Economic and Social Commission for Western Asia

© Songsak P, Shutterstock

UNITED NATIONS
الاسكوا
ESCWA

ESCWA Water Development Report 7

Climate Change and Disaster Risk Reduction in the Arab Region

E/ESCWA/SDPD/2017/3

Economic and Social Commission for Western Asia

ESCWA Water Development Report 7

Climate Change and Disaster Risk Reduction in the Arab Region

United Nations
Beirut

United Nations publication issued by ESCWA, United Nations House, Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org.

Executive Summary

This seventh issue of the ESCWA Water Development Report focuses on climate change adaptation (CCA) and disaster risk reduction (DRR) within the context of scarcity in the water sector in the Arab region as a whole. A number of global frameworks and strategies have called for an integrated approach to DRR and CCA, since the World Conference on Disaster Reduction in Kobe in 2005, and the thirteenth session of the Conference of the Parties (COP 13) to the United Nations Framework Convention on Climate Change (UNFCCC) in Bali in 2007. The issue gained greater prominence in 2015, as this was a landmark year for the international community, with the adoption of three main and interrelated agendas, namely the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction (2015-2030) and the Paris Agreement on climate change. While the Sendai Framework includes ambitious targets, and aims to secure the commitment of countries to DRR strategies, the Paris Agreement calls for addressing “loss and damage” in cases where impacts are beyond the limits of adaptation. The 2030 Agenda for Sustainable Development includes 17 Sustainable Development Goals (SDGs) addressing all aspects of development, including the management of natural resources, the challenges of climate change and the impacts of natural hazards.

Even though the CCA and DRR communities have followed separate paths, there are numerous challenges and opportunities to be found in bringing the two communities together, stemming from differences and similarities in their methodologies and approaches, and in their means of implementation. While there are clear synergies between DRR and CCA processes that must be exploited, there are also some mutually exclusive elements, which need to be addressed separately. The key similarities between the two processes lie in managing disaster risks related to climate variability and weather extremes, and preparing for risks related to climate change. Significant differences can also be noted between the two communities, in particular in terms of terminologies, approaches, organizations and institutions, international platforms and mandates, assessment tools, strategies, and funding mechanisms and sources. In that regard, the climate change community has, in the past year, focused on extremes, vulnerability, resilience and adaptation, while the DRR community has addressed disasters, risks, hazards and disaster management or risk reduction. Thus, there is a need to achieve synergy between the two communities in dealing with all aspects of weather-related hazards, particularly in terms of impact modelling and risk assessment.

Several challenges hinder the achievement of integrated approaches in this respect. There is the lack of integrated and common databases on disaster loss and climate-related hazards, insufficient access to information, inadequate understanding of data related to social vulnerability, and insufficient science-based

analyses and projections of climate change scenarios. Disaster loss databases are based on observed historical data, whereas climate change databases focus on future projections based on different scenarios. However, information on disaster losses, while it only reflects the historical record, can be used to show the vulnerability of certain areas and regions to future climate change impacts, using regional climate models as tested in this report. This will help prioritize actions based on evidence, and provide strong justification for investments in CCA and DRR, in certain locations, in national development plans. Climate projections and vulnerability maps can be used to identify future risks of weather-related disasters. Thus, a better understanding of the patterns, trends and quantitative indicators of disaster risk can contribute to improving the process of planning, and enhance the efficiency of investments allocated for megaprojects, such as dams or storage and flood protection infrastructures.

CCA and DRR are managed by different institutions at the global, regional and national levels. This can be attributed partly to their different thematic agendas and related investments by donors, and partly to existing silos within governments. For instance, CCA usually falls under the mandate of the ministry of the environment, while DRR responsibilities usually lie with the cabinet, the ministry of the interior and civil defence. A lack of institutional interaction and integration between DRR, CCA and national development plans may lead to redundant or conflicting policy responses. Furthermore, CCA and DRR strategies, when they exist, are developed nationally with limited downscaling activities targeting the local, city or community levels.

With respect to the means of implementation for achieving an effective linkage between CCA and DRR, the role played by science and technology, finance, and capacity-building, is increasingly being recognized. Advanced technological equipment is needed to undertake pre-disaster risk assessment, to formulate decisive actions before, during and after a disaster, in order to save lives, reduce losses and support recovery. The development and transfer of technology are also important for strengthening climate change resilience, establishing early warning systems for different hazards, and reducing greenhouse gas (GHG) emissions. In terms of financial resources, both processes call for their mobilization from all sources, public and private, domestic and international, and promote alternative sources of financing, in particular blended finance. Furthermore, both frameworks stress the importance of capacity-building in dealing with climate change issues and disasters. For instance, the Paris Agreement focuses on enhancing adaptive capacity, while the Sendai Framework focuses more on building anticipatory and absorptive capacities. Capacity-building is a cross-cutting issue between DRR, CCA and sustainable development processes at large.

In order to improve policy coherence across CCA and DRR communities in the Arab region, there is a need for increased regional and country-level efforts to overcome the challenges related to climate change, natural hazards and water security, which hinder the achievement of sustainable development in the region. The main recommendations of this report are:

- Adopting an intersectoral approach to respond to climate change impacts and disaster risks;

- Establishing and continually maintaining a single online database of past, current and planned DRR, CCA and related issues;
- Developing a comprehensive risk assessment process, based on both climate change modelling and disaster loss surveys, specific to the Arab region and/or to countries making use of the outputs and databases of the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR);
- Promoting technological innovations and the use of global platforms, using geographic information systems (GIS) and innovations in information and communications technology;
- Making the best use of global platforms while formulating and submitting proposals to, for instance, the Climate Technology Centre and Network (CTCN), and linking it to regional mechanisms, such as the ESCWA Technology Centre (ETC), and national technological institutions and research centres;
- Establishing regional scientific platforms to jointly address the issues of CCA and DRR;
- Developing a DRR and CCA regional comprehensive action plan that could serve as a set of guidelines for developing national strategies and plans in Arab States;
- Mainstreaming gender into disaster risk assessments and climate-related policies, by considering gender disaggregated data and indicators in related vulnerability assessments, as followed in RICCAR;
- Clearly identifying the roles and responsibilities of national institutions and stakeholders with respect to risk assessment, risk management and the implementation of DRR and CCA policies and actions, and enhancing governance and institutional settings to facilitate the development of integrated policies and joint programmes and projects;
- Supporting the adoption, at the national level, of advanced tools, such as GIS and remote sensing techniques, for the development of hazard maps and early warning systems for different hazards;
- Mobilizing financial resources from all sources, public and private, domestic and international, and promoting alternative sources of financing;
- Calling upon international and regional support, and mobilizing resources to help national and local governments develop tailored financing mechanisms that can respond to national needs and specificities;
- Exploring the full potential of blended finance, and mobilizing official development assistance (ODA) from regional and international sources;
- Supporting the efforts of the League of Arab States, and other organizational and capacity-building efforts by Arab countries, to implement the Sendai Framework by pursuing the Arab Disaster Risk Reduction Strategy (2015-2030);
- Enhancing public awareness of disaster risks, and of ways to reduce vulnerability and risks at all levels, to build resilience;
- Developing capacities to deal with climate change issues and disasters in the Arab region in an integrated manner.

This seventh issue of the ESCWA Water Development Report is structured into six chapters, covering the above-mentioned topics and issues. The first chapter presents an overview of CCA and DRR discourse, emphasizing the main similarities and key differences between the two. Chapter two focuses on the Arab region and discusses the technical and institutional challenges facing the integration of CCA and DRR there. Chapter three

introduces climate change and disaster risk assessment tools and presents the main findings of disaster loss databases in the Arab region. This chapter also attempts to link historical disaster loss databases with RICCAR's projected extreme indices hotspots and vulnerable areas. Chapter four undertakes a comparative analysis of DRR, CCA and water-related SDGs, and examines their references to gender and vulnerable groups. Chapter five tackles the means of implementation of the CCA and DRR agendas, namely technology, financing and capacity-building. Chapter six concludes with a number of recommendations and key messages that aim to improve policy coherence across CCA and DRR communities.

Contents

List of Tables

List of Figures

List of Boxes

Acronyms and Abbreviations

ACCWaM	Adaptation to Climate Change in the Water Sector in the MENA Region
ACSAD	Arab Centre for the Studies of Arid Zones and Dry Lands
AF	Adaptation Fund
AMWC	Arab Ministerial Water Council
BMZ	German Federal Ministry for Economic Cooperation and Development
CAMRE	Council of Arab Ministers Responsible for the Environment
CBA	Community-based adaptation
CBDRM	Community-based disaster risk management
CDD	Consecutive dry days
CCA	Climate change adaptation
CIHEAM	Centre International de Hautes Etudes Agronomiques Méditerranéennes
COP	Conference of Parties
CTCN	Climate Technology Centre and Network
CWD	Consecutive wet days
DANIDA	Danish International Development Agency
DRM	Disaster risk management
DRR	Disaster risk reduction
EBA	Ecosystem-based adaptation
ESCWA	United Nations Economic and Social Commission for Western Asia
ETC	ESCWA Technology Centre
FAO	Food and Agriculture Organization
GAR	Global Assessment Report
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
GIS	Geographic information systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH

GP-DRR	Global Platform for Disaster Risk Reduction
ha	Hectare
HFA	Hyogo Framework for Action
HYPE	Hydrological Predictions for the Environment
ICARDA	International Centre for Agricultural Research in the Dry Areas
IDSC	Information and Decision Support Centre
IDNDR	International Decade for Natural Disaster Reduction
IDRC	International Development Research Centre
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
INDC	Intended nationally determined contribution
ISDRR	International Strategy for Disaster Risk Reduction
IWRM	Integrated water resources management
km	Kilometre
LDC	Least developed country
LDCF	Least Developed Countries Fund
MDG	Millennium Development Goal
MENA	Middle East and North Africa
NAP	National adaptation plan
NAPA	National Adaptation Programme of Action
NASA	National Aeronautics and Space Administration (USA)
NCCC	National Committee on Climate Change
NDC	Nationally determined contribution
NEMEDECA	Network on Drought Management for the Near East, Mediterranean and Central Asia
NGO	Non-governmental organization
NMHS	National Meteorological and Hydrological Service
ODA	Official development assistance
OECD	Organization for Economic Cooperation and Development
PPP	Public private partnership
RCM	Regional climate model
RCP	representative concentration pathway
RHM	Regional hydrological model

RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
ROAS	Regional Office for Arab States
ROWA	Regional Office for West Africa
R20	Very heavy precipitation days (≥ 20 mm)
SCCF	Special Climate Change Fund
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SIDA	Swedish International Development Cooperation Agency
SMHI	Swedish Meteorological and Hydrological Institute
STAG	Scientific and Technical Advisory Group
UNDAC	United Nations Disaster Assessment and Coordination
UNDP	United Nations Development Programme
UN Environment	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNISDR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UNU-INWEG	United Nations University Institute for Water, Environment and Health
USAID	United States Agency for International Development
VIC	Variable Infiltration Capacity
WCDRR	World Conference on Disaster Risk Reduction
WHO	World Health Organization
WHS	World Humanitarian Summit
WMO	World Meteorological Organization

Introduction

Introduction

Background

Climate change and disaster risk reduction are increasingly being linked to one another and to water resources management, at the national, regional and global levels. Negotiations and efforts to implement the 2030 Agenda on Sustainable Development, the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), and the Sendai Framework on Disaster Risk Reduction, have revealed the importance of bringing the climate change adaptation (CCA) and disaster risk reduction (DRR) communities together, in order to formulate integrated policies on natural hazards. This is particularly true with respect to water-related hazards, such as droughts and floods, which are being exacerbated by climate change.

The water sector plays a central role in bridging understanding and action across these two communities, particularly in such water-scarce areas as the Arab region. The existing and projected impacts of climate change and natural hazards on socioeconomic development, livelihoods and the natural resource base, are significant and directly related to the achievement of Sustainable Development Goals (SDGs) in the Arab region.

The focus on CCA and DRR is particularly timely, in view of the two global instruments that have been adopted – namely the Sendai Framework and the Paris Agreement – and of how they support the achievement of the SDGs. It also falls in line with some regional instruments, such as the Arab Strategy for Disaster Risk Reduction 2020, and associated country-level mechanisms.

Objectives and approach

This seventh issue of the ESCWA Water Development Report focuses on CCA and DRR within the context of the water sector in the Arab region. It examines the aforementioned global processes, from a regional perspective, as well as associated regional strategies and action plans related to CCA, DRR and water security, taking into consideration the water-scarce conditions that dominate the region. It aims to present the challenges and opportunities of bringing the CCA and DRR communities together. It examines the differences and similarities between the methodologies and approaches used by each community, as well as their means of implementation, with the aim of pursuing synergy and coherence between them, within the context of achieving the 2030 Agenda for Sustainable Development in the water-scarce Arab region.

The report presents the results of the work conducted within the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR), implemented by ESCWA in partnership with the League of Arab States. It also draws upon country-level work on disaster loss databases,

based on the work done by the United Nations Office for Disaster Risk Reduction (UNISDR) within the context of RICCAR, to develop and update national disaster loss databases (which are mainly climate-related) in selected Arab countries, and to estimate associated socioeconomic costs and impacts. The use of these disaster loss databases to validate future projections of climate extremes relating to various hazards is tested in this study, in an attempt to identify and map hotspot areas with high disaster risk towards the end of the century, under various climate change scenarios.

In addition, the report makes use of science-based information – generated from regional climate modelling, hydrological modelling, vulnerability assessment, impact assessment and disaster loss database analysis – to inform the formulation of policies, strategies and positions with respect to CCA, DRR, the costing of disaster losses from extreme weather events, and negotiation processes at the global level. It also uses data, collected at the national level in selected Arab countries by UNISDR and ESCWA, on losses from climate- and weather-related hazards, including information and analysis relating to historical events, the frequency of occurrences, types of hazards, socioeconomic costs, climate change impacts, and vulnerability assessments.

Furthermore, the report reviews current efforts in the region to address the challenges associated with climate change, natural hazards and water security, from an integrated perspective. It also reviews the Arab Strategy for Disaster Risk Reduction 2020 in relation to the priorities of the Sendai Framework. The report concludes with a set of recommendations on ways to advance regional and country-level efforts to overcome the challenges of climate change, natural hazards and water security, which impede the achievement of sustainable development in the Arab region.

The report draws upon modelling outputs and policy measures developed in ESCWA-led regional initiatives, and shows how such outputs can help link CCA strategies to those of DRR. It approaches CCA tools and measures from a DRR perspective, and demonstrates how these instruments can support climate-related DRR priorities, as defined in the Sendai Framework. The analysis presented in this report on priority measures and means of implementation can help Arab States strengthen their resilience to climate change and reduce their disaster risks in a water-scarce context.

Structure and contents

The report consists of six chapters. The first chapter presents an overview of CCA and DRR discourse, and examines their evolution and purpose, emphasizing the main similarities and key differences between them. This chapter also addresses the global progress made in, and challenges faced by, CCA and DRR integration.

Chapter two focuses on the Arab region and discusses the technical and institutional challenges facing CCA and DRR integration at the regional level, as well as the progress achieved to date. It also reviews the main global and regional goals and action plans pertaining to CCA and DRR.

Chapter three introduces climate change and disaster risk assessment tools, and presents the main findings of disaster loss databases in the Arab region. This chapter also attempts to link historical disaster loss databases with RICCAR's projected extreme indices hotspots and vulnerable areas.

Chapter four undertakes a comparative analysis of DRR, CCA and water-related SDGs, and examines their references to gender and vulnerable groups. In addition, it addresses existing national and regional mechanisms for CCA and DRR.

Chapter five tackles the means of implementation of the CCA and DRR agendas. It focuses on science, technology and financing, particularly in terms of mobilizing resources from international sources and exploring innovative means of gathering the financial resources needed to achieve national agendas. It also stresses the importance of capacity-building in both processes.

