using a systemic risk management lens.[b]

a UNDP, "Covid-19 in the Arab region". Available at https://www.arabstates.undp.org/content/rbas/en/home/coronavirus.html.
b UNESCWA, 2020a.

33 Benaim, 2020; FAO, "Desert Locust upsurge continues to threaten food security in Horn of Africa and Yemen despite intense efforts", 2020.

5. Chemical and technological hazards

The complex infrastructures of oil and hydrocarbon industries in the region are susceptible to failures during normal operations due to poor maintenance or external shocks. There have been advances in procedures for extracting, storing and transporting oil and gas, though there is a lengthy record of historical events that have resulted in spills and explosions.

During the 1991 Gulf War, more than 1 million m^3 of crude oil ended in the sea along Saudi Arabia's coastline.[34] In 2004, a poorly maintained boiler in a liquefied natural gas plant in Algeria exploded, killing 27 people.[35] The consequences of such events can reach beyond chemical and technological fields. They significantly impact on nature and the environment, affecting ecosystems and having social and economic repercussions. For instance, potable water can become contaminated, and in fishing communities, existing vulnerability to climate change and hydrometeorological hazards can be severely aggravated by water contaminated with chemicals, highlighting the need for a systemic approach to managing disaster risk.

There are several conventions for managing and transporting hazardous chemicals, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Stockholm Convention on Persistent Organic Pollutants.[36] The control of major accidents and hazards in chemical and industrial factories forms part of DRR efforts across economic sectors, where specific regulations are developed to assess, reduce and manage residual risks, including the Control of Major Accidents and Hazards Regulations[37] and the Strategic Approach to International Chemicals Management.[38]The Beirut port explosion on 4 August 2020 is testament to the potential of major accidents to cause damage that can run into billions of dollars,[39] with a consequent impact on public safety,[40] thereby underlining the importance of risk governance and accountability.[41]

C. Exposure

The region's geographical and geological characteristics have driven Arab communities to build on coastal, mountain, valley and riverside locations because of the obvious benefits in trade, agricultural production, water access and communications. More than 90 per cent of the total population now lives on approximately 3 per cent of the land surface,[42] and this concentration of exposure[43] has been mostly overlooked. Further, since the 1950s, the regional economy has grown at a much higher rate than the population, resulting in the transformation and alteration of ecosystems, mostly to cope with food demand.[44] This has impacted on biodiversity and increased the exposure and vulnerability[45] to hazards, leading to high disaster risk levels. A paradigm shift is required to enable economic development to be considered a tool for achieving safe, inclusive and resilient communities that leave no one behind, and endeavour to reach the furthest behind first.

1. Exposure of the built settlements

Figure 1.7 shows the location of rural and urban built settlements across the region. Many capital and large cities such as Rabat, Algiers, Tripoli, Kuwait City and Muscat are located within kilometres of the shore. These coastal locations

34 Linden, Jerneloev and Egerup. 2004.
35 Oil and Gas Journal, 2004.
36 The Hazardous Chemicals and Wastes Conventions.
37 Control of Major Accident Hazards Regulations 2015 (COMAH). Available at hse.gov.uk.
38 https://www.saicm.org/.
39 World Bank, "Beirut Rapid Damage and Needs Assessment (RDNA)", 31 August 2020 .
40 Abouzeid and others, 2020.
41 Fakih, 2021.
42 UNDP, Bahrain Center for Strategic and International Studies and Energy and UN-Habitat. 2020.
43 Exposure is defined as the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas, see United Nations General Assembly, 2016a.
44 UNDP, 2018a.
45 Vulnerability is defined as the conditions determined by physical, social, economic and environmental factors or processes that increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards, see United Nations General Assembly 2016a.

increase the exposure of their populations and infrastructure to hazards, including storm surge, sand encroachment, coastal erosion and tsunamis. Slow onset hazards such as rising sea levels can also pose problems in the medium and long term, and should therefore be taken into account in social, economic and urban development plans.

Figure 1.7 Location of built settlements in the Arab region

Source: WorldPop, 2018.

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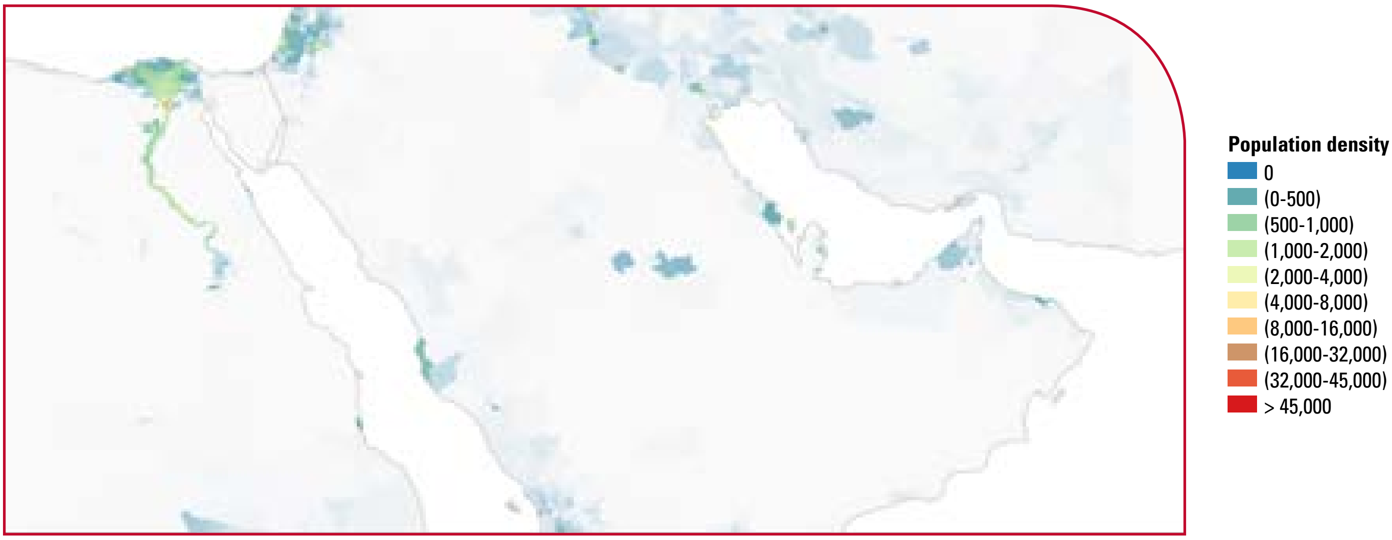
2. Exposure of population

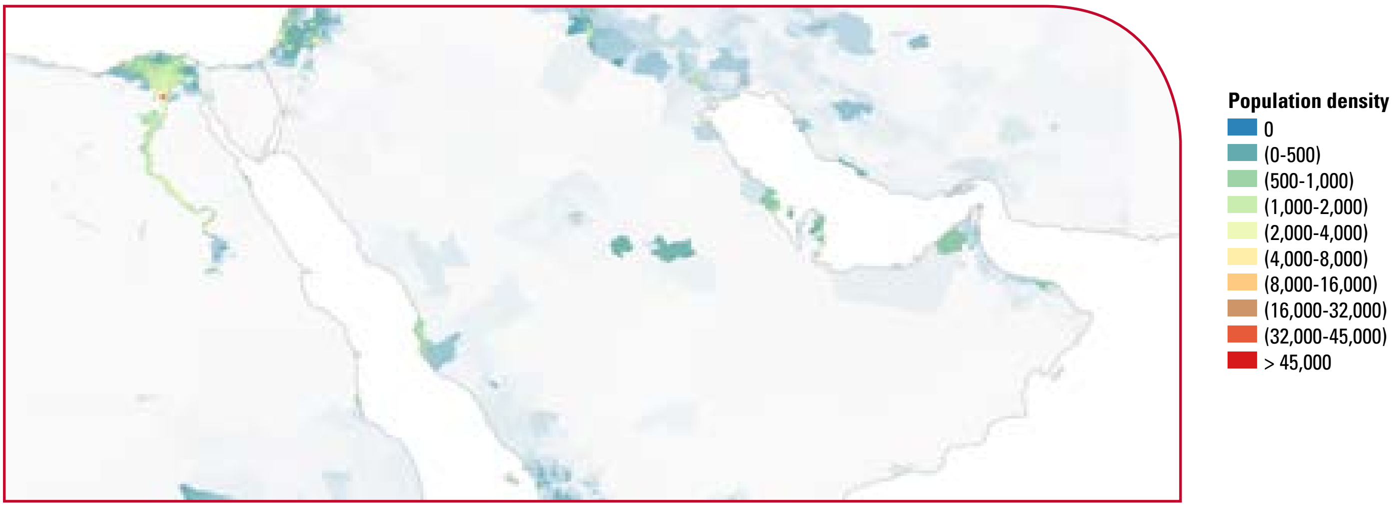
Figure 1.8 shows the population density in the northern Arabian Peninsula and eastern Egypt for the years 2000, 2010 and 2020, aggregated on pixels of 1x1 km. A significant increase in density can be observed in several places, but no major variations in the location, with new settlements appearing around previously existing urban centres. Growing populations in densely built areas put pressure on economic growth due to changes in the demand for goods and services in an environment with many constraints. These processes will continue to transform societies and economies in the region.

Figure 1.8 Aggregated population density in 1x1 km cells, 2000, 2010 and 2020

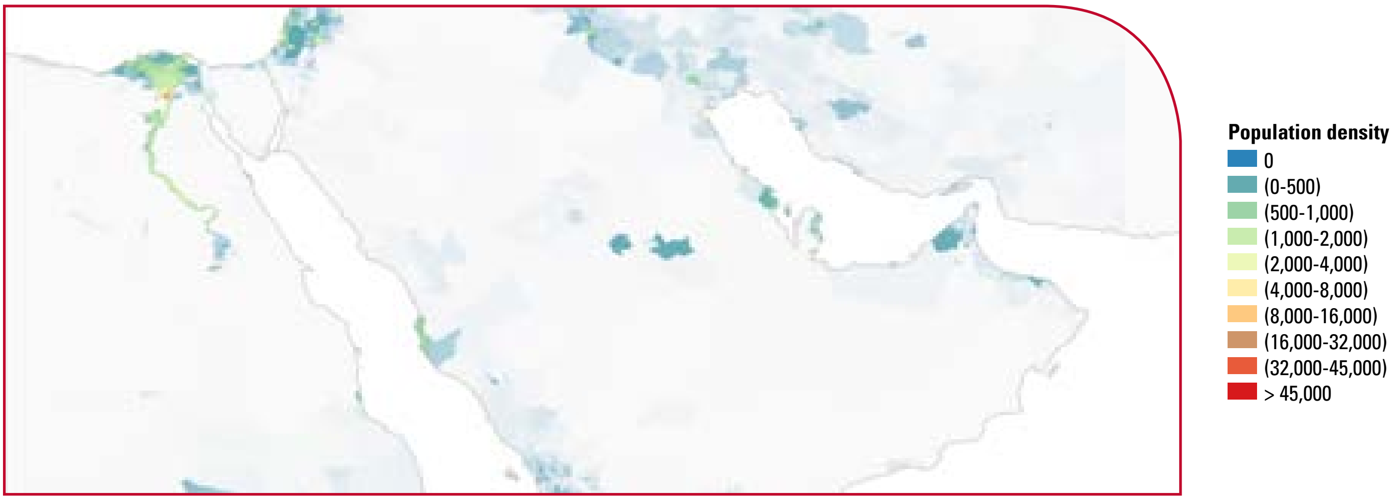
2000



2010



2020



Source: NASA, 2020a.

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3. Exposure databases for the Arab region

Exposure databases have different resolution levels depending on available information, allocated resources and expected use. Relevant information may include main usage and the state of infrastructure, construction date and material, number of occupants and economic value. Since 2013, under the Global Risk Model framework,[46] a coarse-grain, multi-hazard exposure database was developed for urban regions, including population, buildings and local infrastructure. In 2015 and 2017, this database was refined and extended to provide coverage at rural levels. The aim is to raise awareness and inform DRM and development policy at national level. In many cases, particularly in the least developed countries (LDCs), the data filled a gap in exposure knowledge and assessments, and informed the decisions and actions of local and international public and private stakeholders. Figure 1.9 shows the total economic exposed value at country level as per the global exposure database, disaggregated in 5x5 km pixels for the region.

46 Cardona and others, 2014.

Figure 1.9 Total exposed value at country level (left), and example of disaggregation in 5x5 km pixels (right), as per Global Exposure Database

Source: De Bono and Chatenoux, 2015.

Note: The designations employed and the presentation of material on these maps do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

More recent studies have provided higher resolution information on building typologies,[47] focusing on residential building stock with a more detailed overview of the characteristics of buildings and houses. In countries with the highest income levels and newest infrastructure, such as Bahrain, Qatar and the United Arab Emirates, more than 80 per cent of the residential exposure corresponds to well-built units of reinforced concrete. In countries heavily affected by armed conflict, such as Iraq, the Syrian Arab Republic and Yemen, more vulnerable earthen and masonry houses are found. Continuous and systematic updating of the databases is required to account for newly built areas and changes in the attributes of existing assets.

Box 1.3 Country risk profile for the Comoros

A country specific risk profile was developed for the Comoros in 2014,[a] based on a probabilistic risk assessment for earthquakes and tropical cyclones with a resolution level that allowed a disaggregation of results by sector. The private residential sector had the largest absolute and relative average annual loss. The public sector, although having a lower exposed value, had the same risk levels in relative terms. For instance, public administrative offices and urban infrastructures (ports and bridges) had a large share of potential losses with impacts on other dimensions.

These results will inform the drafting of DRR policies and recommendations at national level, while building the public sector's capacity in the use and understanding of risk assessment results. Continuous support for such initiatives can promote DRM and mainstream it at local levels.

a Ingeniar, 2014.

D. Vulnerability

Vulnerability has social, economic, environmental and physical dimensions, with health falling under the social dimension. Different methodologies have been developed to account for social vulnerability[48] that exacerbates direct losses assessed by physical dimension approaches at global levels.[49] Vulnerability analyses at regional level, however, mostly cover the physical dimension. Understanding the vulnerability of complex social, economic and environmental systems – which cannot be captured using a siloed approach – will require more effort.

47 Dabbeek and Silva, 2019.
48 Cutter, Boruff and Shirley, 2003; Cardona, 2001; Carreño, Cardona and Barbat, 2007; Salgado-Gálvez and others, 2016a, 2016b.
49 UNDRR, 2017a.

1. Water, food and energy insecurity

Low crop yields in the region have made most Arab countries net food importers, increasing vulnerability to food insecurity for a large share of the population. Food demand has long exceeded domestic agricultural production and will continue to do so in the coming years. Further, unresolved conflicts, and the resulting loss of livestock, destruction of machinery and disrupted market access, are a key driver of food insecurity, discouraging the required investment in the agriculture sector. These factors exacerbate the overall vulnerability and need to be integrated within comprehensive risk assessments.

2. The rising uncertainty

A medium and long-term overview is required to assess future trends in hazards, exposure and vulnerability. The confidence level of climate change data actually improves over time, assuming a conservative emissions trajectory. However, disaster loss databases are based on observed historical data, while those for climate change focus on future projections based on various scenarios. Information on disaster losses reflects the historical record and should not be considered a reliable indicator of the future due to uncertainties that go beyond the frequency and severity of future hazardous events.[50] Indeed, uncertainties regarding the exposure in 30, 40 or 50 years are extremely high, even more so under conditions of unplanned urban expansion. Further, uncertainties due to the growing complexity of human financial, economic, social, health and political systems, and their interaction with environmental systems, are increasing. Uncertainty due to our limited understanding of the systemic nature of risk within and between these systems is also present. Such considerations should be accounted for when assessing vulnerability associated with future hazard scenarios.