The report concludes, in chapter six, with a number of recommendations and key messages that aim to improve policy coherence across the CCA and DRR communities.

1. Bridging Climate Change Adaptation and Disaster Risk Reduction

1. Bridging Climate Change Adaptation and Disaster Risk Reduction

Similarities and differences between disaster risk reduction and climate change adaptation

1. Evolution of disaster risk reduction and climate change adaptation

(a) Disaster risk reduction discourse

Extensive research has been undertaken on vulnerability since the mid-1970s, and has led international development and relief agencies, as well as governments, to adopt the concept of disaster management, and in particular DRR.[1] Although DRR is a relatively new concept, it has quickly become widely recognized among international agencies, governments, disaster planners and civil society organizations.

In 1987, the United Nations General Assembly declared the 1990s the "International Decade for Natural Disaster Reduction" (IDNDR), as a way of promoting internationally coordinated efforts to reduce the material losses and social and economic disruption caused by natural hazards, especially in developing countries.[2] During this decade, the first World Conference on Natural Disasters was held in Yokohama, Japan, and concluded with the adoption of the "Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation" in 1994.[3] At the end of the decade, another key document was adopted by the General Assembly, namely "A Safer World in the 21st Century: Disaster and Risk Reduction" in 1999. In 2001, the International Strategy for Disaster Risk Reduction (ISDRR) was adopted, building on the outcomes of the International Decade for Natural Disaster Reduction and highlighting the paradigm shift, from disaster response to disaster reduction, by promoting a "culture of prevention".

The second World Conference on Disaster Reduction took place in 2005 in Kobe, Japan, in response to growing calls by international development and relief agencies to clearly identify DRR components and indicators of progress towards resilience. In view of this, the "Hyogo Framework for Action (2005-2015)" was adopted, as the first internationally accepted framework for DRR.[4] The Hyogo Framework for Action (HFA) identifies five priorities for DRR interventions. Subsequently, four biennial United Nations Global Platforms for Disaster Risk Reduction were held, namely, in June 2007, June 2009, May 2011, and May 2013, in Geneva, Switzerland. These platforms provided the opportunity to review progress on HFA. A recognized and systemic process for responding to disasters begun to emerge, and standards for response were developed by multiple sources.[5]

Between 2005 and 2015, HFA managed to change the international community's mindset, by focusing not only on disaster preparedness, but also on building resilience to mitigate inevitable disasters. With that mindset, the

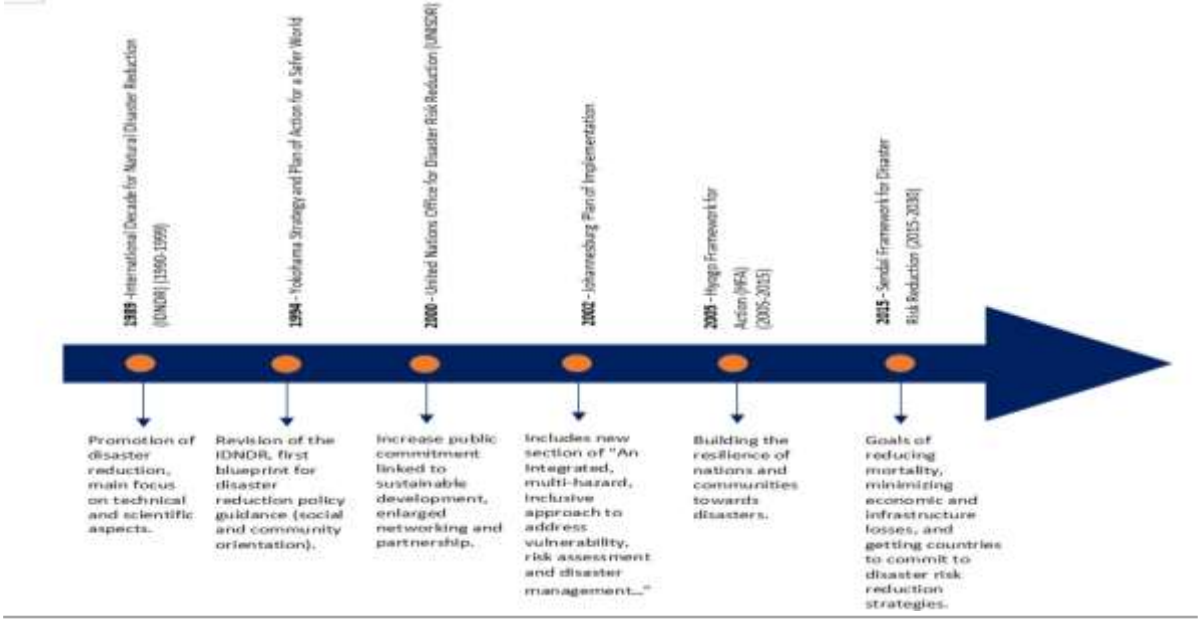
third World Conference on Disaster Risk Reduction (WCDRR) was held in Sendai, Japan, in 2015, and concluded with the adoption of the "Sendai Framework for Disaster Risk Reduction (2015-2030)" (Sendai Framework) to replace HFA.[6] The Sendai Framework includes ambitious targets and goals, and aims to secure the commitment of countries to DRR strategies. Figure 1 illustrates major milestones for the DRR agenda.

Furthermore, UNISDR coordinates and supervises the preparation of the biennial Global Assessment Reports (GAR) on DRR (2009, 2011, 2013 and 2015), which aim to monitor risk patterns, trends and progress in DRR, while providing strategic policy guidance to countries and the international community on the issue of disaster risk, and encouraging political and economic support for DRR.

(b) Climate change adaptation discourse

The first World Conference on Climate Change took place in 1979, and it has since become essential to address the causes of climate change, and in particular to reduce greenhouse gas (GHG) emissions from human activity.[7] As climate change impacts started to materialize, the seventh Conference of Parties (COP 7), held in Marrakech in 2001, was the first venue to discuss adaptation.[8] The outcome of COP 7, the 2001 Marrakesh Accords, emphasized procedural justice and the contributions of developing countries to decisions on adaptation. In 2001, two funds were established under the UNFCCC to support CCA, namely the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), in addition to another programme under the Global Environment Facility (GEF), namely the Strategic Priority on Adaptation (SPA).[9]

Figure 1. Disaster risk reduction: an agenda in progress



Source: Adapted from UNISDR, 2014b.

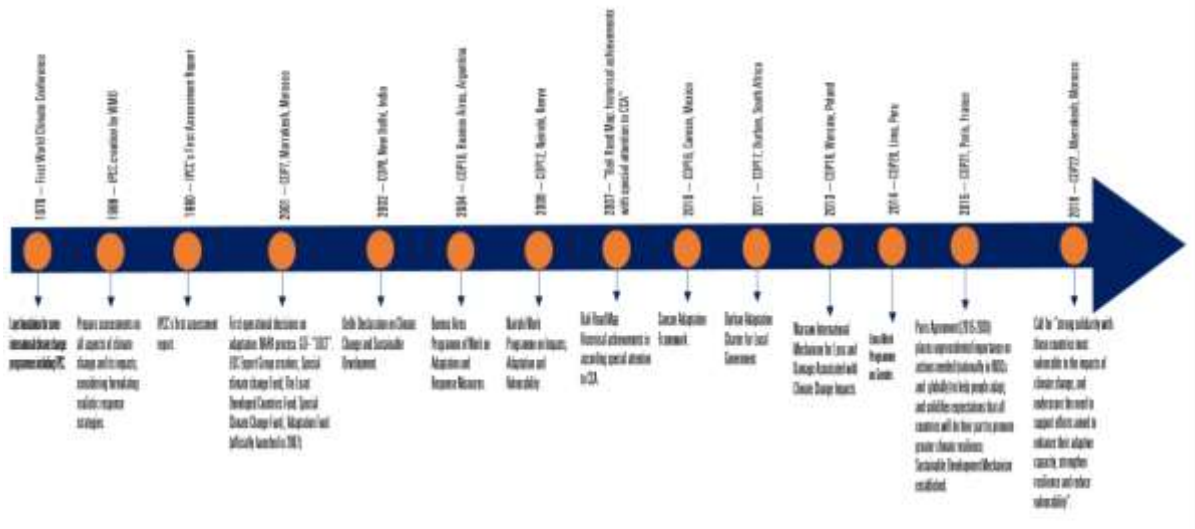
The Intergovernmental Panel on Climate Change (IPCC) defines adaptation, in its first assessment report in 2007, as an "adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities".[10] Strategies to respond to climate change exist at varying levels, including local, national and international interventions.[11] These strategies include risk assessment, early warning systems, improvements to agricultural systems (such as crop diversification or the introduction of hazard-resistant crop varieties), the protection of natural resources, education and awareness measures.[12] Some of the least developed countries (LDCs) have developed National Adaptation Programmes of Action (NAPAs) to identify critical areas.

In 2015, COP 21 was held in Paris, France, and was concluded with the adoption of the Paris Agreement.[13] The latter underlines the actions needed, nationally and globally, to adapt to climate change and increase climate resilience. It also calls for developing ways to address "loss and damage" in cases where impacts are beyond the limits of adaptation.[14] Figure 2 illustrates major milestones for the CCA agenda.

2. Purpose and scope

In 2015, the international community agreed on the Sendai Framework and the Paris Agreement. These frameworks identify goals and targets that can, if achieved, address the current disaster and climate challenges. Even though both DRR and CCA aim to reduce vulnerability and build resilience, each agenda follows a different path.[15]

Figure 2. Climate change adaptation: an agenda in progress



Source: Adapted from Kelman, 2015.

UNISDR defines DRR as “the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events”.[16] DRR has essentially been focused on addressing existing risks, relating to all categories of hazards, particularly extreme events. It looks at a broader range of risks, beyond just those relating to climate, including, for example, those associated with earthquakes, volcanic eruptions and tsunamis. DRR was originally linked to humanitarian assistance, and has a comprehensive range of established tools and practices at the national and local levels[17] with the following elements of response: (a) pre-disaster, including prevention, mitigation and preparedness; (b) disaster emergency response; (c) post-disaster, including recovery and development.[18] DRR discussions still attract only low to moderate political interest, leading to insufficient funding allocations.[19]

The IPCC, however, defines CCA as an “adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities”.[20] CCA includes not only climate extremes, but also evolving risks posed by increasing mean temperatures and sea levels.[21] Traditionally, CCA focuses on physical exposure and bases its discussions on science.[22] Hence, CCA-related strategies are concerned with future climate projections and scenarios, but not humanitarian assistance.[23] CCA has the following elements of response: (a) observation; (b) assessment; (c) planning; (d) implementation; and (e) monitoring and evaluation.[24] CCA discourse attracts high political interest, and funding extremes are growing and sizable.[25] In the context of the water resources sector, Integrated Water Resources Management (IWRM) concepts provide an important framework for achieving CCA measures. That is, CCA addresses strategies that focus on water demand and supply, implemented across multiple sectors, which form the core of IWRM principles.

Thus, while there are clear synergies between DRR and CCA processes that must be exploited, there are also some mutually exclusive elements that need to be addressed separately. Some of these factors have acted as barriers to closer collaboration in addressing CCA and DRR. Even though there appear to be clear linkages between the two processes, there is still a lack of clarity on how integration may be achieved. As a matter of example, issues concerning when, at what level, and to what extent coordination is required, as well as who should take the lead, need to be addressed. The reason behind this may be that coordination must take place between scientists, practitioners, policymakers and community-level organizers, who all draw on different types of information and operate from different perspectives.

3. Similarities

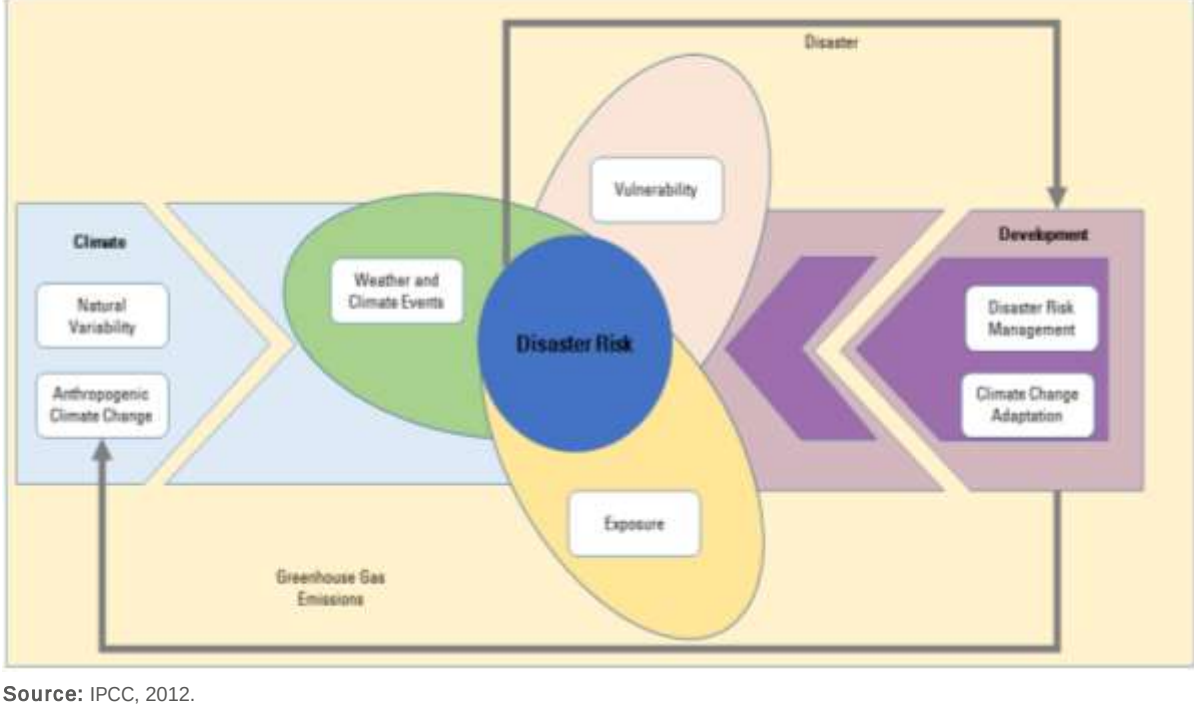
Both DRR and CCA aim to reduce natural hazard risks and to raise societal capabilities to lessen and manage these risks.[26] The key similarities between the two processes lie in managing disaster risks related to climate variability and weather extremes, and preparing for risks related to climate change.[27] IPCC defines disaster risk as the intersection of vulnerability and exposure to weather and climate events (figure 3), and both DRR and CCA have a role to play within a wider socioeconomic development context.

Hazards cannot be prevented, but DRR and CCA can mitigate their impacts. The two processes share overlapping objectives, methods and benefits, but their approaches to mitigation differ significantly. While DRR focuses on reducing risks by adopting mitigation measures to reduce the vulnerability of populations, thereby reducing the impact of hazards, CCA focuses on the ability of a community or society to adapt to the changing climate by using its own resources. In addition to having the same implementation timeframe, the Sendai Framework and the Paris Agreement, which guide these processes, share a number of similarities.

Even though both processes have been developed separately and by different communities, both DRR and CCA aim to reduce vulnerability and hazard exposure, in order to increase resilience to the potential adverse impacts of climate extremes.[28] Additionally, both processes examine hazards in the context of sustainable development, improving methods to anticipate, resist, cope with and recover from their impact.[29] Figure 4 illustrates similarities and differences between DRR and CCA.

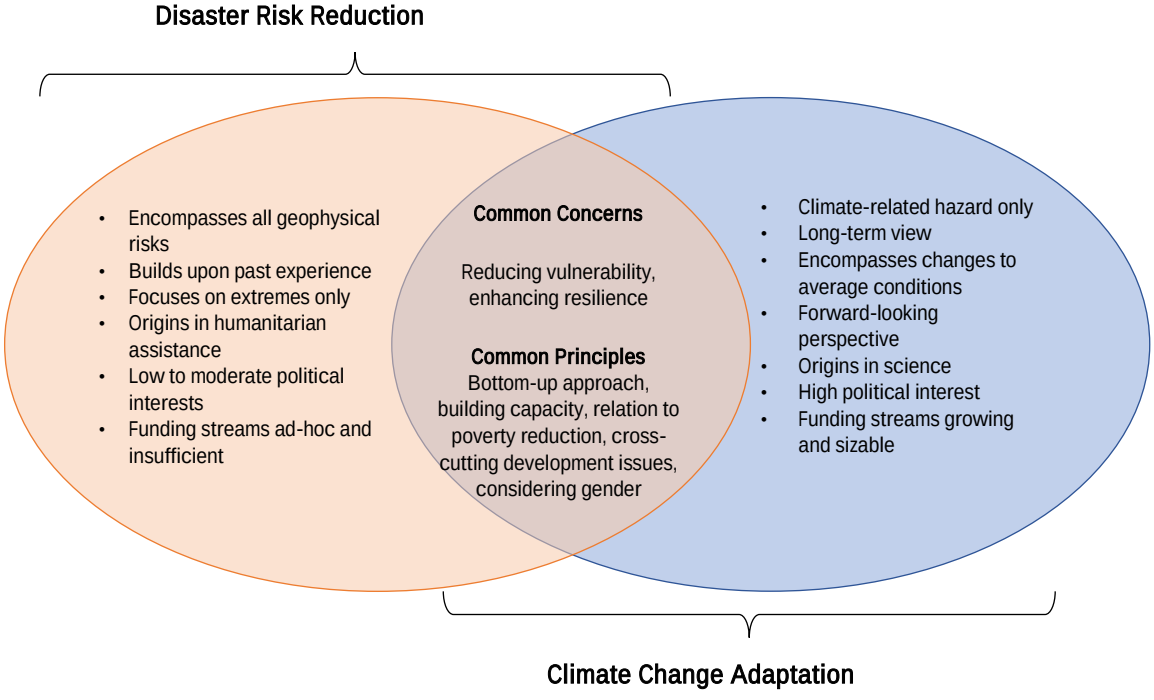
Both DRR and CCA emphasize the importance of resilience for achieving global change in a variety of sectors, and the importance of enhanced international support for adaptation and capacity-building in developing countries and LDCs.

Figure 3. Synergies between CCA and DRR



Source: IPCC, 2012.

Figure 4. Similarities and differences between DRR and CCA



Source: Adapted from Venton and La Trobe, 2008; Gero, Méheux and Dominey-Howes, 2011; UNISDR and UNDP, 2012.

Within the climate change discourse, no single definition of "resilience" has been adopted. It was not until COP 16 in 2010 that resilience was embedded in CCA discourse, reflecting the rising popularity of the term globally, and highlighting the link between CCA and DRR.[30] From the climate change point of view, resilience was understood as strengthening the capacities of both socioeconomic and ecological systems.[31] In the Paris Agreement, the concept of resilience features prominently, in particular with regard to building adaptive capabilities and reducing vulnerabilities to the adverse effects of climate change. Article 7 of the Paris Agreement states that "Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response".[32]

The DRR community, however, defines resilience as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions".[33] This definition was also the one used in the Sendai Framework, following a long debate to reach a single definition for this term within the DRR community.[34]

It should also be noted that the absence of a common definition of "resilience" was recognized internationally at the 2016 World Humanitarian Summit (WHS). In response to a call by the United Nations Secretary-General during the Summit, senior United Nations officials committed themselves to proposing a definition and getting it approved across the different development frameworks.[35]

The role of cities, regions and local authorities is highlighted by both the DRR and CCA communities, but to varying degrees. The Paris Agreement recognizes the responsibility of different stakeholders – party and non-party in the agreement – in addressing climate change, including cities, subnational authorities, civil society, the private sector and others.[36] The 2015 Sendai Declaration of Local and Subnational Governments on "Ensuring Enhanced Resilience to Disasters in the Urban World" recognizes the role of cities and local governments as the primary responsible authority in disasters, and calls for establishing a global network to share information and best practices, and allow mutual cooperation between cities suffering from disasters.[37] In addition, UNISDR launched, in 2010, the "Making Cities Resilient" campaign, which aims to enhance local governance and address urban risks. To date, the campaign works with over 3,400 cities worldwide, including in 12 Arab countries.[38]

The Paris Agreement calls upon different stakeholders to scale up their efforts to reduce emissions, build resilience, and decrease vulnerability to the adverse effects of climate change, and to uphold and promote regional and international cooperation. The Sendai Framework stresses the greater need for international cooperation, and calls upon local authorities to collaborate with national governments and the global community to advance the implementation of the framework.

Both CCA and DRR communities recognize that the poor are more vulnerable to hazards and have limited economic, social, physical and environmental means to improve their resilience.[39] This issue was also addressed in SDG1 in the 2030 Agenda for Sustainable Development, in particular in target 1.5, which calls upon stakeholders to **"**build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters".[40]

4. Differences

Despite a number of similarities between DRR and CCA processes, significant differences can also be noted, in particular in terms of approach, organizations and institutions, international conferences and mandates, assessment tools, strategies and funding mechanisms. DRR focuses mainly on the hazard event and exposure to it with a short-term perspective, deriving mainly from a background of engineering and natural sciences. Conversely, CCA focuses on vulnerability with a long-term perspective, deriving mainly from an interdisciplinary scientific approach.[41] DRR is also a multidisciplinary science in which social and natural/physical perspectives are most prominent.

There is a wide range of both established and newly developed tools available and applicable to CCA and DRR alike, including early warning systems; climate forecasts and outlooks; insurance and financial risk management; land use planning and management; and building code designs and standards. Despite their similarities, each community has developed its own tools. The following section provides examples of CCA and DRR assessment tools.

(a) Climate change assessment tools

Climate change vulnerability assessment is a process in which a community identifies areas of exposure to possible impacts of climate change. Such impacts could include an increase in storm frequency and intensity, sea level rise, coastal erosion, and coastal flooding. The aim of this assessment is to develop awareness at the community level, identify impacts that will affect the community, share knowledge of similar issues and damage from previous weather events, discuss future impacts and damage from similar events, and identify possible solutions and adaptation strategies.[42]

Climate change risk management is a process that provides a systematic, information and science-based tool to analyse risks and potential benefits, and to select optimal courses of action,[43] even under high uncertainty.[44] Once identified and prioritized, adaptation actions or measures can be developed for risks with the greatest consequences and the greatest likelihood of occurrence.[45]

Risk assessment is a risk management process that measures the magnitude of consequences, and the likelihood of occurrences.[46]

Climate change monitoring is the process of observing changes in the natural environment. Monitoring data provides valuable information about the kinds of short-term and long-term changes that are taking place in the areas of climate, streams, erosion and sea ice. Historical climate data provides information such as temperature and precipitation normals for a given location. Climate data reveal trends that can show whether certain climatic variables are increasing or decreasing over time.[47]

Climate change mapping examines flood risk maps, satellite images, topographic maps, aerial photographs, geographic information systems (GIS) data, and other mapping resources. It looks at the types of biophysical, natural, or human-made features that are important to map, such as urban areas, vegetation cover and its characteristics, and population density, among others. Mapping tools are essential for the formulation of low-emissions and climate-resilience measures, strategies and action plans.[48]

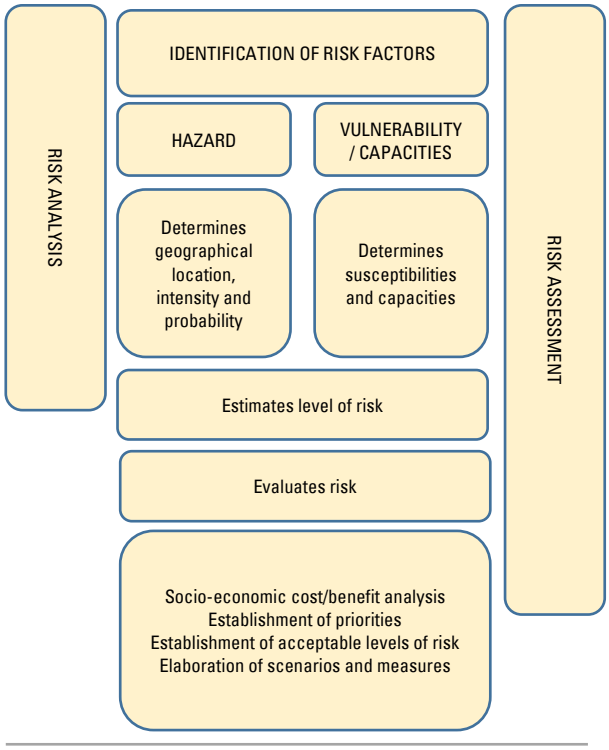
Modelling tools include regional climate models (RCMs) and hydrological modelling. RCMs examine small-scale information, giving weather and climate information at resolutions as fine as 50 or 25 km.[49] Hydrological modelling examines mainly hydrological processes at finer resolutions.[50]

(b) Disaster risk reduction assessment tools

DRR assessment tools adopt a holistic approach, focusing on different stakeholders, which renders the tools suitable for CCA, as impacts would affect various sectors and communities. These assessment tools have been developed by a broad range of institutions, including research centres, government agencies, United Nations organizations, non-governmental and intergovernmental organizations.[51]

Disaster loss and damage databases identify the different types of disasters that are most common in a given country, and that have had a significant human impact, such as in terms of the number of people killed, injured or affected, or physical and economic impacts, such as damage to roads, the number of schools and hospitals affected, and the number of houses destroyed. Such databases help stakeholders identify the risk profile of countries, compare between countries and prioritize support.[52]

Figure 5. Stages of risk assessment



Source: World Vision, 2017.

Risk assessment is a method used to analyse potential hazards and existing vulnerability,[53] which together can affect people, property, services, livelihoods, and the environment.[54] Risk analysis includes the identification of hazards, vulnerability, capacity, and risk estimation.

Disaster loss **and damage databases** identify the different types of disasters that are most common in a given country, and that have had a significant human impact, such as in terms of the number of people killed, injured or affected, or physical and economic impacts, such as damage to roads, the number of schools and hospitals affected, and the number of houses destroyed. Such databases help stakeholders identify the risk profile of countries, compare between countries and prioritize support.

Figure 5 shows the five stages of risk assessment according to World Vision's disaster risk reduction toolkit:[55]

1. Hazard analysis is the process of identifying potential hazards in a particular area in order to understand their nature and behaviour. It includes geographical analysis (location, extent); temporal analysis (frequency, duration); dimensional analysis (scale, intensity); and probability of occurrence.[56]
2. Vulnerability analysis is the process of estimating the susceptibility of "elements at risk" – including people, crops, buildings and services – to hazards and their impact. This analysis includes socioeconomic and cultural data.
3. Capacity analysis is the process of analysing the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed-upon goals. In the case of disaster risk, the goal would be to increase a community's ability to deal with such risk, by preventing, preparing for, withstanding, surviving, and recovering from it.
4. Hazard maps illustrate possible dangers in a given area. Hazard maps cannot stop a disastrous phenomenon, but they can help decrease the degree of its impact on individuals and communities, by providing people with clear information on the extent of possible harm and identifying buffer zones. Disaster prevention activities can then be designed and implemented, based on the likelihood and consequences of potential disasters.
5. Risk monitoring and evaluation is a tool intended to track changes in risk within a project area. It helps establish the baseline data needed to track the progress and

impact of DRR projects. Monitoring and evaluation uses specific indicators to track progress and assess the integration of DRR measures in the project.

5. Global progress and challenges for DRR and CCA integration

(a) Policy level

A number of global frameworks and strategies call for an integrated approach to DRR and CCA. The World Conference on Disaster Reduction in Kobe, in 2005, and UNFCCC COP 13 in Bali, in 2007, both discussed the significance of integration. The 2007 Bali Action Plan called for enhanced action on adaptation, including in terms of disaster reduction strategy considerations and means of addressing the loss and damage associated with climate change impacts in developing countries, thus acknowledging linkages between DRR and CCA.[57] DRR has appeared in CCA processes as follows:

- **At COP 13**, the 2007 Bali Action Plan referred to DRR under its section on adaptation, highlighting: (i) "risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance"; (ii) disaster reduction strategies and means to address loss and damage in developing countries vulnerable to the adverse effects of climate change;[58]
- **At COP 16**, the 2010 Cancun Adaptation Framework called for "enhancing climate change related disaster risk reduction strategies, taking into consideration the Hyogo Framework for Action, (...) early warning systems, risk assessment and management, and sharing and transfer mechanisms such as insurance";[59]
- **COP 17**, in 2011, called for reducing "vulnerability to the impacts of climate change, by building adaptive capacity and resilience";[60]
- **COP 18**, in 2012, called for enhancing the adaptive capacity of developing countries, particularly vulnerable to the adverse effects of climate change, by addressing loss and damage associated with climate change impacts;[61]
- **COP 19**, in 2013, called for reducing climate change vulnerability and building the resilience of developing countries.[62]

Table 1. Key differences between DRR and CCA

Climate change adaptation (CCA)	Disaster risk reduction (DRR)
Characteristics[a]	
Tackles vulnerability to changing distribution of extreme climatic events; relevant to climate-related hazards.	Tackles vulnerability to natural hazards and extremes; relevant to all hazard types.[b]
Approach	
Risk management; strong scientific basis; environmental science perspective; highly interdisciplinary; vulnerability perspective; long-term perspective; global scale; top-down approach.	Risk management; engineering and natural science basis; traditional focus on event and exposure, and on technological solutions; shift from response and recovery to awareness and preparedness; short-term but increasingly longer-term; local scale; community-based.[c]

Climate change adaptation (CCA)	Disaster risk reduction (DRR)
Organizations and institutions	
United Nations Framework Convention on Climate Change (UNFCCC); Intergovernmental Panel on Climate Change (IPCC).	United Nations Office for Disaster Risk Reduction (UNISDR); Global Platform for Disaster Risk Reduction (GP/DRR).
International conferences	
Conference of the Parties (COP).	World Conference on Disaster Risk Reduction (WCDRR).
Assessment	
IPCC assessment reports (international); communication reports (national); biennial reports (national); nationally determined contributions (NDCs).	Vulnerability and capacity assessment; International Federation of Red Cross and Red Crescent Societies (IFRC) World Disasters Report; International disasters databases (DesInventar, GAR Universe, etc.); Global Assessment Report (GAR).
International agreement/framework	
Kyoto Protocol (2005-2012); Paris Agreement (2015-2030).	Hyogo Framework for Action (HFA) (2005-2015); Sendai Framework (2015-2030).
Strategies	
National communications to the UNFCCC; National Adaptation Programmes of Action (NAPAs) for LDCs; new and emerging agenda; increasing political and widespread recognition.	United Nations International Decade for Natural Disaster Reduction (IDNDR) 1990-2000; Yokohama Strategy and Plan of Action for a Safer World (1994); Hyogo Framework for Action (HFA) (2005-2015); incremental development; frequently poor political and widespread recognition.
Funding	
Funding streams sizeable and increasing;[d] Special Climate Change Fund (SCCF); Least Developed Countries Fund (LDCF); Kyoto Protocol Adaptation Fund (AF); Green Climate Fund (GCF); Global Environment Facility (GEF).	Funding streams ad hoc and insufficient; national civil defense/emergency response; international humanitarian funding; multilateral banks; bilateral aid.

Sources: Schipper and others, 2014; Thomalla and others, 2006.

[a] OECD, 2009.
[b] Davies, Oswald and Mitchell, 2009.
[c] Forino and others, 2014.
[d] Venton and La Trobe, 2008.