3. Limitations of siloed vulnerability analysis

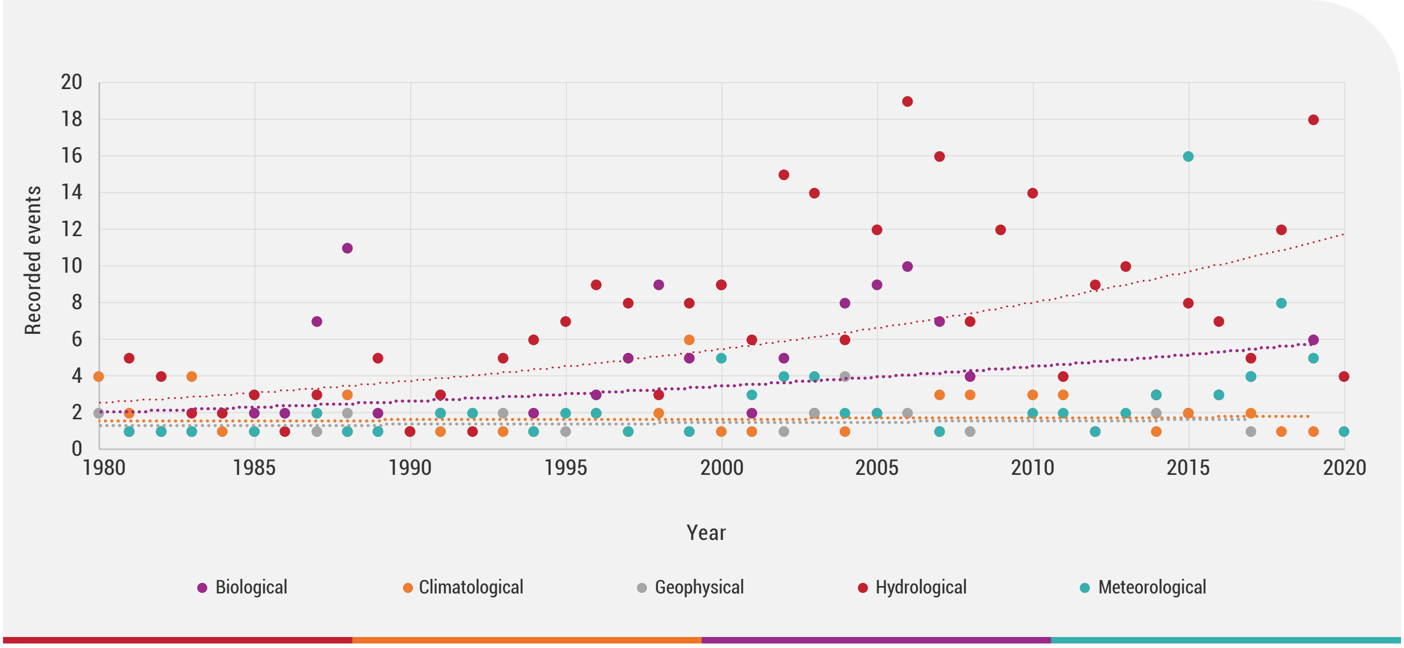
Progress has been made in developing multi-hazard risk assessments in different regions of the world (such as the Global Risk Model facilitated by UNDRR), often corresponding to a set of hazards without accounting for the interaction between them.[51] Recent events have shown that individual failures in one component or system, depending on the characteristics, complexity and integration levels of the system, can be amplified, leading to disruptions with catastrophic and unpredictable consequences. Current siloed exposure and vulnerability analyses can serve as the bases for expanding the coverage to other hazards and systems. Collaborative efforts towards defining data standards and accessibility, quality control and assurance are needed with experts from different disciplines. A paradigm shift in managing disaster risk, from the traditional siloed approach to a more comprehensive and holistic one, is required. The use of entry points to link CCA, conflict mitigation, sustainable development and DRR is one possible way forward.[52]

E. Risk trends in the region

A review of disaster risk trends by country and type has already been carried out.[53] This section provides a regional overview of risk trends based on available data. Figure 1.10 shows the number of events by subgroup and year between 1980 and 2019, based on the Centre for Research on the Epidemiology of Disasters, or CRED, international emergency events database (EM-DAT);[54] national disaster loss databases are not homogeneous or updated for most countries.[55] Analysing events within a relatively short observation period should proceed with caution; a country not having been affected by a severe event in recent decades is not indicative for the future.

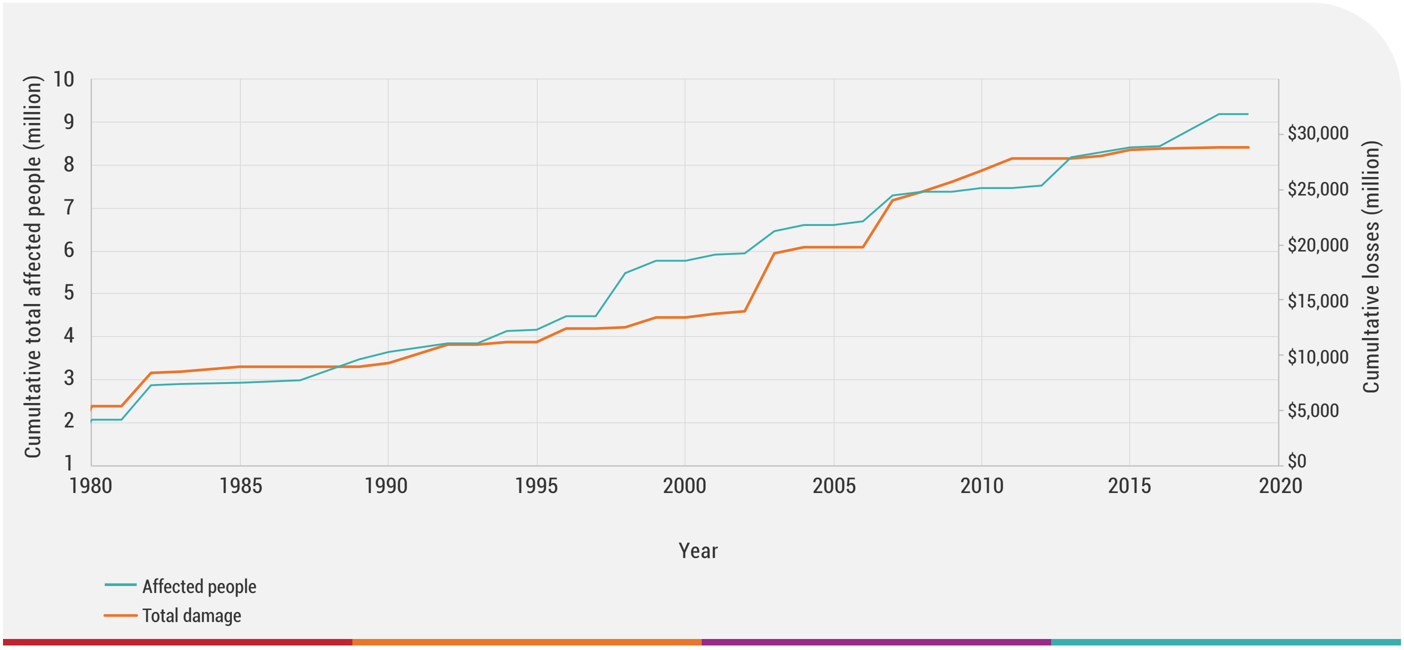
50 UNDRR, 2019a.
51 Ordaz and others, 2019.
52 UNDRR, 2019a.
53 UNDRR, 2020a.
54 CRED, 2020.
55 Of the 22 countries, 10 have UNDRR DesInventar national databases, with only Lebanon and Jordan having cut-off date of 2019.

Figure 1.10 *Disasters by type and year in the Arab region, 1980–2019*



Source: Centre for Research on the Epidemiology of Disasters (CRED), 2020.

Figure 1.11 *Regional cumulative total damages and affected people in current $, 1980–2019*



Source: CRED, 2020.

Figure 1.11 shows the cumulative number of total affected people and economic losses over the same period in the Arab region. Both dimensions have similar trends, and the impact of large events such as the 2003 Boumerdes earthquake in Algeria and Cyclone Gonu in Oman in 2007 is clearly visible. Exposure and vulnerability have increased significantly in the region, leading to an increase in absolute losses without requiring variation in the frequency or intensity of hazards.

Table 1.1 shows 10 events from the EM-DAT database causing the largest damage, in United States dollars (current 2020). Sudden onset events such as earthquakes and tropical cyclones are the most common, although the 1999 drought that affected Morocco is also included.

Table 1.1 Events with the 10 largest total damages in the Arab region

Year	Country	Event	Total damages (M USD)
1980	Algeria	Earthquake	$5,200
2003	Algeria	Earthquake	$5,000
2007	Oman	Storm	$3,900
1982	Yemen	Earthquake	$2,000
1992	Egypt	Earthquake	$1,200
1996	Yemen	Flood	$1,200
2010	Oman	Storm	$1,000
1982	Yemen	Flood	$975
1999	Morocco	Drought	$900
2009	Saudi Arabia	Flood	$900

Source: CRED, 2020.

Table 1.2 Events with the 10 largest total damages in the Arab region, relative to GDP

Year	Country	Event	Total damages (M USD)	Relative to GDP (%)
1996	Yemen	Flood	1,200	20.7
1980	Algeria	Earthquake	5,200	12.3
1983	Comoros	Storm	23	12.0
2007	Oman	Storm	3,900	9.3
1992	Jordan	Extreme temperature	400	7.4
2003	Algeria	Earthquake	5,000	7.4
1992	Egypt	Earthquake	1,200	3.2
1985	Comoros	Storm	6	2.8
1987	Comoros	Storm	9	2.7
1992	Lebanon	Storm	155	2.7
1999	Morocco	Drought	900	2.2
1990	Tunisia	Flood	243	2.0

Source: CRED, 2020.

Absolute losses are not a comprehensive overview of the impact of events on a country's GDP. For instance, at global level, Japan and the United States have the largest absolute expected losses for earthquakes and hurricanes,[56] but not as a percentage of their GDP. Table 1.2 shows the events reported by EM-DAT where losses have equalled or exceeded 2 per cent of the country's GDP.

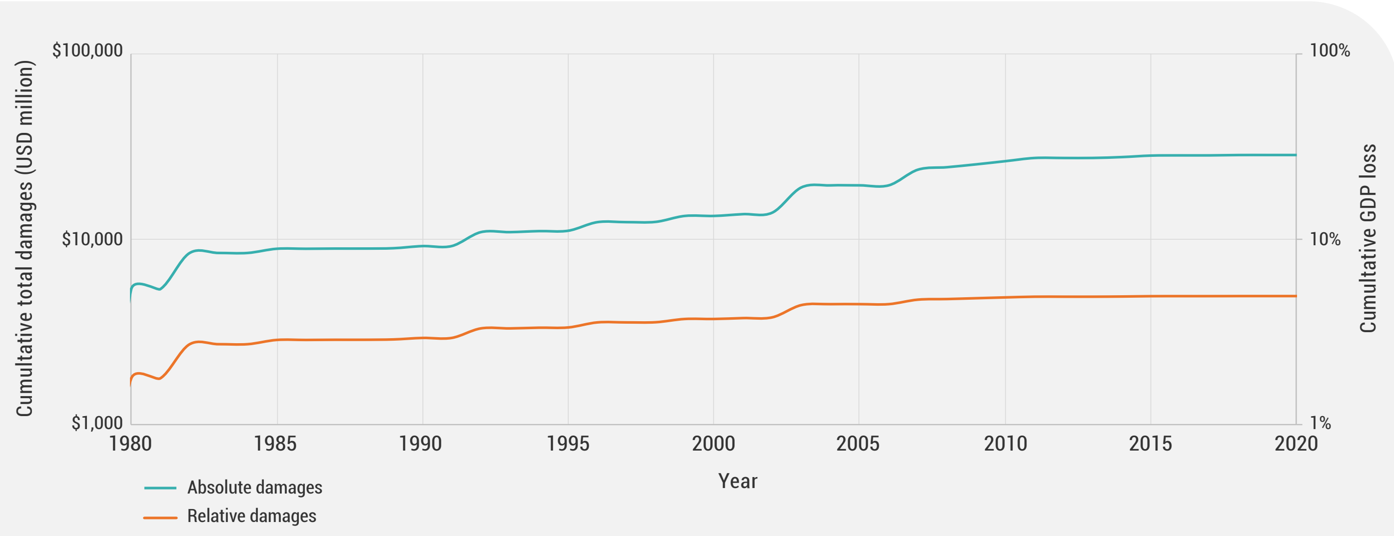
Drought has the largest cumulative impact in terms of deaths and affected people. It is the costliest type of disaster, with reported losses of $29.742 billion over the past 50 years. The practice of reporting economic losses means those recorded with EM-DAT over the period 1970–2020 are a fraction of the real total for all countries, including low-income countries, which make up 59 per cent of total losses.[57]

56 UNDRR, 2017b.
57 CRED, 2020.

SIDS are highly exposed to extreme events; for example, since 1980 the Comoros has been affected by at least three tropical cyclones, with total damages relative to GDP exceeding 2 per cent, a value large enough to set back social and economic aspects (table 1.2). Without financial preparations this necessitates a reallocation of resources, with resulting delays in infrastructure and social development investments, or requires international assistance. Figure 1.12 shows the cumulative total damages in absolute and relative terms (to GDP) in the region for the period 1980–2019. In absolute terms, the trend is increasing, while in relative terms, since 2015, the values have had the same orders of magnitude at regional level.

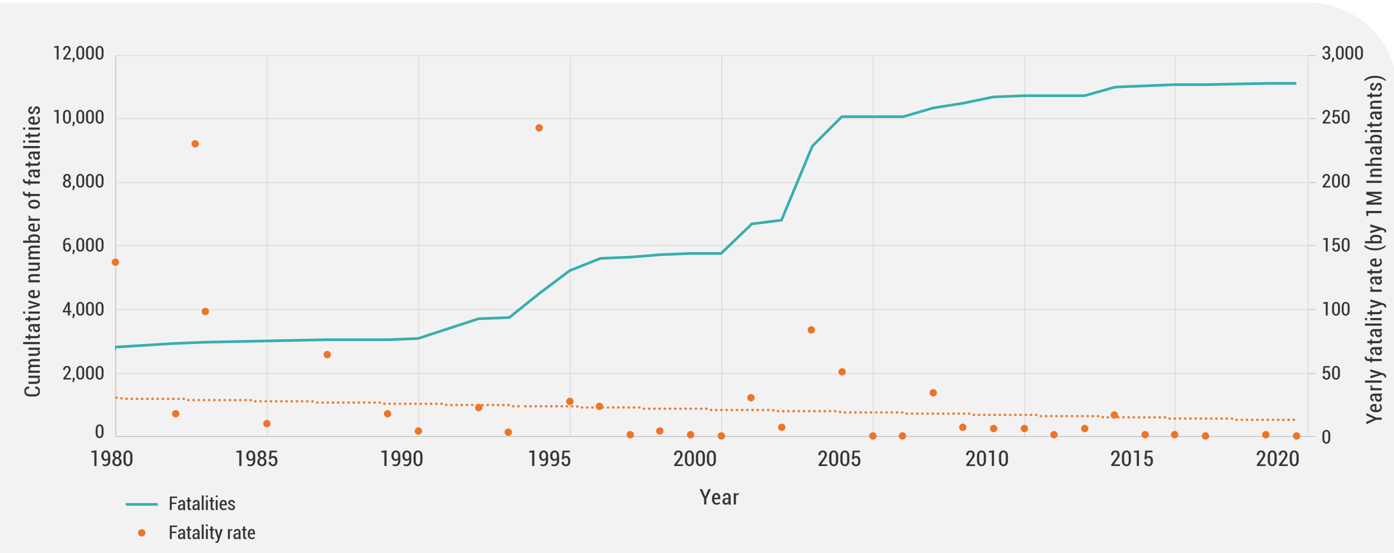
A common feature of the events discussed is that they correspond to low frequency and high severity events as defined by EM-DAT,[58] without accounting for small and medium scale recurrent disasters that affect localized populations, and can act as disaster risk drivers for large events.

Figure 1.12 Regional cumulative total absolute and relative damages in current $, 1980–2019



Source: *CRED, 2020.*

Figure 1.13 Regional cumulative number of fatalities and annual fatality rates, 1980–2019



Source: *CRED, 2020.*

58 Only events that meet one of the following conditions are included in EM-DAT: (a) 10 or more deaths; (b) 100 or more people affected; (c) declaration of state of emergency; and (d) call for international assistance.

Refining the resolution of disaster loss data disaggregation remains a challenge in the region. Initiatives such as RICCAR, the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region,[59] and the DesInventar methodological tool[60] are, however, promoting the systematic collation of disaggregated disaster losses at different scales, using local and national disaster loss databases.

When disaggregated, disaster loss databases may enhance the understanding and modelling of hazards and risks with local impact, such as frequent flash floods and landslides that often affect more vulnerable areas and communities. When consistently recorded in loss databases on a sufficient time frame, data help to estimate recurrence patterns for different loss values, which can be as useful as engineering models for different purposes.[61]

Strengthening data collection is a cost-effective way to systematically understand disaster risk and provide evidence on its adverse impacts on exposed populations and infrastructure. The shared language presents an opportunity to develop robust disaster loss databases to serve individual countries and the region. This commonality does not exist in many other world regions for which disaster loss databases have been compiled, and should act as an incentive for their promotion and development.