In 2005, HFA called explicitly for the integration of climate change strategies in DRR, and argued that such integration would facilitate the identification of climate-related disaster risks.[63] In 2009 and 2011, the Global Platforms on DRR (GP/DRR) reiterated the importance of synergies between the two communities.[64] In 2012, the IPCCC's Working Group II published a special report on "Managing the Risk of Extreme Events and Disasters to advance Climate Change Adaptation",[65] which explored the challenges of understanding and managing the risks of climate extremes and advancing climate change adaptation. This special report provided input for the IPCC's Fifth Assessment Report. Furthermore, in 2013, UNISDR published the "Implementation of the Hyogo

Framework of Action",[66] which strongly encouraged actors from both fields to coordinate their actions more closely. In 2014, IPCC suggested that a significant increase in the frequency and magnitude of hazardous processes related to climate change is to be expected at the global scale. Consequently, it is necessary to improve preparedness, increase public awareness, fill institutional gaps and improve planning, in order to reduce the potentially disastrous impact of climate change-related natural hazards.[67]

(b) Implementation level

A number of international organizations are actively involved in integrating DRR and CCA in humanitarian and development programmes. For example, the Red Cross Red Crescent Climate Centre supports the International Federation of Red Cross and Red Crescent Societies (IFRC) in understanding and addressing the humanitarian consequences of climate change and extreme weather events.[68] Furthermore, various financial and development institutions, such as the World Bank, the United States Agency for International Development (USAID), the Danish International Development Agency (DANIDA), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and others, have developed guidelines on climate-proofing in their development agenda. Other organizations, including the Swiss Agency for Development and Cooperation (SDC), the Swedish International Development Cooperation Agency (SIDA), the International Development Research Centre (IDRC), the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), have invested in DRR and allocated resources for its integration in humanitarian or development programmes and policies.

Many institutions, including the United Nations Office for Disaster Risk Reduction (UNISDR), the United Nations Environment Programme (UN Environment), the United Nations Development Programme (UNDP) and the Organization for Economic Cooperation and Development (OECD), have held debates, issued recommendations and proposed approaches for mainstreaming CCA into sustainable development and DRR, while calling for the simultaneous implementation of DRR and CCA.[69] Some programmes aim to examine how DRR and CCA can be effectively undertaken together. The 2005 Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change includes has as its fourth work area, "climate-related risks and extreme events".[70] It calls for assessing, planning and implementing risk management in the context of adaptation and sustainable development, and also considers new and novel mechanisms for climate risk assessment and management.[71] Furthermore, researchers argue that the integration of DRR and CCA in urban planning would contribute to protecting existing urban communities and designing resilient cities in the future.[72]

2. Disaster Risk Reduction and Climate Change Adaptation in the Arab Region

2. Disaster Risk Reduction and Climate Change Adaptation in the Arab Region

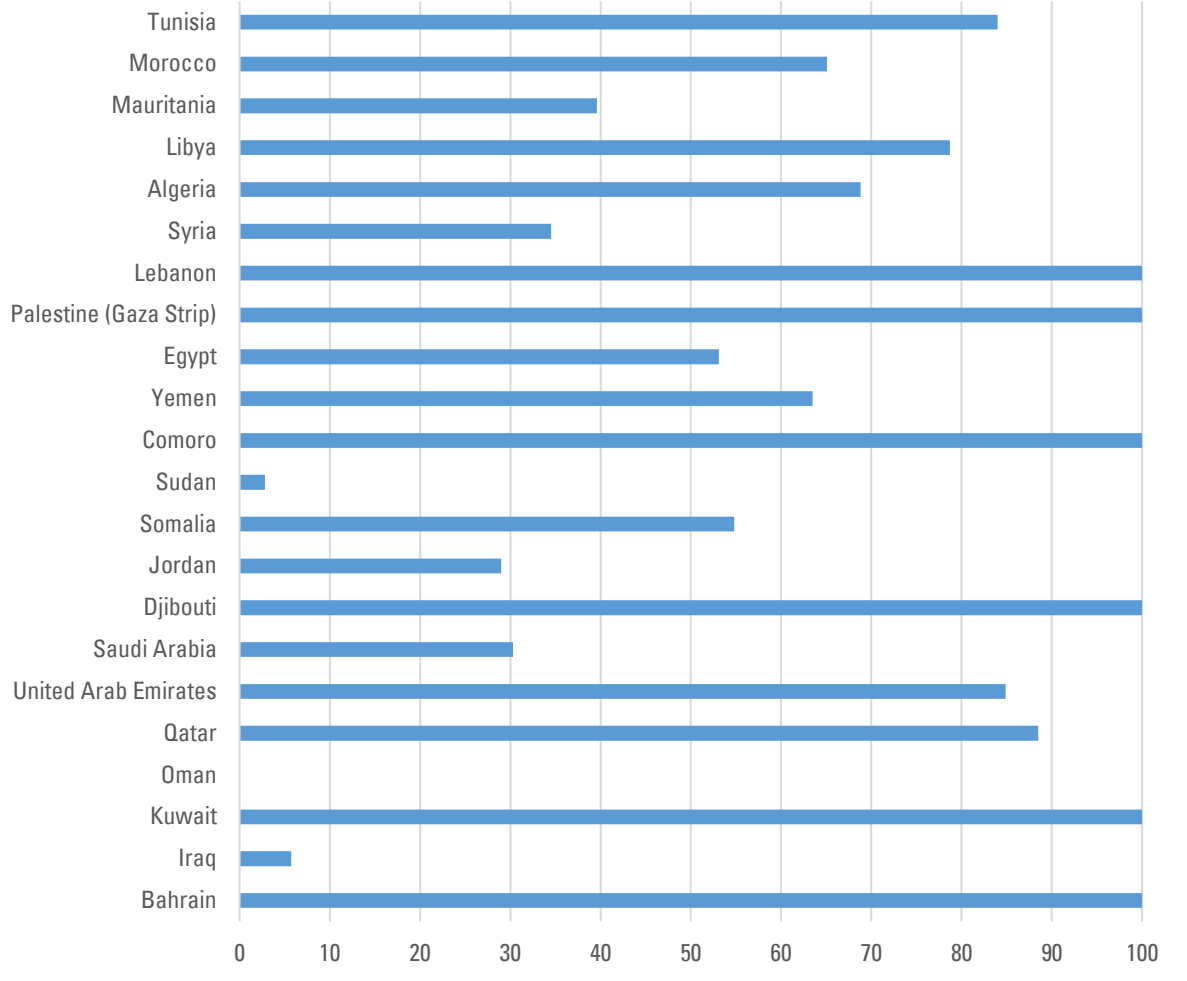
A. Problem analysis within the context of the Arab region

1. Arab region overview

The Arab region is one of the most urbanized regions in the world. With an average population growth rate of between 2 and 2.2 per cent per year, Arab countries will be home to 646 million people by 2050, compared to 373 million in 2014[73] and 172 million in 1980, with their urban population escalating from 56 per cent in 2010 to 68 per cent in 2050.[74] The region covers 10 million km^2, of which 90 per cent consists of arid, semi-arid and dry subhumid areas, and only 3 per cent is home to 92 per cent of the total population.[75] Urbanization in the Arab region has been fuelled by high fertility rates, rapid economic development, environmental degradation, international and regional migration to oil-rich countries, rural-urban migration, poverty, drought, and conflicts. This rapid urbanization has also resulted in the growth of large cities (such as Amman, Baghdad, Cairo, Jeddah and Riyadh), bringing about a range of social, economic and demographic changes, as well as concerns about service provisions.[76] Rapid urbanization in Arab countries is often unplanned, resulting in the creation and expansion of informal settlements, which are highly vulnerable to the impacts of climate change and disasters. This kind of growth often leads to the destruction of natural environments that act as buffers to climate change impact. Added to inadequate drainage systems and weak non-structural flood mitigation measures, this can make the consequences of extreme weather events and disasters more severe.[77] Currently, when it comes to the environment, most Arab countries are facing climate change, hot weather conditions, disasters, and water scarcity.

Water scarcity is one of the main constraints to socioeconomic development in the Arab region.[78] The imbalanced distribution of water resources and the high demand for water, in addition to the water sector's interconnectedness with other sectors (including energy, food and health) and threats (such as climate change), have created outstanding challenges for policymakers and planners across the region. For instance, in 1950, per capita renewable water resources were four times greater than they are today. In the Arab region, renewable water resources per inhabitant reached 650 m^3 in 2014, compared to a world average of about 6,000 m^3 per inhabitant, placing 13 out of 22 Arab countries in the category of severe water scarcity at less than 500 m^3 per capita).[79] And there are indications that, by 2050, water resources in the region will drop even further, to 11 times less than the global average.[80] Furthermore, by 2030, the effects of climate change will reduce renewable water resources by another 20 per cent, through declining precipitation, rising water demand as temperatures mount, and expanding seawater intrusion into coastal aquifers as sea levels rise and groundwater overexploitation continues.

Figure 6. Arab national populations living within 100 km of coastal zones (percentage)



Source: Adapted from El-Raey, 2009.

As climate change accelerates, developing countries in general, and Arab countries in particular, will suffer sooner from its impacts, as they are more vulnerable, less resilient, and generally have a lower capacity to adapt to identified hazards.[81] Women, the urban poor, and marginalized communities are especially at risk.[82] Based on IPCC estimates, most Arab countries are expected to be negatively affected by climate change. The region will become hotter and drier; higher temperatures and the lack of precipitation will jeopardize water quality and quantity, increase the occurrence of droughts, and decrease agricultural productivity.[83] Climate change will also give rise to many challenges for Arab cities, for example through warming (and associated heat waves and health hazards) and flooding (extreme precipitation combined with infrastructural inadequacies).[84] Additionally,

rising sea levels and coastal erosion could affect much of the Arab population living within 100 km of coasts, as illustrated in figure 6. For example, in the case of Alexandria, Egypt, a 0.5 m rise in sea level would leave more than 2 million people displaced, with losses of $35 billion in land, property and infrastructure, as well as incalculable losses in historical and cultural assets.[85]

The Arab region is also prone to weather volatility, and the frequency of natural hazards has increased over the past two decades, probably as a result of climate change. Coupled with a low level of disaster preparedness, this has led to a substantial increase in the number of lives lost, mainly in the region's LDCs.[86] Disasters pose a serious threat to the Arab region in general and to urban centres in particular. The region suffers from the impacts of severe and extreme weather events, including dust storms, droughts (despite the growing intensity of rains), flash floods, heat waves, and marine storms. For instance, according to UNISDR, the region has been affected by more than 270 natural disasters in the past three decades, resulting in more than 150,000 deaths and affecting about 10 million people.[87] The synergy of urban vulnerability, natural hazards, rapid urbanization, water scarcity, food insecurity and climate change has emerged as a serious challenge for policymakers and planners in Arab countries. This interaction will reshape the risk landscape by making the region's natural resource base fragile and extremely susceptible to a variety of internal and external factors.[88]

This increase in climate-related extreme weather, combined with urban population growth and unplanned urbanization, significantly hinders regional and national efforts toward sustainable development. These challenges are expected to worsen, and the region is expected to become even more vulnerable to climate change impacts.

Natural hazards by themselves do not cause disasters; it is the combination of an exposed, vulnerable and ill-prepared population or community with a hazard event that results in a disaster.[89] The Arab region is particularly vulnerable to climate change, owing to its prevailing low adaptive capacities, which arise from endemic poverty, weak institutions, inefficient urban planning, insufficient infrastructure and conflicts. As a result, climate change will affect disaster risks in the Arab region in two ways: firstly, through the likely increase in severe weather and climate-related hazards; and secondly, through an increase in the vulnerability of communities to natural hazards, particularly due to ecosystem degradation, negative impacts on water availability and quality, and its associated impact on food production and food security, as well as its long-term impact on livelihoods. Chapter 3 provides a detailed analysis of how climate vulnerability can be determined for different socioeconomic sectors, based on the outputs of specialized climate models for the Arab region.

There is much discussion concerning the integration of DRR and CCA from the global institutional and policy level through to regional and national levels.[90] However, in the Arab region as a whole, most CCA and DRR strategies are developed in silo at the national level, with limited integration and downscaling activities targeting the local, city or community levels. As a result, to date, little progress has been made in achieving genuine integration between DRR and CCA and developing practical solutions. This limited progress can be attributed to various technical and institutional challenges.

2. Regional technical challenges

The Arab region is witnessing an accelerating number of weather- and climate-related disasters, and this trend is likely to increase in the future. In fact, climate change is expected to exacerbate extreme weather events in the region, such as floods and droughts, which will in turn further exacerbate pressures on limited water resources and food security, and will add to the vulnerability of communities and urban inhabitants, especially the poor. Another growing concern is that of increased conflicts over shared water resources and other natural resources in the coming years. There is a need to develop databases and gather information on risks and vulnerabilities, in order to inform policies and decision-making processes. However, the region lacks comprehensive and integrated data, and operates with inconsistent information across agencies and sectors. This section outlines the main technical challenges that hinder integration between DRR and CCA in the Arab region, which are as follows:

Lack of integrated databases on disaster loss and climate-related hazards. A crucial aspect of effective decision-making is access to relevant climate-hazard databases, meteorological and hydrological data, as well as information on other hazards. Accurate economic information on costs and benefits to advocate for prevention and adaptation measures at different levels are also necessary. These databases need to be standardized, updated and accessible to all relevant stakeholders, including non-governmental organizations (NGOs), research centres and academia. Ensuring the availability of reliable and credible information on existing risk levels will be particularly helpful in achieving integration between DRR and CCA in its different aspects;

Lack of integrated approaches to risk assessment. Risk assessment is one component of the broader risk governance framework for adaptation to climate change and DRR. The IPCC has pointed out that "effective risk management generally involves a portfolio of actions to reduce and transfer risk and to respond to events and disasters, as opposed to a singular focus on any one action or type of action".[91] Risk assessment in DRR and CCA follows different approaches and methods in spite of significant synergies and common goals that exist in their application. For instance, DRR assessment aims to ensure evidence-based decision-making, in order to lower the impact of natural hazards, and prevent threats by examining socioeconomic, institutional, political and cultural factors, to determine both the impact of natural hazards on communities, and the resilience of these communities and their ability to cope and recover. Conversely, CCA assessment views these factors as part of the adaptive capacity that determines how people would cope with climate impacts. Therefore, the management of risks associated with climate extremes, extreme impacts and natural hazards should benefit from an integrated systems approach that would combine both DRR and CCA assessments tools and instruments;

Poor urban planning. Urban areas will be most vulnerable to climate-related hazards. Urban development in many Arab cities occurs without compliance with legal regulations, building codes or integrated land use plans. Urban development requires standard procedures to manage risk and emergency plans, and to enforce regulations and building codes. Around 75 per cent of buildings and infrastructure in the region are estimated to be at direct risk from climate change impacts, mainly rising sea levels and the increased intensity and frequency of hot days and of

storm surges.[92] In urban settings, climate-related hazards will negatively impact services such as transport systems, energy plants, water supply, and wastewater networks. Besides, recovery and rebuilding projects are usually stand-alone initiatives that last for a short time, resulting in DRR being absent from long-term reconstruction, regulations and planning systems. In Arab countries, little effort has been made towards planning and management projects that would influence investment policies to encourage effective integrated risk management;

Lack of multi-hazard early warning systems. Arab countries need to build up the resilience of vulnerable communities and develop integrated coastal zone management plans. They lack the early warning systems needed to deal with hazards such as flash floods, sea level rise and impacts on coastal zones, prolonged drought cycles, sandstorms, heat waves, and more. There is a need to build risk assessment and information tools, dissemination and communication tools, as well as response capacities, in order to enhance core elements of these early warning systems;

Insufficient access to information. Effective communication, standardized and integrated databases, and information-sharing between relevant stakeholders is essential to strengthen integration between DRR and CCA. The way in which weather and climate information is packaged, delivered and presented to decision-makers and the local public is always a key challenge in the Arab region;

Inadequate understanding of data related to social vulnerability. Although scientists and researchers have recognized, in recent years, the importance of social groups (gender, age, and others), there is still a need to achieve a clear understanding of the cultural, economic and political factors that affect the vulnerability of communities to disasters. Refugees and marginalized groups are impacted or affected the most by extreme events. The underlying causes of social vulnerability are still not well understood or addressed in public policy in the Arab region. Despite the progress made by Arab countries in terms of reporting their actions on HFA, this has had a limited impact on improving policies and governance issues, at the national and subnational levels, to reduce social vulnerability and empower marginalized groups;[93]

Uncertainty in assessing the economic costs of extreme events and disasters. This is mainly due to uncertainties in climate change modelling results and damage cost estimates, as well as gaps in data records and inaccurate methods being used to analyse disaster damage data. Costing is further limited by the interaction between different adaptation options, assumptions about future exposure and vulnerabilities, and levels of adaptive capacity and resilience in communities;[94]

Lack of science-based analyses and projections of climate change scenarios. Climate change modelling in Arab countries relies on national and local studies that are only conducted in reaction to emergencies, or for short-term projects such as the UNFCCC's national communications. Given the high complexity and multidisciplinary nature of climate change, it is important to rely on science-based analyses and projections of climate change scenarios to formulate policy at regional and subregional levels;

Lack of credible data and information. The difficulty of collecting consistent and credible data and information on water resources,

climate change impacts, the vulnerability of different sectors, and DRR in the Arab region hinders accurate analysis and well-informed decision-making processes. It also prevents the establishment of coherent and cooperative policy frameworks.