1. National versus international disaster loss databases

Official statistics data make disaster risk visible at different scales. Table 1.3 shows recorded events in Lebanon, between 1980 and 2019, in the EM-DAT and DesInventar database. The latter is missing information on key attributes, such as fatalities, affected people and total damages; however, the scale and types of events not included in the EM-DAT can be easily identified.

Table 1.3 Comparison of EM-DAT and DesInventar, type/number of events in Lebanon, 1980–2019

Type	EMDAT	Desinventar
Geophysical	1	115
Hydrological	2	287
Meteorological	7	624
Climatological	1	1,251
TOTAL	11	2,277

Source: *For EM-DAT, see CRED, 2020; for DesInventar, see https://www.desinventar.net/DesInventar/profiletab.jsp.*

More than half of DesInventar data correspond to forest fires, while EM-DAT reports one, in 2007. For highly localized, small-scale hazards such as landslides and flash floods, EM-DAT shows one landslide and no flash floods; there have been more than 10 flash floods in Lebanon in the recent past. The cumulative impact of small-scale events has been shown to have a similar or higher order of magnitude than large-scale events. Failing to maintain consistent recording makes risk invisible, which leads many countries to perceive DRM and reduction as less of a priority. In turn, vulnerable populations remain caught in an unsustainable trap of poverty and small-scale disaster losses.

2. Risk transfer trends and practices

Disaster insurance penetration in the region is low, evidenced by the lack of comprehensive disaster loss information in insurance databases. Global insurance penetration, as a percentage of GDP, is about 3 per cent, compared with 1 per cent in the Arab region.[62] At national level, high-income countries, such as the United Arab Emirates, have greater insurance penetration, with values above 2 per cent of their GDP. The figure may drop to less

59 UNESCWA and others, 2017.
60 UNDRR, DesInventar Sendai. Available at https://www.desinventar.net/DesInventar/profiletab.jsp (accessed on 21 March 2021).
61 Velásquez and others, 2014.
62 Swiss Re, 2020.

than 0.5 per cent in middle-income countries. This low penetration rate is reflected in large protection gaps during past events, such as the 2007 storms in Oman, where less than 15 per cent of the total losses were insured, or the 2003 earthquake in Algeria, where the insured losses accounted for less than 1 per cent of the total.

3. Role of national statistics systems

A risk-informed development plan requires investment in data, methods, tools and capacity to identify and manage disaster risk. A common recommendation in the region is to clarify the role of the National Statistical Systems within DRM and DRR frameworks; for instance, risk identification can be enhanced with information from national statistical offices by making available exposure, vulnerability, resilience and risk data for setting baseline scenarios. Risk prevention and mitigation efforts can be complemented by a more nuanced examination of the factors that drive and cause disaster risk, such as land degradation, unplanned urban expansion and extreme poverty. Emergency preparedness plans can be better informed if organized inventories of supplies, personnel and the number of shelter areas are available, and the response would progress more efficiently if rapid statistics for an affected area were available in the immediate aftermath.[63]

F. Emerging systemic risks

1. Socioeconomic development background to emerging risks

Development priorities in the region have contributed to its climate and disaster risks. While Arab countries are shifting to more diversified economies, especially the oil-rich Gulf Cooperation Council (GCC) countries with investments in medium- and high-tech industries, this has not created sufficient decent employment, or increased labour productivity or wealth redistribution. In 2017, manufacturing value-added as a share of regional GDP was the second lowest globally, at 9.6 per cent against the world average of 16.4 per cent,[64] and provided 10.18 per cent of total employment.[65] Governments are the largest employers regionally, followed by agriculture and market services in non-oil and oil-exporting countries, respectively. Small and medium enterprises comprise 96 per cent of registered companies, and provide about half of all jobs. They receive just 7 per cent of bank lending, the lowest globally,[66] and have limited access to other financial services.[67] Poor infrastructure, especially in the LDCs, offers the region the least economic integration in the world.

The region has some of the highest levels of wealth concentration and income inequality globally.[68] Despite periods of positive economic growth, there has been little improvement in the income of the poor.[69] Excluding agriculture, informal employment is at 45–65 per cent.[70] Intraregional inequality is high and rising.[71] Access to basic services is limited. Some 47.5 million to 70.5 million people have no access to drinking water and basic sanitation.[72] Region-wide, out-of-pocket expenditure on health and education consumes 8 per cent and 11 per cent of poor and middle-class disposable income, respectively.[73]

Globally, the region has recorded the only increase in extreme poverty. The headcount poverty ratio at the $1.90 per day international poverty line rose from 4 per cent in 2013 to 6.7 per cent in 2015.[74] Some 16 per cent of people in the Arab LDCs are below this threshold. Extreme poverty in the region is higher than the world average, and higher than all

63 Bernal and others, 2017.
64 UNESCWA, 2020b.
65 Ibid.
66 Azour, 2019.
67 Rocha, Arval and Farazi, 2011; Saleem, 2017.
68 Arab countries included in report are: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the State of Palestine, the Syrian Arab Republic, the United Arab Emirates and Yemen. The report also covers Iran (Islamic Republic of), and Turkey. See World Inequality Lab, 2018.
69 UNESCWA, 2020b.
70 Chen and Harvey 2017.
71 Calculated by UNESCWA, based on data from World Bank, 2019a.
72 UNESCWA, 2020b, p. 86.
73 UNESCWA, 2017a.
74 Calculated by UNESCWA, based on data from World Bank online datasets, POVCAL.NET.

developing regions, save sub-Saharan Africa.[75] Multidimensional poverty measures[76] place poverty rates at 41 per cent for 10 countries covering 75 per cent of the Arab people.[77] The propensity to slip into extreme poverty, especially in middle-income countries is high.[78] GCC countries have used oil revenues to address poverty and access to services, but stark disparities exist between their nationals and the huge proportion of overseas migrant workers. In addition, future generations are unlikely to enjoy the benefits of oil and public spending, with diminishing or depleted reserves.

This ‘development pattern’ makes the Arab region particularly vulnerable to systemic risks due to intertwining environmental degradation, unsustainable production and consumption, multidimensional poverty, rapid and poorly managed population growth and urban growth, water scarcity, inefficient agriculture, pandemics, population displacement, disease outbreaks, market volatility, governance deficits and disruptions in social cohesion.[79] For example, the extreme drought in Iraq in 2018/19 was brought about by environmental, development and political factors, with cascading consequences.[80] Some systemic risks, if not addressed, threaten the fabric of society and social cohesion in several Arab countries, with spillover effects for their neighbours.

2. Systemic rural/agricultural risk with rising food insecurity

The creation of new rural and agricultural risks is dependent on development choices at the rural/agricultural sector level. Two thirds of fresh water resources originate outside the region. There is a high concentration of surface water flow in only three rivers, namely the Nile, Tigris and Euphrates. These rivers, which account for more than 80 per cent of the total flow in the region, originate in the upstream countries of Turkey, Iran (Islamic Republic of) and Ethiopia.

The region is also one of the most water scarce in the world. In total, 18 of the 22 Arab States fall below the annual threshold for renewable water resources of 1,000 m^3 per person, and 13 below the annual absolute water scarcity threshold of 500 m^3 per person.[81] North Africa has been ranked the second most vulnerable region to emerging climate risks by the IPCC,[82] which will likely exacerbate freshwater scarcity. High subsidies for water and fuel – up to two thirds of the supply cost – have contributed to the overuse of scarce water resources.

For many countries, annual freshwater withdrawals exceed total renewable water resources. For instance, Bahrain, Egypt, Libya, Kuwait, Qatar, Saudi Arabia, the United Arab Emirates and Yemen are currently withdrawing more groundwater each year than the sustainable recharge rates. On average, 80 per cent of extracted water is used in the agriculture sector; for some countries, this rises to 90 per cent.[83] Planting water intensive crops in arid regions has positive trade-offs in the short term but leads to water and food insecurity over time.[84] Due to the loss of biodiversity, the aforementioned actions threaten freshwater ecosystems and increase socioeconomic vulnerability, while also exacerbating desertification and land degradation. Depending on the location of underground water sources, high rates of extraction can lead to soil subsidence, with damage to above- and below-ground infrastructure, such as water and sanitation systems.