3. Regional institutional challenges

The institutional dimension is a key determinant of vulnerability to extreme events, as it encompasses the relationship between policy setting and policy implementation in risk and disaster management.[95] Despite the fact that CCA and DRR are managed by different institutions, they have similar aims and therefore a strong rationale for institutional integration. However, a number of institutional challenges exist in the Arab region that impede coordination and communication between the CCA and DRR communities. Some of these challenges are related to the nature of vertical and horizontal relationships and dynamics between DRR and CCA communities at the global, regional and national levels; others are specific to Arab countries' decision-making environment and policymaking framework. These challenges include:

Separate global/regional/national frameworks for DRR and CCA. In the Arab region, the mutual isolation of the DRR and CCA communities can be attributed partly to different thematic agendas and related investments by donors, and partly to existing silos within governments. For instance, CCA usually falls under the mandate of the ministry of the environment, while DRR responsibilities lie with the ministry of the interior and civil defence. A lack of institutional interaction and integration between DRR, CCA and national development plans may lead to redundant or conflicting policy responses;[96]

Weak or poor risk governance. Both DRR and CCA communities emphasize the need for more bottom-up initiatives, such as community-based adaptation (CBA), community-based disaster risk management (CBDRM) and ecosystem-based adaptation (EBA) projects. Community-centred strategies and local expertise can be more cost-effective for reducing weather and climate-related risks and more equitable than large-scale structural measures. However, the prevailing centralized and top-down approach to dealing with CCA and DRR in most Arab countries will continue to hinder effective integration between the two communities. Furthermore, CCA and DRR strategies in Arab countries, if they exist at all, are developed nationally with limited downscaling activities targeting the local, city or community levels. For instance, comprehensive CCA and DRR programmes are needed during land-use and development planning processes, to help local governments minimize vulnerability to climate change impacts and related hazards, and enhance climate and disaster resilience in key sectors, such as water resources, agriculture and urban development. Inadequate coordination between the CCA and DRR communities within the Arab region has also increased administrative burdens, prevented the efficient use of financial, human and natural resources, and decreased the overall effectiveness of efforts to reduce risk. Other challenges in this respect include: competing rather than complementary agendas; complicated policy frameworks; missed opportunities to share tools, methodologies and approaches; and a lack of opportunities to co-fund DRR and CCA efforts. Such inefficiencies should be addressed as an urgent priority for achieving maximum levels of risk reduction on a comprehensive basis. Weak coordination between DRR and CCA exists at different levels (regional/national, national/national,

national/local). The institutional framework is fragmented, as the primary responsibility for CCA lies with sector ministries (environment, water, agriculture and health), while for DRR, it lies primarily with civil defence and interior ministries;

Low capacity. Countries in the Arab region have initiated national strategies for DRR and CCA. However, the scale of climate change impacts and related risks and hazards in the Arab region is likely to be beyond their coping capacity, and significant efforts will be required to develop additional capacities both technically and financially. In addition, prolonged reliance on central governments has resulted in weak local governments in the Arab region, with a remarkably low capacity to mitigate hazards and adapt to climate change and associated disaster risks;[97]

Insufficient financial resources. A main challenge is the lack of funds allocated to DRR and CCA nationally and locally. Governments in the region are suffering from budget constraints, especially in low-income countries. Many countries are suffering from mounting debt concerns, and public investment in DRR and CCA is limited. Furthermore, there is limited engagement by civil society groups, local communities and the private sector in the development of DRR and CCA strategies and plans from the early stages, which consequently limits the resources base for DRR and CCA. Arab countries also lack disaster risk financing and insurance instruments.[98] There is, therefore, a significant need to promote financing mechanisms and consider innovative strategies in Arab countries;

Incoherent policies and lack of monitoring and evaluation frameworks. The absence of a comprehensive policy framework for DRR and CCA in Arab countries, coupled with a lack of enforcement of risk management regulations in most of these countries, significantly raises the risk of disasters. The limited number and weakness of comprehensive risk mitigation and CCA response programmes in the region, in addition to the absence of a proper and comprehensive framework for monitoring and evaluation, will hinder the transition to more integration between DRR and CCA;

Ineffective implementation. To date, in the Arab region, the CCA and DRR communities have operated largely in isolation from one another. CCA and DRR policymakers, experts and stakeholders need to communicate and collaborate with each other effectively to ensure a comprehensive risk management approach at the local, national and regional levels. The current isolated policy and institutional settings for both CCA and DRR have resulted in the development of separate implementation and funding mechanisms, and distinctive methodologies for climate and disaster risk assessment. Even though separate guidelines for mainstreaming DRR and CCA into national development were developed in many Arab countries, they have been implemented by different agencies in their respective work programmes with no integration;

Gap between research and policymaking. It is important for knowledge and understanding of DRR and CCA to be transmitted beyond the directly concerned academic and scientific circles. For example, experts in DRR and CCA need to raise awareness, using a language that their counterparts in key sectors such as health, environment, finance, agriculture and other line ministries can understand. DRR and CCA specialists need to not only explain risks to other development actors, but also propose practical responses and policy interventions to

policymakers (the science-policy interface). Communication across disciplines and sectors will help address the barriers linked to the lack of understanding of the synergies between DRR and CCA, and demonstrate the benefits of integration;

Lack of awareness. The lack of awareness and understanding of CCA and DRR synergies and differences at all levels (global, regional, national, local) delays future efforts and the benefits of a more integrated approach. The effectiveness of public awareness campaigns and formal education programmes has suffered from a lack of clear, long-term strategies and of harmonization among the various objectives pursued across the region. More targeted, hazard and sector-specific inputs are needed for curricula and training modules, and for the identification and activation of local knowledge. In several countries, these targeted inputs include, for example, addressing training needs in safe building techniques.[99]

4. Progress in the Arab region in DRR and CCA integration

There have been a few initiatives in the Arab region that have addressed DRR and CCA issues over the past years. For example, the Arab Ministerial Declaration on Climate Change (2007) expressed the commitment of Arab countries to move towards climate change adaptation and mitigation, and was followed by the Arab Framework Action Plan on Climate Change (2010-2020). In addition, Arab countries have concurrently sought to assess the impact of climate change on national water resources, so as to inform their national adaptation plans and communications to the UNFCCC. The Arab Water Security Strategy (2010-2030) was adopted in 2011 and proposes a series of measures to respond to the region's water scarcity challenges. It is complemented by an action plan that includes a set of implementation projects focused on water use efficiency, non-conventional water resources, climate change, integrated water resources management, and water security.

In response to resolutions adopted by the Arab Ministerial Water Council (AMWC), the Council of Arab Ministers Responsible for the Environment (CAMRE), ESCWA's 25th Ministerial Session, as well as inter-agency collaborative processes involving the specialized and regional organizations of the United Nations and the League of Arab States, a Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) was launched in 2010.[100] RICCAR focuses on four pillars of work comprising: (a) a baseline review; (b) an integrated assessment that combines impact assessment and vulnerability assessment tools; (c) awareness-raising and information dissemination; and (d) capacity-building and institutional strengthening. RICCAR has produced outputs from future projections of climate change to mid- and end century, for different scenarios for temperature, precipitation, extreme climate indices, surface runoff, evapotranspiration and other parameters, for the entire Arab region. Vulnerability assessment of key sectors based on indicators and overlaying techniques using GIS tools was also conducted. In addition, the establishment and updating of historical disaster loss databases in specific Arab countries was supported as part of RICCAR activities. These results are presented in detail in chapter 3 of this report, along with linkages between climate change projections of extreme events and disaster loss databases.

Furthermore, ESCWA and its partners conducted a series of consultations with Arab

governmental and non-governmental stakeholders in 2013-2014, to help distil a regional perspective on the Post-2015 Development Agenda and the SDGs.[101] An increased frequency of natural hazards in the Arab region could lead to losses in lives and property and hinder socioeconomic development, especially when natural hazards are coupled with a high exposure of populations. Therefore, addressing the SDGs will strengthen the capacity of Arab communities and will achieve sustainability, by avoiding exposure to new risks, minimizing current risks and working towards sustainable development. This will reduce disaster mortality, the number of people affected and the direct economic loss. The following sections describe some of the global and regional DRR and CAA initiatives, targets and action plans in more detail.

B. Key global and Arab region goals, strategies and action plans

1. DRR policy instruments and components

(a) Hyogo Framework for Action 2005-2015 and associated Arab actions

In 2005, the international community working on DRR adopted HFA as a global instrument to guide the implementation of DRR at all levels of society. HFA was conceived to give further impetus to the work that had been done at the global level under the International Framework of Action for the International Decade for Natural Disaster Reduction (1990s); the Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation, adopted in 1994; and the 1999 International Strategy for Disaster Reduction. HFA's overarching goal was to achieve a substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries, through the following five priorities for action: (i) "ensure that disaster risk reduction is a national and a local priority, with a strong institutional basis for implementation"; (ii) "identify, assess and monitor disaster risks and enhance early warning"; (iii) "use knowledge, innovation and education to build a culture of safety and resilience at all levels"; (iv) "reduce the underlying risk factors"; and (v) "strengthen disaster preparedness for effective response at all levels".[102]

Despite the fact that national and local governments bear the primary responsibility for their own socioeconomic development and national development strategies and plans, including DRR, an enabling international and regional environment is essential to support the development of the knowledge, capacities and resources required to build resilient nations and communities. Since the adoption of HFA in 2005, the League of Arab States, in collaboration with regional agencies, has taken the lead in promoting the integration of DRR in key regional policies on climate change and the environment, and in disaster management coordination mechanisms. It also supports and calls for the implementation of HFA at the regional and national levels, and promotes the coordination of efforts towards implementing the International Strategy for Disaster Reduction (ISDR). Furthermore, the League of Arab States and UNISDR initiated, in 2009, the first review of progress on the implementation of HFA in Arab countries, and assessment of the current status of DRR in the region.[103]

In addition, the first Arab Conference on DRR was held in Aqaba, Jordan, in 2013, and the

second in Sharm el Sheikh, Egypt, in 2014. Both conferences provided a forum for Arab Governments, policymakers, planners, academia, civil society and development experts to discuss DRR in the region, and were respectively concluded with the adoption of the Aqaba and Sharm el Sheikh Declarations.[104] The Sharm el Sheikh Declaration on Disaster Risk Reduction reflected the challenges faced by DRR in the region and the commitment of Arab countries to the post-2015 framework for DRR. Moreover, it included new stakeholder recommendations from civil society and youth/children. Subsequently, the Arab ministers of environment endorsed the Sharm el Sheikh Declaration in their 26th meeting in Jeddah in November 2014.

The UNISDR's regional report (2015) on progress in reducing disaster risk and implementing HFA in the Arab region provides an overview of trends in progress, challenges and gaps in implementing HFA for the period 2005-2015. The report reveals increased recognition by Arab Governments and other stakeholders of the rising importance of DRR. However, it also reveals that progress and achievements at the national level have been neither substantial nor comprehensive. Significant challenges remain for the implementation of HFA, with the lack of clear mandates, financial resources and capacities, at both the national and local levels, as the most severe constraints.[105]

(b) Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the Third United Nations World Conference in Sendai, Japan, on 18 March 2015. It was the outcome of stakeholder consultations initiated in March 2012 and intergovernmental negotiations held from July 2014 to March 2015, supported by UNISDR at the request of the United Nations General Assembly. The Sendai Framework is the successor instrument to HFA, and is built on elements which ensure continuity with what was done by States and other stakeholders under HFA. However, the Sendai Framework deviates from its predecessor in several ways, most significantly by: (i) placing strong emphasis on disaster risk management; (ii) setting seven global targets; (iii) viewing the reduction of disaster risk as an expected outcome; (iv) focusing on preventing new risk; and (v) reducing existing risk and strengthening resilience. In addition, the Sendai Framework adopts a number of guiding principles, including the primary responsibility of States to prevent and reduce disaster risk, and the need to engage society and all institutions.[106] Furthermore, the scope of DRR has been broadened significantly, to focus on both natural and human-made hazards, and related environmental, technological and biological hazards and risks, with health resilience being strongly promoted throughout. Furthermore, the Sendai Framework articulates the need for the following: (i) a better understanding of disaster risk, in all its different aspects, including vulnerability, exposure and hazard characteristics; (ii) strengthening disaster risk governance, including national, regional and global platforms; (iii) accountability for disaster risk management; (iv) preparedness to "build back better" in the recovery and reconstruction stages; (v) recognition of relevant stakeholders and of the roles they play; (vi) mobilization of risk-sensitive investment, so as to avoid creating new risks; (vii) improving the resilience of health infrastructure, as well as cultural heritage and workplaces; (viii) strengthening global partnerships and international cooperation, and developing risk-informed donor policies and

programmes, including the financial support of international financial institutions.[107] It also expresses clear recognition of the Global Platform for Disaster Risk Reduction and of regional platforms for DRR, as useful mechanisms for achieving coherence across agendas, monitoring and conducting periodic reviews in support of United Nations bodies. UNISDR has been tasked to support the implementation, follow-up and review of the Sendai Framework,
which focuses on the following four priorities for action:[108]

(i) Understanding disaster risks;
(ii) Strengthening disaster risk governance to manage disaster risks;
(iii) Investing in DRR for resilience;
(iv) Enhancing disaster preparedness for effective response, and to "build back better" in recovery, rehabilitation and reconstruction.

(c) Arab Strategy for Disaster Risk Reduction 2010-2020, its implementation plan and adaptation in the light of the Sendai Framework

In recognition of the increasing risk and frequency of disasters that challenge the development process in the region, and as a follow-up to the First Arab Economic and Social Development Summit, CAMRE adopted specific actions relating to DRR, through a decision in May 2009 to develop an Arab strategy for DRR. This strategy, entitled the Arab Strategy for Disaster Risk Reduction 2020, adopted in December 2010, has a twofold purpose, namely:[109]

- To outline a vision, strategic properties and core areas of implementation for DRR in the Arab region;
- To enhance institutional and coordination mechanisms and monitoring arrangements in order to support the implementation of the Strategy at the regional, national and local levels, through the preparation of a Programme of Action.

The Strategy was reaffirmed at the Second Arab Summit for Socio-Economic Development in January 2011, endorsed by the Economic and Social Council of the League of Arab States in its September 2011 session, and adopted at the highest political level at the Arab Heads of State Summit in Baghdad in March 2012.[110] The Strategy is designed to complement existing and ongoing efforts in DRR by national institutions and regional organizations in the Arab region. It focuses on enhancing knowledge on risk reduction and capacities to reduce disaster losses and boost resilience. During the 2010-2015 period, implementing partners of the Strategy were to focus on multisectoral approaches, with the purpose of reducing emerging risk across the Arab region by 2020, in line with the global priorities outlined by HFA and the Millennium Development Goals (MDGs). The League of Arab States led the development and implementation of this Strategy in collaboration with the UNISDR Regional Office for Arab States, and with the contributions of many regional technical institutes, United Nations agencies, the World Bank, IFRC and civil society networks. The Strategy as initially adopted was followed by the development of a detailed programme of action for the implementation of its priorities. In 2011, the League of Arab States also agreed to establish an Arab centre for the prevention of earthquakes and other natural disasters, hosted by Algeria.[111]

In 2015, the League of Arab States, in collaboration with UNISDR, held an Arab regional

meeting aimed at introducing the Sendai Framework to the Arab region. The meeting also included the review and update of the Arab Strategy for Disaster Risk Reduction (2015-2030), in order to ensure its coherence with the Sendai Framework and other regional commitments.[112]

In May 2017, Qatar, in coordination with UNISDR and the League of Arab States, hosted the Third Arab Preparatory Conference on DRR, three weeks before the Global Platform for Disaster Risk Reduction got underway in Cancun, Mexico. With wide representation from Arab Governments, regional and international organizations, civil society, the academic sector and youth, the delegates wrapped up the conference by adopting the "Doha Declaration for the Fifth Global Platform for Disaster Risk Reduction", which focuses on the Arab Strategy for Disaster Risk Reduction 2030, with a strong emphasis on aligning the region's efforts with the Sendai Framework.[113] The Declaration called for adopting the Arab Strategy for Disaster Risk Reduction 2030, and developing a strategic work programme with clear priorities in line with the Sendai Framework, with the first milestones being set for 2018-2020. It also called for a stronger role for science and technology in the Arab region, in line with a global drive launched at a UNISDR conference in January 2016. It emphasized the need to appoint a scientific focal point to represent each country at the Arab Science and Technology Advisory Group, which was set up in November 2015.[114]

2. Climate change policy instruments and components

(a) Paris Agreement

The Paris Agreement reflects a global commitment to reduce GHG emissions to relatively safe levels; limit global warming to an increase in global temperature well below 2°C, and hopefully of no more than 1.5°C; implement adaptation and mitigation measures; and secure financial resources.[115] Its new provisions and implementation requirements will certainly impact global climate governance and related financial mechanisms and implementation modalities. As a result, it will influence the national climate debate and related agendas on how to best account for anthropogenic emissions and removals corresponding to their Intended Nationally Determined Contributions (INDCs). For instance, both developed and developing countries should promote environmental integrity, transparency, accuracy, completeness, comparability and consistency and ensure the avoidance of double counting when reporting about emission reductions, in accordance with guidelines adopted by COP. Consequently, planners, policymakers and decision-makers will have to coordinate, design, and enact intersectoral policies, and implement adaptation and mitigation projects included in INDCs. Due to their political positions since the 1990s, developing countries will likely be the most challenged, largely as a result of their political systems, poor economies, weak governance and limited technical, financial, and administrative capacities.[116] Overcoming these obstacles requires policy reforms and changes in governance (considering, among others, actors, dynamics, processes and networking models.), as well as financial and technical support from developed countries.

In accordance with its Article 20, the Paris Agreement was open for signature at the United Nations Headquarters in New York from 22 April 2016 until 21 April 2017 by States and regional economic integration organizations that are Parties to UNFCCC. As of 16 June 2017, 194 Parties signed the Agreement, and 148 Parties ratified it. Among them, 21 Arab countries signed the Agreement, and 11 ratified it.[117]

It should be noted that out of the 19 Arab countries that submitted their INDCs, 8 included DRR-related plans and targets in their submissions.[118]

(b) The Arab Framework Action Plan on Climate Change (2010-2020)

The Arab Ministerial Declaration on Climate Change, issued in 2007, stresses the potential impacts of climate change and the need for urgent action to achieve sustainable development. It was followed by the drafting of the Arab Framework Action Plan on Climate Change (2010-2020),[119] under the auspices of the League of Arab States, in partnership with regional Arab organizations. The framework was designed to enhance the capacities of Arab countries to take appropriate measures, both in adaptation and mitigation, and to address climate change issues while achieving sustainable development targets in the Arab region. This can be done by enabling social and institutional structures, as well as economic sectors, to assess the implications of climate change, and develop policies and programmes of emissions mitigation and adaptation to the potential impacts of climate change.[120] The Action Plan follows the principles and objectives of the 2007 Arab Ministerial Declaration on Climate Change. The strategic objectives of the Action Plan are the following:

(i) Reduce the risks of climate change and increase the readiness to tackle its potential impacts through mitigation and adaptation programmes;
(ii) Preserve natural and human resources and ensure a decent standard of living for Arab citizens;
(iii) Enhance the pace of sustainable development in Arab countries, including MDGs;
(iv) Strengthen and build national and regional institutional capacities to deal with issues of climate change and to cope with weather and climate-related disasters;
(v) Provide favourable conditions to stimulate the regional and international cooperation necessary to support national programmes.

The Plan addresses climate change impacts and the need to reduce the risk of climate-related disasters. Furthermore, it stresses the synergies between CCA and DRR frameworks, and highlights the need to integrate DRR in all programmes relating to adaptation. It also calls for building and strengthening cooperation with ISDR at the national, regional and international levels, and for the use of appropriate mechanisms and capacities to reduce disaster risk in the planning and implementation of adaptation programmes. The plan recognizes the importance of DRR and lists four ways in which it can be implemented under CCA:

(i) Implementation and follow-up of HFA;
(ii) Integration of DRR in all programmes relating to adaptation;
(iii) Building and strengthening cooperation with UNISDR at the national and regional levels;
(iv) Making use of appropriate mechanisms and capacities to reduce disaster risk in the planning and implementation of adjustment programmes.

The Plan identifies programmes for focus areas and concerned sectors, as illustrated in table 2.

Table 2. The Arab Framework Action Plan on Climate Change: programmes

	Elements of the programme	Sectors
Adaptation	Preparation of a vulnerability to climate change assessment of economic and social development in the region; Development of adaptation strategies in different sectors; Preparation and implementation of strategies for DRR.	Climate and meteorology; water, land and biodiversity; agriculture and forestry; industry; construction; population and human settlement; public health; and seas and coastal areas.
Mitigation and finance	Assessment of sectoral and national GHG emissions and their growth rate in various sectors; Assessment and evaluation of mitigation options in various sectors; Development of mitigation strategies, policies and programmes.	Water, land and biodiversity; agriculture and forestry; industry; energy; transport; and construction.
Cross-cutting issues	Awareness-raising and improving of behaviour; Promotion of dialogue and building of partnerships; Capacity-building.	Awareness and behavioural development.
	Production of simplified scientific and information material; Training of media personnel; Public awareness programmes.	Public information.
	Reviewing and updating of existing legislation to reflect climate change issues; Creation of a legislative environment which enables bilateral and multilateral cooperation on climate change issues.	Legislative development.
	Use of financial instruments to encourage investment in energy efficiency, renewable energy and clean production technologies.	Financial policies and operations.

Source: Haddad, 2009.

Recently, the Arab Framework Action Plan has incorporated additional elements and actions, related to linkages with the Sendai Framework, the 2030 Sustainable Development Agenda and the SDGs. In addition, the Action Plan is currently being reviewed, in order to cluster programmes connected to the implementation of NDCs, which are submitted to UNFCCC as part of the implementation of the Paris Agreement.

The successful implementation of the Arab Framework Action Plan is contingent on the availability of substantial technical and financial support to address climate change issues. There is a good potential for renewable energy and

energy efficiency to support sustainable development in the Plan. For example, climate change impact needs to be assessed in detail across sectors, ecosystems and societies. Without the proper institutional infrastructure and technical capacities on climate change (climate models, knowledge, expertise, enabling environment and others), efforts will neither be successful nor sustainable. Furthermore, it is critical to build on existing regional frameworks and utilize the capacities of regional organizations to serve as support mechanisms for countries.

Much work has been done at the regional level to build resilience to climate-related hazards. For example, in order to produce a unified assessment to inform regional policies on CCA, RICCAR has provided the assessment tools needed to deal with climate change impacts, as well as those needed for vulnerability assessment and linkage to DRR.

(c) Role of the Arab Negotiation Group in global climate change processes

The Arab Negotiation Group comprises 22 member countries of the League of Arab States. Some of these countries' economies are strongly dependent on the fossil energy sector, particularly oil. The Arab Ministerial Declaration on Climate Change, adopted in 2007, constitutes the foundation for the Arab Group's future actions and reflects its position in dealing with climate change issues.[121] Having declared its alignment with the Group of 77 and China, the Arab Group regularly reiterates its determination to strive to achieve the following: the inclusion of climate change issues in all national and regional sectoral policies; the encouragement of national and regional actions to cope with the changing climate; the adoption of mitigation programmes (production and use of cleaner fuels, improving energy efficiency, diversifying energy sources, and others); and the adoption of adaptation measures that are fully consistent with socioeconomic growth and the eradication of poverty.[122] In addition, the Group calls for ambitious and rapid action on climate change.

The Group of 77 and China and the Arab Negotiation Group agree on the broad principles that underlay the positions of developing countries in climate change negotiations. The first principle is to ensure the continuance of the multilateral process under UNFCCC. The second is the preservation of the concept of common but differentiated responsibilities and respective capabilities, with continued emphasis on the fulfilment of commitments under the Kyoto Protocol by developed countries. The third principle is that development is critical for developing countries to address their own domestic challenges of inequality and poverty. Finally, access to technology, finance and capacity-building is seen as critical if developing countries are to achieve their socioeconomic priority goals while addressing the challenges of climate change.

Furthermore, some Arab countries (such as Algeria, Egypt, the Sudan and the Syrian Arab Republic) support the Like-minded Developing Countries Group, which was recently established with three main guiding principles, which are as follows: (i) poverty should be eradicated and the sustainable development efforts of developing countries should not be curtailed; (ii) efforts should be made to maximize the commitments of developed countries to fulfil their obligations towards the Paris Agreement and to take the lead in reducing emissions and providing support to developing countries in their adaptation and mitigation efforts; and (iii) restrictions that

might be set on developing countries should be minimized, while the principle of common but differentiated responsibilities should be fully embraced.

(d) The Arab Strategy for Water Security and its Action Plan

The Arab Strategy for Water Security in the Arab Region to Meet the Challenges and Future Needs for Sustainable Development 2010-2030 was adopted in June 2011 by the Arab Ministerial Water Council. The Strategy lays out key issues facing the Arab region and identifies various priorities for action, with a focus on the following:[123]

- **Socioeconomic development priorities**, namely, access to water supplies and sanitation, water for agriculture, finance and investment, technology, non-conventional water resources and IWRM;
- **Political priorities** relating to the management of shared water resources and the protection of Arab water rights, particularly in areas under occupation;
- **Institutional priorities** associated with capacity-building, awareness-raising, research and participatory approaches involving civil societies.

The Action Plan of the Arab Strategy for Water Security provides a concrete timetable for five years of well-defined actions to be undertaken for the Arab water security strategy to succeed, with indicators to track progress towards the achievement of its objectives. The Action Plan focuses on the regional level, but is prioritized in accordance with national objectives and priorities. The Plan has the following six themes, with different activities, outputs, goals and targets listed as subprogrammes under each of them:

(i) Enhance the provision of updated information on the status of water in the Arab region;
(ii) Improve the implementation of IWRM;
(iii) Strengthen the scientific, technological and industrial base;
(iv) Increase funding-for-water projects;
(v) Enhance the capacity for climate change assessment and adaptation;
(vi) Establish mechanisms for the protection of Arab water rights in the context of shared water resources.

3. Climate Change and Disaster Risk Reduction Assessment Tools: Findings and Opportunities for Complementarity

3. Climate Change and Disaster Risk Reduction Assessment Tools: Findings and Opportunities for Complementarity

A. Assessment tools

1. Assessment tools for climate change impacts and vulnerability

As demonstrated in the previous chapters, there has been a lack of integrated approaches in the assessment of climate change impacts and vulnerabilities in the Arab region. Most of the previous work has been based on small-scale and local-level studies, conducted by downscaling global climate models to examine specific issues, mainly relating to the supply and balance of water resources in terms of changes in precipitation and temperature. Very few efforts have been made to use these RCM outputs to simulate changes in hydrological aspects, such as river discharge, surface runoff, flash floods and extreme events, among others. These parameters could have damaging effects on urban areas, human settlements, agricultural lands, rural livelihoods and people at large. "What if" scenarios were utilized, based mainly on assumptions of arbitrary changes of hydrological and meteorological parameters, to simulate impacts and develop policy measures that help cope with these impacts, in national adaptation and development plans. Moreover, no efforts have been made to conduct an integrated assessment of these impacts, and related socioeconomic vulnerability across Arab countries, based on a common methodological framework.

In response to this challenge, in December 2007, the Arab Ministerial Declaration on Climate Change, adopted by CAMRE in its 19th Session, called for the development and dissemination of methodologies and tools to assess the impact of climate change on water resources, so as to inform the formulation of adaptation strategies and measures that would be fully consistent with economic and social development goals. Subsequently, ESCWA adopted resolution 281 (XXV) at its twenty-fifth Ministerial Session, held in Sana'a in May 2008, which requests the secretariat to prepare an assessment of economic and social development vulnerability to climate change in the region, with particular emphasis on freshwater resources. This resulted in the agreement that the United Nations and the League of Arab States, along with their specialized organizations, would collaborate on the preparation of a vulnerability assessment of the impact of climate change on water resources, which in turn led to the implementation of RICCAR.

As part of the work done under RICCAR, disaster loss databases were collected in specific Arab countries, in order to detect and assess the historical trends of weather- and climate-related disasters and their socioeconomic impacts. This inventory included key parameters, such as type of disaster, frequency, spatial footprint of disaster frequency, trend/time-series of disasters,

mortality, losses in assets and infrastructure, economic losses and spatial distribution.

This chapter introduces the key components of the methodology adopted by RICCAR, and provides a summary of outputs and projected climate extreme indices, in addition to the details and analysis of the disaster loss information collected from Arab countries. Historical databases, trend analyses and the spatial distribution of disaster frequencies and occurrences will be used to validate the projected hotspots resulting from climate change in the future. In addition, projected climate change impacts on extreme indices will be tested for the development of high- and low-risk areas of potential disasters in the long term. This approach may enable scientists and researchers to link climate modelling tools with disaster loss parameters in an integrated manner, when databases and climate change modelling are readily available, as is the case with RICCAR.

The integrated assessment pursued under RICCAR has followed a stepwise approach. Its impact assessment component is based on the generation of dynamically downscaled RCMs covering the Arab/Middle East and North Africa (MENA) region, from a series of general circulation models. These outputs are used as inputs to run regional hydrological models (RHMs), as well as basin-level hydrological models for selected basins in the Arab region. The outputs of these models are then used to inform the regional vulnerability assessment, based on an integrated mapping approach, as shown in figure 7. The resulting integrated assessment links climate change impact assessment to socioeconomic and environmental vulnerability assessment. The application of this integrated assessment approach can be used to inform policies, measures and strategies of CCA, and, to a lesser extent, DRR, specifically for certain scales that are appropriate for the resolution used in analysis for policymaking.

(a) Regional climate modelling

Climate change projections conducted within the framework of RICCAR are based on two representative concentration pathways (RCPs): RCP 4.5 as the moderate-case scenario, and RCP 8.5 as the worst-case/business-as-usual scenario. These were developed by IPCC and used to inform global and regional climate modelling in its Fifth Assessment Report. Climate modelling outputs in RICCAR were generated at a 50 x 50 km scale, and the results were based on regional climate modelling outputs generated by SMHI using the Rossby Centre regional atmospheric model.