Agricultural strategies have not raised productivity or resilience to desertification.[85] Forest cover has fallen steadily since 1990,[86] due to encroachment on fragile natural habitats, and intensive farming, among other reasons.[87] Unsustainable soil and water management accelerate groundwater depletion, increasing agropollution and soil salinity. Irrigation efficiency is low, at 30–45 per cent,[88] causing losses of nearly 60 per cent.[89] The lack of permanent river systems

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75 Calculated by UNESCWA, all means are population weighted using latest (2015) population estimates (UNESCWA, 2020b). The calculated Arab regional aggregate includes the data values of the following countries: the Sudan (2009), Jordan and Tunisia (2010) Algeria, Lebanon and the State of Palestine (2011), Iraq (2012), Comoros and Djibouti (2013), Mauritania and Yemen (2014), and Egypt (2015).
76 UNESCWA, 2020b.
77 Covers Algeria, Comoros, Egypt, Iraq, Jordan, Mauritania, Morocco, the Sudan, Tunisia and Yemen, See UNESCWA 2017b.
78 UNESCWA, 2020b.
79 Sapountzaki, 2019.
80 UNDRR, 2019a.
81 IOM, 2019.
82 Seneviratne and others, 2012.
83 League of Arab States, AGIR, 2019.
84 Abdel-Dayem and McDonnell, 2012.
85 ANND, 2019.
86 Calculated by UNESCWA, based on World Bank, 2015. p. 190.
87 UNDP, 2018a.
88 UNESCWA and League of Arab States, 2013.
89 UNESCWA, 2015.

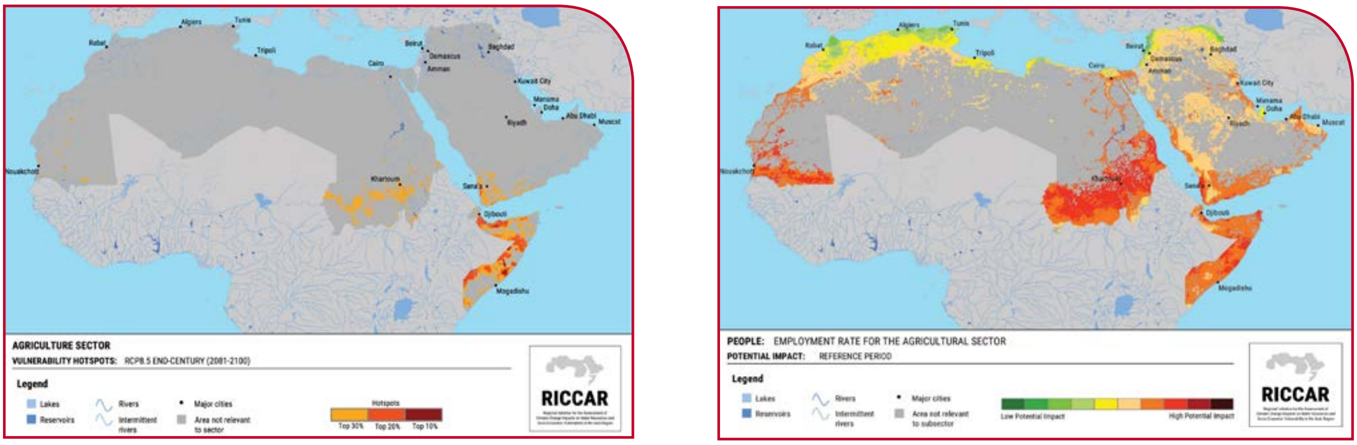
causes floods and erosion, even with poor rains. Water supply and diversion infrastructure is not climate-proofed and does not reduce flood impacts.[90]

The situation accentuates droughts, desertification, dust storms, heatwaves and floods. The Syrian drought in 2006–2010 destroyed the livelihoods of 800,000 people, and left a million food-insecure.[91] The 2017 Somalia drought reduced average harvests by 70 per cent, caused huge livestock loss and food insecurity for nearly 3 million mostly rural people.[92] The number of people affected by flash floods has doubled, to 500,000 region-wide, in the past decade.[93] By 2030, climate change will likely reduce renewable water sources by 20 per cent due to lower rainfall, increased water demand as temperatures rise, and seawater from rising sea levels entering coastal aquifers.[94] Agricultural production patterns could further change, reducing regional output by 21 per cent by 2080,[95] threatening livestock production, forests, wetlands and agricultural employment.[96] In the Sudan, the line of semi-desert and desert that has moved 50–200 km south since 1930 will continue to do so, threatening some 25 per cent of agricultural land and reducing food production by 20 per cent.[97]

Most poor people live in climate-sensitive rural areas. Agriculture constitutes 7 per cent of regional GDP, and employs 38 per cent of the population. It accounts for 23 per cent of GDP in Arab LDCs,[98] employing from 35 per cent of people (in Yemen) to 72 per cent (Somalia).[99] Further, 92 per cent of Arab land is hyper-arid and 73 per cent of arable land is degraded (figure 1.14).[100] Agriculture uses 80 per cent of water regionally,[101] yet water productivity is low. Scant rainfall inhibits natural recharging of surface and groundwater resources. Saline soil reduces productivity, causing an annual economic loss of $1 billion regionally.[102]

Figure 1.14 Agriculture sector vulnerability hotspots, end century (a), and employment rate vulnerability, 1968–2005 (b)

a **b**



Source: UNESCWA and others, 2017a, 2017b.

Note: The designations employed and the presentation of material on these maps do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

90 UNDP, 2018a.
91 Nature Middle East, 2010.
92 Food Security and Nutrition Analysis Unit, 2017.
93 UNDP, 2018a.
94 UNESCWA, 2017c.
95 Cline, 2008.
96 UNESCWA and others, 2017a.
97 United Nations Human Settlements Programme, 2017b.
98 Calculated by UNESCWA, based on World Bank 2019a.
99 World Bank, 2019a.
100 UNESCWA and FAO, 2020.
101 UNESCWA, 2015.
102 UNESCWA and FAO, 2020.

With the largest food deficit, the region is the largest food importer in the world.[103] The average annual increase in the food production-consumption gap was 7.3 per cent between 2005 and 2014.[104] In the Arab States, nearly 55 million people (13.2 per cent of the population) are hungry, an increasing trend from 2013.[105]

Safe food, water, sanitation and health-care deficits place the poor at greater risk of undernutrition, anaemia, stunting and other illnesses. The interaction of rural poverty, growing population, environmental degradation, inequality, water scarcity, drought, conflict, displacement, market volatility and food insecurity is creating feedback loops, with cascading consequences that are difficult to identify and understand without a complex systemic lens for investigating risk.

3. Systemic risk in poorly planned rapid urbanization and population growth

Globally, 85 per cent of economic activity takes place in cities, accounting for approximately two thirds of energy demand and carbon emissions. Urbanization in the region has substantially increased in past years, due to demographic growth, rural to urban migration, conflict-inflicted displacements and investment deficits in rural development.

The Arab population will be about 520 million by 2030, and 676 million by 2050,[106] with eight of the 22 countries hosting 80 per cent of the total population. The urban population, on average above 70 per cent, will more than double by 2050,[107] reaching over 439 million[108] and making up 80 per cent of the total projected population.[109]

Urban development with limited planning and regulation is constructing new risks, locking the region into an unsustainable path.[110] The urban risk profile is incomplete, due to limited data, and significant effort is needed to avoid underestimating risk. Development choices need to be risk-informed, which increasingly requires assessment of interactions within and across urban systems, and between urban and rural systems.

Rising land values and rapid appreciation of buildings since the mid-1970s have led to a segmented land market and expensive housing. About 30.9 per cent of urban people live in slums, informal settlements or inadequate housing.[111] Intensive urbanization and overpumping is affecting groundwater volume and quality, particularly along coastlines, raising dependence on water transfers from other river systems and basins.

About 98 per cent of the Arab population is exposed to high levels of air pollution.[112] Water pollution from industrial waste, wastewater, and unregulated pesticide and fertilizer use threaten water quality and health. Coastal zones and the most fertile agricultural lands (especially in Egypt and Tunisia) hosting urban centres and increased economic activity are vulnerable to sea level rise, storm surges and coastal erosion. This threatens more than 43 Arab port cities,[113] industrial and tourist infrastructure and jobs,[114] and the assets and livelihoods of concentrations of urban poor living on precarious terrain that houses hazardous informal industrial or home-based production employing adults and children.[115] Further, unclean water, poor sanitation and multi-hazard exposure increase their susceptibility to waterborne diseases.

Risk managers and urban planners in the region do not properly recognize that mega-cities are prone to emergent systemic risks. Future risks will be more complex than current ones, and the interconnection of social, economic, technological and financial systems provides the conditions for amplifying the effects over a large geographical extent;[116] for example, a sustainable city needs to be supported by economic growth that serves to guarantee access to clean water and sanitation for its inhabitants, and also provides access to health and education services.

103 AFED, 2017.
104 Ibid.
105 FAO, 2019b.
106 UNESCWA, 2017d.
107 UN-Habitat, 2012.
108 Ibid.
109 UNDP, Bahrain Center for Strategic and International Studies and Energy and UN-Habitat, 2020.
110 UNESCWA, 2020b.
111 Ibid.
112 United Nations Human Settlements Programme, 2017b.
113 UNEP, 2015.
114 Balgis, 2010.
115 El-Zein and others, 2014.
116 UNDRR, 2019a.

4. Systemic risk due to overdependence on natural resource extraction and non-sustainable consumption and production patterns

The region has the world's largest crude oil reserves and is the largest producer of fossil fuels, vital contributors to economic growth. Regional per capita emissions of carbon dioxide are increasing and, in 2013, were similar to the global average. In the GCC subregion, per capita emissions were about four times the global average.[117] Transport contributes about 25 per cent of carbon dioxide emissions.[118]

Energy consumption per person in the region increased by almost 70 per cent between 1990 and 2014, outstripping population growth. Further, energy intensity in the region rose during the 1990s, while global averages declined significantly. Regional energy intensity decreased at a slow pace, about 3 per cent, from 2010 to 2016.[119] Clean renewable energy forms only 4.1 per cent of regional energy consumption versus a world average of 18 per cent.[120] Steps have been made in some locations, such as Masdar City in Abu Dhabi-UAE, towards increasing renewable energy use and decoupling economic growth from overall energy consumption.

Underground aquifers are being exploited at rates that exceed their natural replenishment limits. While some countries have started using seawater desalination techniques[121] and recycling treated wastewater, these are often based on non-renewable energy sources. Building dams remains an expensive option for many countries as they would need to be risk-informed to avoid or reduce the creation of new risks and account for sustainability considerations.

The region is characterized by high rates of waste generation and low levels of recycling and reuse; about 80 per cent of municipal solid waste is decomposable, organic or recyclable material[122] but ends up in unsealed landfill.[123] Compostable solid waste is often mixed with industrial and toxic medical waste during collection and disposal, causing contamination and limiting sustainable treatment options. Some countries have prototyped waste-to-energy technologies using incineration and anaerobic digestion but high costs and low technical capacity have prevented scale-up. Only the United Arab Emirates has a recycling rate above 15 per cent of municipal waste; other countries report rates below 10 per cent.[124]

The region's population of more than 435 million has had a growth rate almost twice the global average in past decades. It is expected to continue to increase at an above-average rate. A consequence of this large demographic growth is an increase in demand for goods and services, thus far mainly supplied based on natural resource extraction. This has promoted non-sustainable production and consumption patterns – all of which exert pressures on ecosystems and the environment, and threaten sustainable development. These patterns challenge food security (most countries are net importers of food), and create economic dependence on oil exports, which are highly volatile, and an unsustainable development paradigm that gives rise to new risks. Continuing on a path of unsustainable development will lead to higher inequality, where risk-benefit trade-offs will serve only the few and exist only for the short term.

5. Systemic risk as manifested by the COVID-19 pandemic

COVID-19 has provided a textbook case of how a biological hazard that started in one place can spread geographically to almost all countries in the world, with a huge impact on economic, social and health complex systems, pushing millions of people back into poverty, increasing the socioeconomic vulnerabilities of several regions, limiting access to education for millions of children for whom online classes are not an option, and heavily disrupting the informal economic sector that employs a large portion of the vulnerable working population in developing countries.

In the Arab region the pandemic has shown the complex interactions between different biological, technological, health, social and economic sectors. In a matter of days, all 22 countries had reported cases, leading to protective measures such as shutting public places, schools and even borders. The closure of the tourism sector has had a large impact on

117 IEA, 2019; OECD iLibrary, 2019; World Bank 2019b.
118 Calculated by UNESCWA, based on IEA, 2019.
119 UNESCWA, 2020b.
120 Ibid.
121 About 70 per cent of water desalination plants are located in the region, see https://thewaterproject.org/water-crisis/water-in-crisis-middle-east.
122 Al-Yousfi, 2004.
123 United Nations Statistics Division, 2016.
124 Ibid.

the employment and livelihoods of various vulnerable groups. Further, the anticipated decrease in remittances from people living abroad in countries such as Morocco can account for up to 6 per cent of the country's GDP.[125]

6. Systemic cyber risk in cities with advanced infrastructure systems

Risk managers and urban planners in major cities in the GCC countries need to recognize cyber risk as a key driver for systemic risk, by having the capability to affect the functioning of different interconnected systems. Current hyperconnectivity is reflected in increasing digitization, larger amounts of data stored in cloud services and greater use of the Internet for running systems. The consequences of cyber risk can be complex, affecting multiple industries simultaneously, reaching multiple geographical regions and cascading in an unpredictable manner. With oil the main export of several countries in the region, DRM of the large and complex production, transport and storage systems should include a cybersecurity perspective to reduce the likelihood of such disruptions.

Cyber risks can also include the control of physical processes, leading to deaths and injuries, and damages to property and assets. In 2017, data was quantified by a group of experts as the world's most valuable resource.[126] Financial services are one of the most connected components of modern economies and, because of the stakes, a highly desirable target for malicious cyberattacks. Digital markets in the region have grown at an average annual rate of 12 per cent[127] and the success of several initiatives increases the exposure to cyberattack. Between January and March 2019, the United Arab Emirates experienced more than 23 million instances of malware,[128] and cyberattacks in the country have accounted for approximately 5 per cent of the global total[129] in recent years. The health sector must prepare to address cyber risk, as it possesses protected information representing lucrative health-care data. In summary, cyber risk needs to be addressed promptly.

7. Emerging nuclear energy risks

The region is characterized by its high energy intensity economies, which goes against global trends. Several countries have embarked on nuclear power generation to try to diversify their energy portfolio. The 2011 Fukushima disaster in Japan is a reminder of the importance of addressing security and safety management considerations in nuclear installations.[130] To this end, comprehensive nuclear risk management plans should be developed, implemented, monitored and constantly updated in line with latest practices and global lessons.

8. The climate change-disasters-conflict-migration nexus

In the past five years, 40 per cent of Arab countries have had some type of armed conflict that has undermined development gains and increased the vulnerability of the population to disaster risk. There are 38.1 million migrants[131] and refugees in the region.[132] Conflict and natural hazard-based disasters displaced 2,566,000 and 631,000 people, respectively, in the Middle East and North Africa (MENA) region,[133] comprising 9.6 per cent of the global total.[134] In 2019, more than 800,000 new displacements due to disasters were recorded in the MENA region.[135] This is not an entirely new

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125 Coronavirus Increases Pressure on Morocco's External Finances, 16 March 2020. Available at https://www.fitchratings.com/research/sovereigns/coronavirus-increases-pressure-on-morocco-external-finances-16-03-2020.

126 Ross, 2020.

127 Strategy&, 2015.

128 Ramesh Chandra, Kumar Sharma and Ali Liaqat, 2019.

129 Ibish, 2017.

130 Fukushima Daiichi Accident - World Nuclear Association (world-nuclear.org) (accessed on April 2021).

131 There is no universally accepted definition of the term migrant. This report draws on IOM's definition: "…an umbrella term, not defined under international law, reflecting the common lay understanding of a person who moves away from his or her place of usual residence, whether within a country or across an international border, temporarily or permanently, and for a variety of reasons. The term includes a number of well-defined legal categories of people, such as migrant workers; persons whose particular types of movements are legally defined, such as smuggled migrants; as well as those whose status or means of movement are not specifically defined under international law, such as international students." See https://publications.iom.int/system/files/pdf/iml_34_glossary.pdf. This report does distinguish between the terms migrant and refugee, defining refugee in line with the 1951 Refugee Convention.

132 UNESCWA and IOM, 2020.

133 The MENA region geographically comprises the States of Algeria, Bahrain, Egypt, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen. It does not include the States of the Comoros, Djibouti, Somalia and Mauritania, which are incorporated in the Arab region.