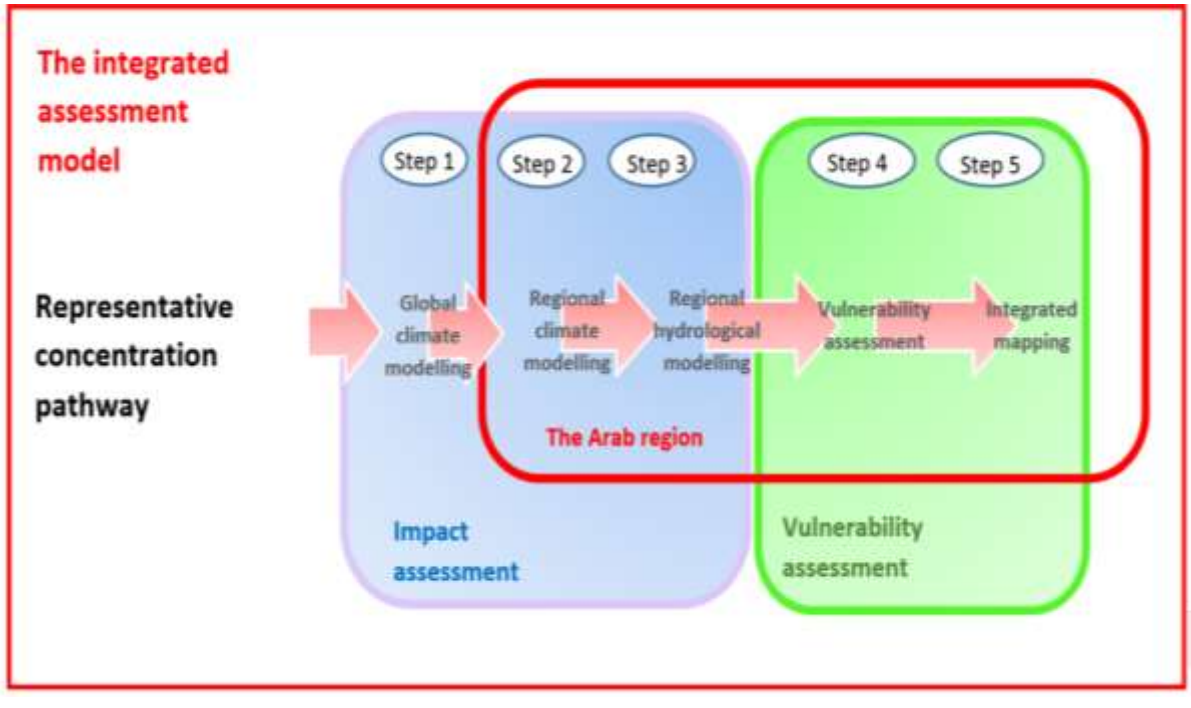
The RCM conducted in RICCAR shows the impacts of climate change on the water-scarce Arab region, mainly indicating higher temperature and decreased precipitation,[124] as shown in figures 8 and 9. The effect of the change in those climatic parameters was determined by comparing the forecasted mid-century (2046-2065) and end-of-century (2081-2100) periods with the 1986-2005 baseline period. The general change in temperature towards the end of the century shows an increase in the mean annual temperature in the Arab region of 1 to 3°C for RCP 4.5, and of 2 to 5°C for RCP 8.5.

However, there are large regional differences across the Arab region for both RCP 4.5 and RCP 8.5 scenarios. The Eastern Mediterranean Coast and North Africa will generally experience increases in average temperature of around 2.5ºC, with a maximum increase of 3.4ºC expected in Morocco's Atlas region, Upper Egypt and the southern Sinai Peninsula. The

north-eastern part of the Arabian Peninsula will see the largest increases in temperature, reaching around 4.2ºC in the upper Tigris-Euphrates Basin. In Sub-Saharan countries, the increase in temperature is expected to reach between 3.5ºC and 4.0ºC. The largest increase in the region, namely 4.2ºC, will occur over the area extending from the northern Hejaz to southern Jordan. The Arabian Peninsula will experience progressive increases in long-term average temperatures over the coming century, reaching 24ºC by 2100, and possibly as high as 25ºC. This confirms earlier studies showing that long-term average temperatures are projected to increase progressively in the Gulf region, reaching 23.1ºC in the 2020s, 23.9ºC in the 2040s, and 25.1ºC in the 2070s.[125]

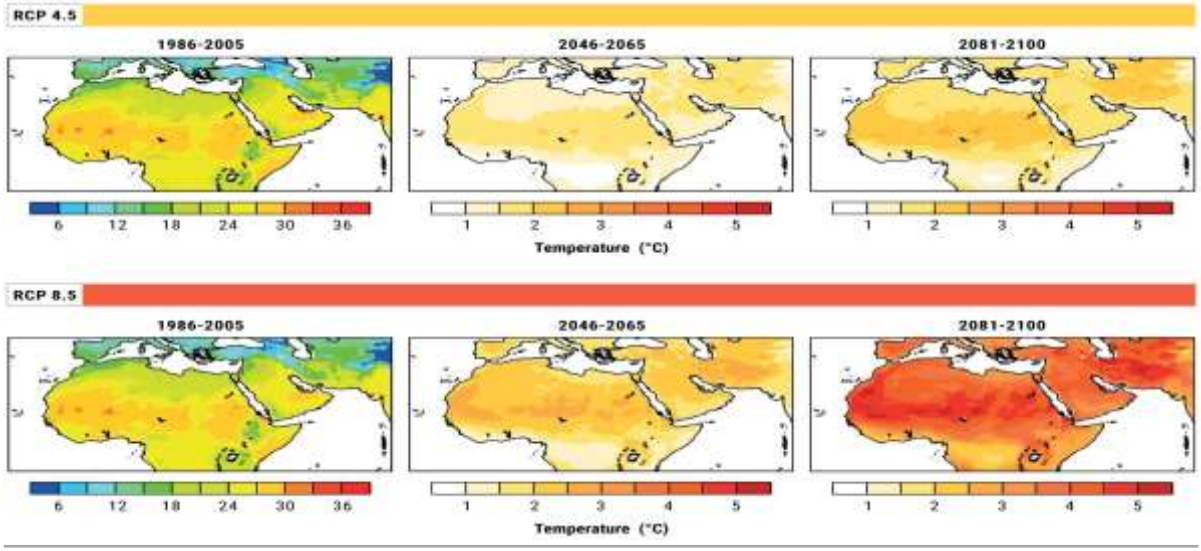
Average precipitation in the Arab region is generally projected to decrease throughout the 21st century, but there will be large spatial variability. For instance, figure 9 shows that, by the end of the century, both scenarios indicate a reduction in average monthly precipitation, reaching 8-10 mm in the coastal areas of the domain, mainly around the Atlas Mountains in the west and the upper Euphrates and Tigris river basins in the East. These changes in precipitation are correlated with changes in runoff and water availability. Across the Arab region, because of its varied geography, there are very large variations between subregions, and the change will be felt through the rate of climate change, which is evident in the increased frequency of extreme events.

Figure 7. RICCAR integrated assessment methodology



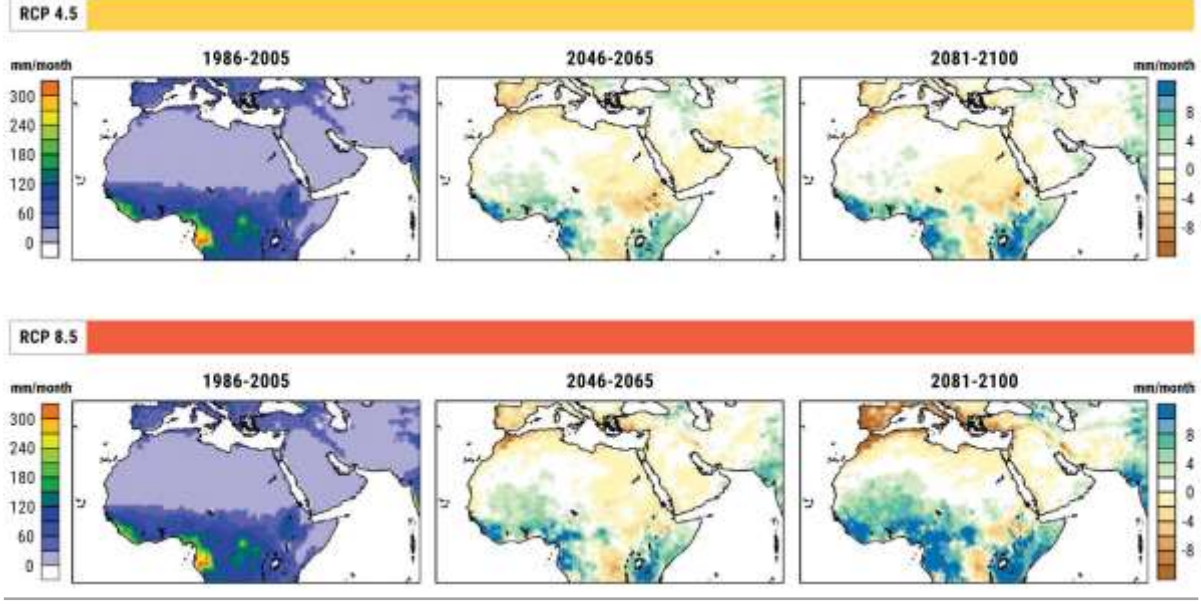
Source: ESCWA, 2011.

Figure 8. Change in average temperature (°C) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5



Source: ESCWA and others, 2017a.

Figure 9. Change in average precipitation (mm/month) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5



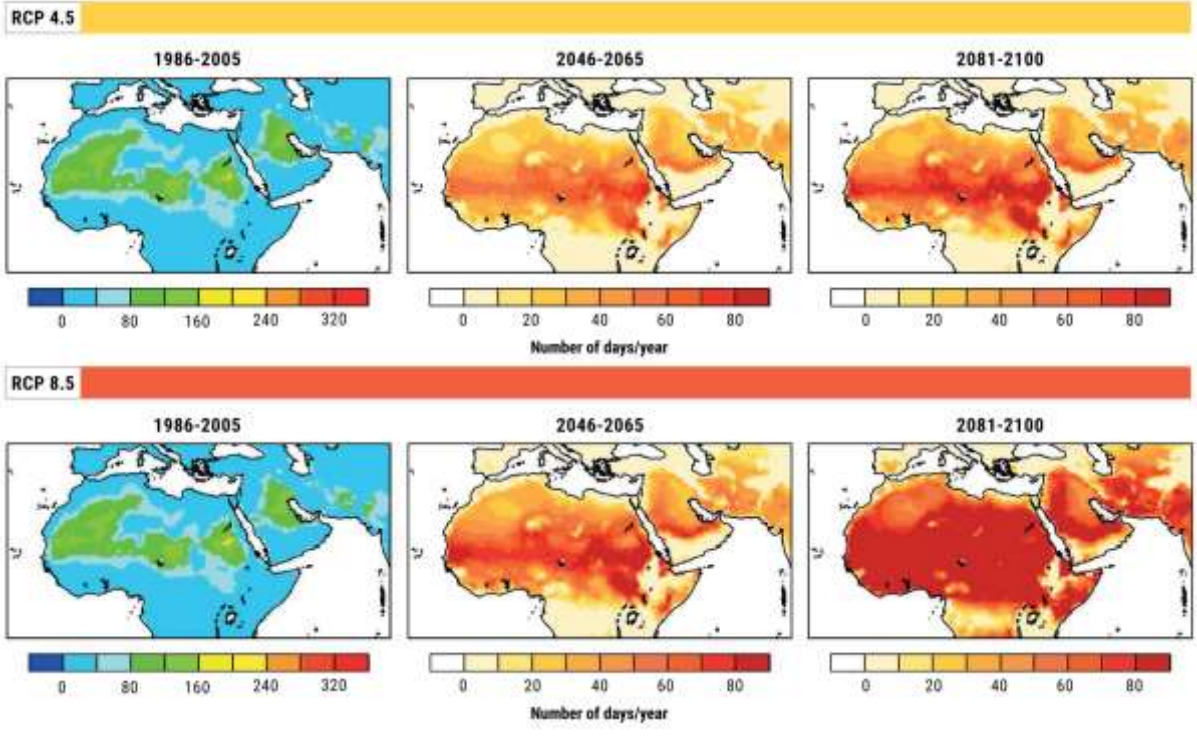
Source: ESCWA and others, 2017a.

(b) Extreme climate indices

Extreme climate indices were also projected in RICCAR, based on those indices formulated by the Expert Team on Climate Change Detection and Indices, a joint working group of the Commission for Climatology, under the auspices of WMO. The types of extreme events that will affect the Arab region will vary widely from one subregion to another. The change in temperature indices included the cold spell duration index, summer days with a maximum temperature of over 35°C and 40°C, and tropical nights. The precipitation indices projected in RICCAR were the maximum length of dry spell, heavy precipitation days (≥ 10 mm), very heavy precipitation days (≥ 20 mm) and other indices.[126]

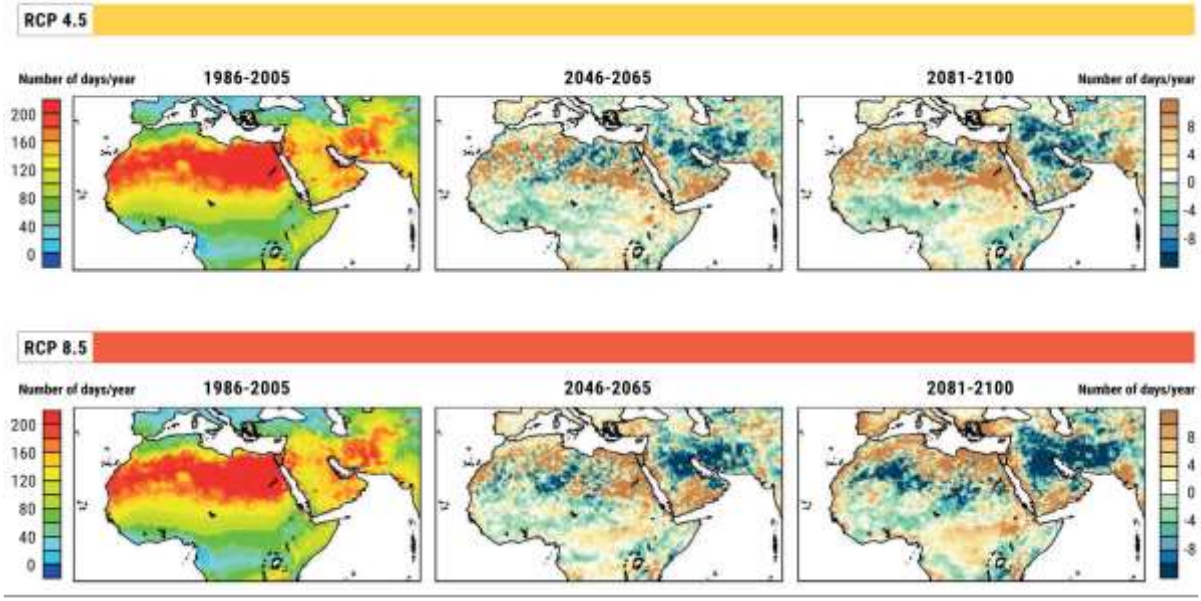
Figure 10 shows the change in very hot days, with a maximum temperature of over 40°C (SU40), for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5. The results reveal strong projected warming in the Sahara and central Arabian Peninsula areas for RCP 8.5, indicating that the increase in extreme temperatures in coastal areas would be less severe than in the central parts of the region for both scenarios.[127]

Figure 10. Change in very hot days (SU40) (days/year) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5



Source: ESCWA and others, 2017a.