134 IDMC, 2020a.

135 IDMC, 2020b.

occurrence, however. Harsh ecological conditions over centuries have driven agropastoral and nomadic communities to move. Migration in the region, as elsewhere, happens for a variety of reasons, though there has been a clear link between climate change, disasters and migration in the past 15 years.[136]

Displacement can result in additional risks for those individuals, and for other communities affected by their movement. This can include reduced access to resources, opportunities and services, and increased exposure to hazards, violence and abuse.[137] In addition to being a symptom of disasters, displacement remains a driver of disaster risk. It frequently reduces available resources and assets, increasing the risk of impoverishment and abuse, and exacerbating pre-existing vulnerabilities. This is amplified when displacement is accompanied by the destruction of homes, livelihoods and assets, which is often the case, and/or when displacement is recurrent or unresolved for protracted periods of time.

Displacement, be it internal, cross-border (refugees and asylum seekers) or voluntary (migrants), is still perceived as a mostly negative issue. While forced migration does burden host communities, local economies and national governments, the opportunities it provides in many areas of development are not sufficiently recognized or acknowledged. This contributes to increasing both the risk and the impact of disasters, particularly on vulnerable displaced groups.

In the Sahel sites of Mauritania, each major drought triggered large-scale migration to cities.[138] In Iraq in 2006 and 2008, more than 60,000 drought-impoverished farmers migrated to urban areas.[139] Jordan witnessed similar migration movements. By June 2009 about 200,000–300,000 persons from Hassaka had migrated to urban centres in western Syrian Arab Republic.[140] In low-lying coastal regions, rising sea levels are expected to force migration away from original sites of residence as storm surges force saltwater into rivers and aquifers and degrade agricultural land, and the sea reclaims the land.[141] A 0.5 m rise in sea level in Alexandria, Egypt, could force 1.5 million of the city's population to migrate,[142] while a 1 m rise could directly impact 41,500 m^2 of territory and about 37 million people in the region.[143] Where direct causal links between climate change, disaster risks and migration are not obvious, migration may still be mediated by declining social and economic conditions, intertwined with poor ecological conditions and longer onset disasters, demanding more attention to be directed to sustainable development.[144]

The current situation where internally displaced persons and refugees are forced to use peri-urban areas due to unaffordable formal housing is reinforcing the creation of poverty traps for highly vulnerable populations. This stresses the need for urban resilience, requiring both urban planning and quality infrastructure. In the region, and globally, reducing disaster risk for displacement-affected populations requires systematic analysis and management of causal factors of disaster. This includes efforts to reduce exposure to hazards and the vulnerabilities of people and property, and increasing preparedness. Acknowledging DRR challenges in conflict settings has been new in recent United Nations Global Assessment Reports on Disaster Risk Reduction (GAR), such as the GAR19, which identified critical aspects to be considered.

9. Developing the tools to address systemic risks

Recognizing the need for a more systemic approach to address the integrated nature of sustainable development, and to establish a real implementation mechanism that can help achieve coherence between the three global agendas, Arab countries are directing efforts to improve the interaction between ecosystems and people, using several initiatives, including the Arab Geographical Information Room (AGIR) (box 1.4).

136 D'Cunha, 2019.
137 IOM, 2020.
138 United Nations Human Settlements Programme, 2017b.
139 Ibid.
140 United Nations, 2009.
141 UNEP, 2015.
142 Verner,, 2012.
143 UNEP, 2015.
144 D'Cunha, 2019.

Box 1.4 The Arab Geographical Information Room

AGIR was established by the League of Arab States in 2015 to improve the science-policy interface in the region through enhanced information and analytical studies. AGIR, which is hosted by the AWC, works to unpack complex topics, such as how emerging climate-related risks interact with structural challenges, and how to foster coherence between regional, national and local actions and rationalize trade-offs between sectors while establishing development plans.

By utilizing advanced technologies, satellite imagery and geographic information systems (GIS) to conduct regional analysis of climate change patterns and hydrometeorological risks, AGIR activities focus on better characterization of hazards, exposure and vulnerabilities. These feed into policy and programmes, and the regular monitoring of emerging risks at national and regional levels. AGIR focuses on increasing synergies between data sets, and enhancing quality and uptake of climate impact and disaster loss databases for proactive preventive measures, as a foundation for more synergetic actions in decision-making.

In 2017, AGIR produced its first report, Geographical Information towards Building Resilience in the Arab Region (Water, Food and Social Vulnerability Nexus). The report covers topics focusing on climate change as a challenge in managing and reducing risks. It emphasized the interconnectedness of climate change with disaster risk, thus highlighting the importance of understanding the multistressors of climate change and disaster risks, which can provide new insights and approaches. The report also enhanced knowledge towards a deeper assessment in several climate change areas, including risk and resilience building.

The use of Earth observations to comprehend losses and make a case for DRR

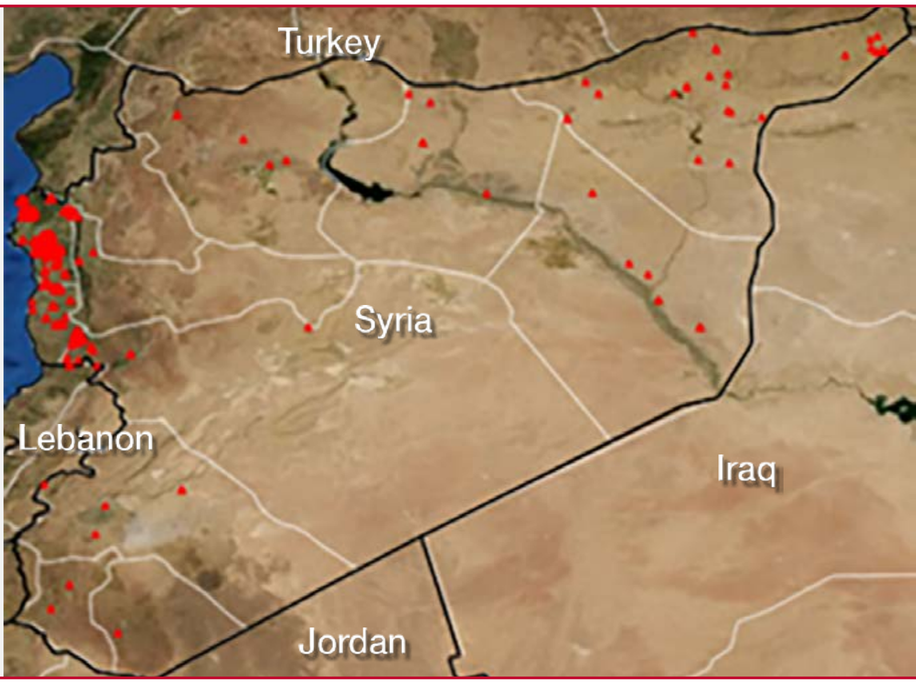
Earth observations (EO) can support several DRM and mitigation activities. Advances that have occurred in the field have applications in the design and use of early warning systems (EWS), in increasing risk knowledge and in disseminating information in almost real time. This is highly relevant in response activities, particularly as risks become more complex and connected across systems (figure 1.15 for aerial image of flooded areas near Khartoum in 2020, and figure 1.16 for forest fires in the Syrian Arab Republic, located from spatial imagery).

Figure 1.15 Satellite images of the Sudan floods near Khartoum, 2020

Source: *NASA, 2020b.*

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Figure 1.16 Forest fire locations in the Syrian Arab Republic gathered from satellite images, October 2020



Source: NASA, 2021.

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

G. Conclusion

The Arab region is exposed to myriad hazards that, combined with the continuous increase in exposure and vulnerability, are driving disaster risk to levels that require prompt management and reduction. The region has been identified as highly vulnerable to the consequences of climate change that may further threaten existing development gains and plans for future sustainable development at rural and urban levels. With one of the world's fastest growing populations, this is leading to excessive demands for basic services and housing within a highly urbanized context. The rapid urbanization process, if it continues in an unplanned manner, will increasingly use floodplain areas and neglect sound urban planning principles, thereby compounding the already high levels of exposure and vulnerability.

The socioeconomic development characteristics exacerbate the emergence of complex systemic risks that threaten existing development gains, the potential for future sustainable development and social cohesion. These include: systemic rural/agricultural risk with rising food insecurity; systemic risk in a rapidly urbanizing region; systemic risk due to overdependence on natural resource extraction and non-sustainable consumption and production patterns; systemic pandemic risks affecting social and economic systems; systemic cyber risk in cities with advanced infrastructure systems; nuclear energy risks; and systemic climate change-disasters-conflict-migration risks. This necessitates the development of new tools for governance arrangements in order to enhance understanding of the complex systemic nature of risk within and between different social, economic and environmental systems, as demonstrated by the COVID-19 crisis.