Figure 11. Change in the maximum number of consecutive dry days (CDD) (days/year) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5

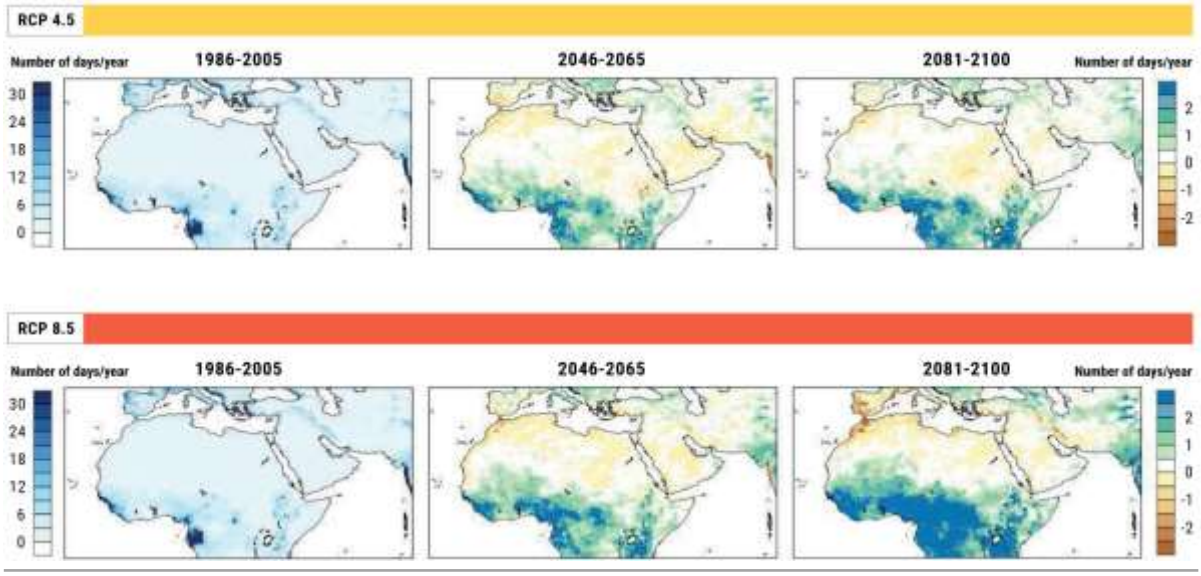


Source: ESCWA and others, 2017a.

Regarding precipitation extremes, there is considerable variation across the region. The projections for CDD show trends towards drier conditions, with an increase in the number of dry days, particularly in the Mediterranean, as well as in the western and northern parts of the Arabian Peninsula by the end of the century (figure 11). This indicates that the dry summer season is growing in length, especially in these areas. Some areas in the central and eastern parts of North Africa show a decline in CDD. The results for this indicator need to be complemented with additional information, since an indication of shorter dry periods does not rule out an increase in drought frequency when other drought-related indices are tested.

Results for the annual number of very heavy precipitation days (≥ 20 mm) (R20), as shown in figure 12, for the end of the century, indicate a projected overall reduction in very heavy rainy days across the region. Indicators for consecutive wet days and days with precipitation of over 20 mm could also be helpful to determine potential flood risks. In fact, the number of consecutive wet days could be a clear indicator of increased flood risk. However, without taking into account the location of surface water, this might not prove very accurate. Another extreme event indicator is when precipitation is greater than 20 mm per day. This indicator shows rainy days with precipitation of more than 20 mm, but not necessarily consecutively. For locations with high urbanization and low yearly precipitation, an increase of 20 mm precipitation could significantly escalate the risk of floods. Areas with an increase in the number of days with precipitation of more than 20 mm are those around Central Africa, south-eastern Oman and the headwaters of the Nile.

Figure 12. Change in very heavy precipitation days (R20) (days/year) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5

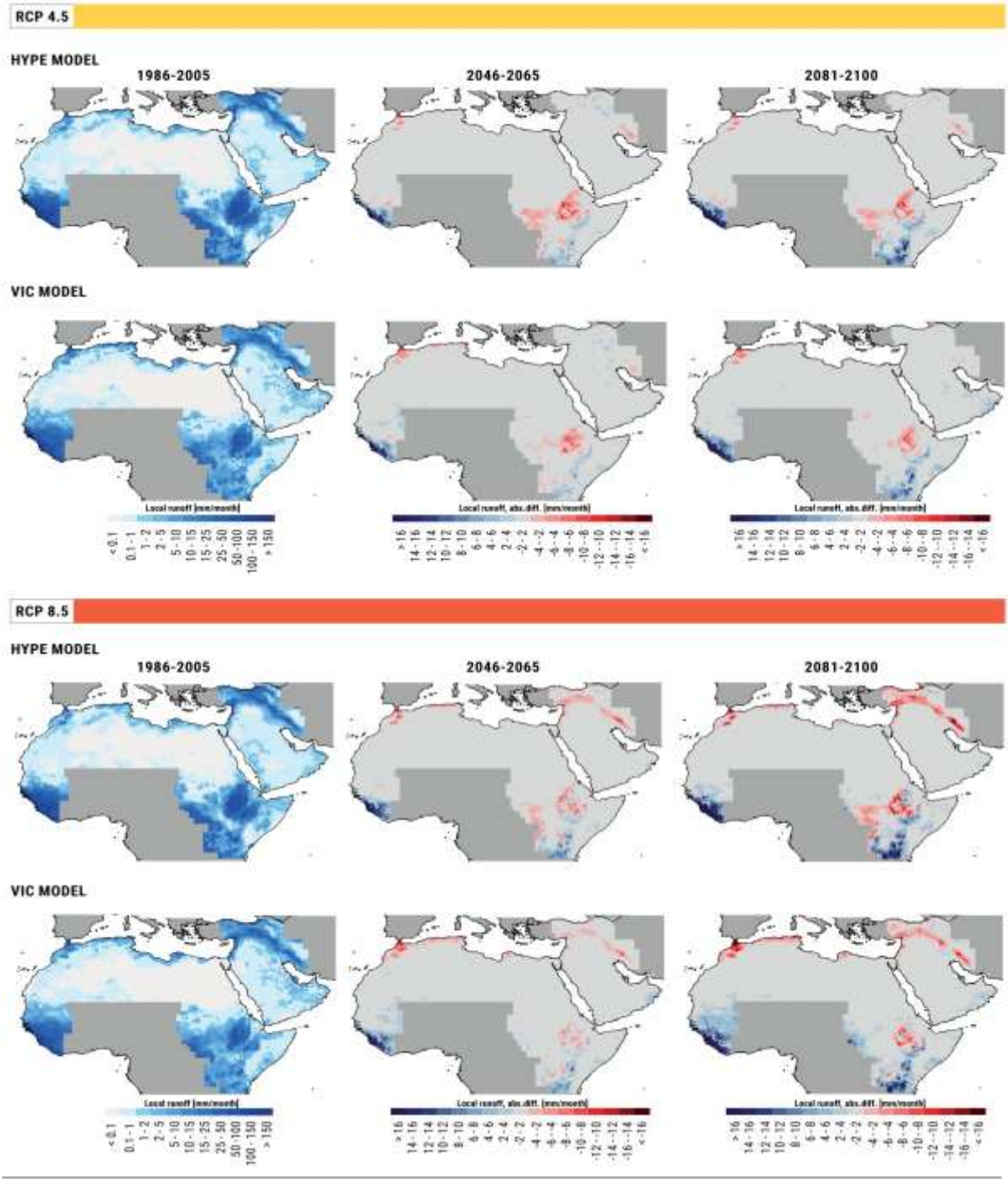


Source: ESCWA and others, 2017a.

(c) Regional hydrological models

Two different hydrological models, namely the Hydrological Predictions for the Environment (HYPE) and Variable Infiltration Capacity (VIC) models, were applied within RICCAR to produce RHM results across the entire Arab region. The HYPE model was developed by SMHI for modelling the flow and transformation of water, nutrients and organic carbon in soil, lakes and rivers, while the VIC model was originally developed by Xu Liang at the University of Washington for modelling water and energy balances.[128] The two models are rainfall runoff models, with a primary focus on surface water and runoff. The different climate models applied under RICCAR provide the results of projections for specific parameters, and are expressed in terms of changes from the baseline period. RCM outputs related to temperature and precipitation were subsequently used as input for RHM, following a bias correction. Changes in area runoff over the Arab region are shown in figure **13** below. Each plot summarizes the ensemble results from both the HYPE and VIC models. Although there are differences in some subregions, outcomes from the two hydrological models generally show similar trends in runoff change. The largest discrepancies appear to be at the upper reaches of the White Nile. Changes in runoff largely follow the same pattern as changes in precipitation. At the Nile basin, there are mixed signals of decrease and increase in surface runoff, while there is a reduction in runoff at the northern coast of Morocco, Algeria and Tunisia, as well as in some subregions in the Tigris and Euphrates basins. These parameters can be used, along with extreme precipitation indices, to identify hotspot areas for flood risks, and can hence be compared to the data on disaster losses due to floods in national databases for the countries under study.

Figure 13. Change in runoff (mm/month) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5 using two hydrological models



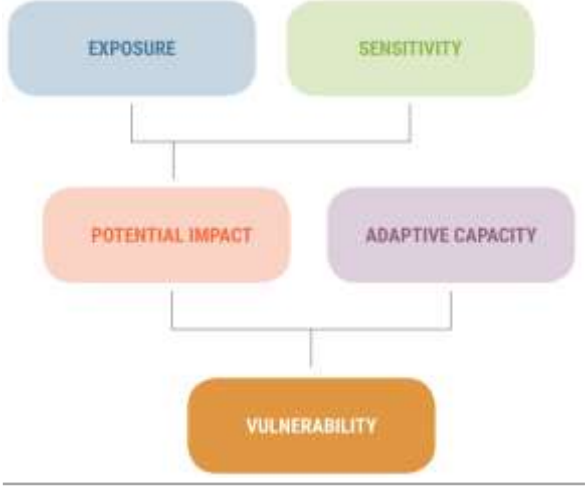
Source: ESCWA and others, 2017a.

(d) Vulnerability assessment tools

The vulnerability assessment component in RICCAR is based on the methodology adopted by the IPCC in its Fourth Assessment Report. Within this perspective, vulnerability is understood to be the function of a system's climate change exposure, its sensitivity to climate change effects, and its adaptive capacity to cope with them, as illustrated in figure **14**. Exposure refers to changes in climate parameters that might affect socioecological systems, such as temperature, precipitation and wind speed, which climate change alters in terms of quantity and quality, as well as in terms of spatial and temporal distribution. Sensitivity, however, refers to the physical status and natural environment of the affected systems that make them particularly susceptible to climate change, such as land use, land cover, distribution and density of population, built environment, proximity to the coast, and others. Potential impact is determined by combining a system's exposure and sensitivity to climate change, as shown in the figure. Adaptive capacity, according to IPCC's Fourth Assessment Report, refers to "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences".[129]

The overall vulnerability of the Arab region comprises the different sectoral vulnerabilities towards the various key climate change impacts identified, which are comprised of one or more subsectors. The sectors selected under RICCAR and their respective impact analyses are summarized in figure 15.

Figure 14. The components constituting vulnerability, based on the approach of IPCC's Fourth Assessment Report



Source: ESCWA and others, 2017a.

Figure 15. Sectors and impacts selected for the Arab region vulnerability assessment

SECTORS	SUBSECTORS
Water	Water availability
Biodiversity and ecosystems	Area covered by forests Area covered by wetlands
Agriculture	Water available for crops Water available for livestock
Infrastructure and human settlements	Inland flooding area
People	Water available for drinking Health conditions due to heat stress Employment rate for the agricultural sector

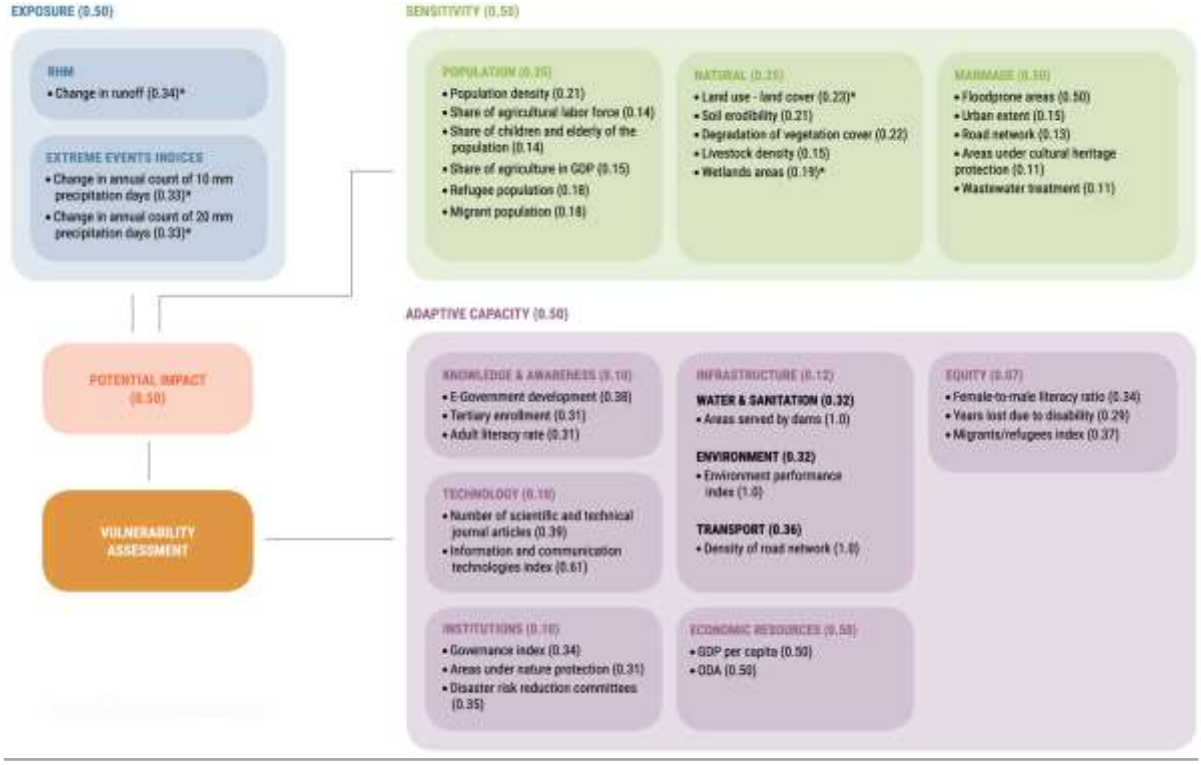
Source: ESCWA and others, 2017a.

The development of a vulnerability assessment map is dependent on selected indicators (71 indicators were selected and used in the analysis) which are categorized into the three different components (exposure, sensitivity and adaptive capacity) and their respective dimensions. For each climate change impact, indicators were identified with the help of an impact chain, which is an analytical tool that illustrates the cause-effect relationships between indicators, dimensions, components and the relevant impacts. Exposure indicators were derived from the climate modelling outputs that have a dynamic nature (meaning that they change with time). The sensitivity component includes indicators categorized into three dimensions: population, natural and human-made. Adaptive capacity indicators are categorized into the following six dimensions: knowledge and awareness, technology, infrastructure, institutions, economic resources and equity. The latter incorporates the gender dimension by including a gender-specific indicator of female-to-male literacy ratio, and includes indicators relating to vulnerable groups (figure 16). Both the sensitivity indicators and the adaptive capacity indicators are assumed to be static for the purpose of the assessment and do not change with time, given the complexity of considering temporal variations in model parameters in the sensitivity and adaptive capacity layers and in order to avoid the risk of biasing the results by introducing different socio-economic scenarios and growth patterns into the analysis. This may result in certain limitations in the interpretation of the model outputs for some applications.

One of the RICCAR vulnerability assessment outcomes examines the change in water availability, which is a cross-cutting issue that affects other sectors, such as agriculture, biodiversity, health, human settlements. The overall vulnerability outputs for the two scenarios, RCP 4.5 and RCP 8.5, for the mid-century and end-of-century periods, on change in water availability are shown in figures 17 and 18.

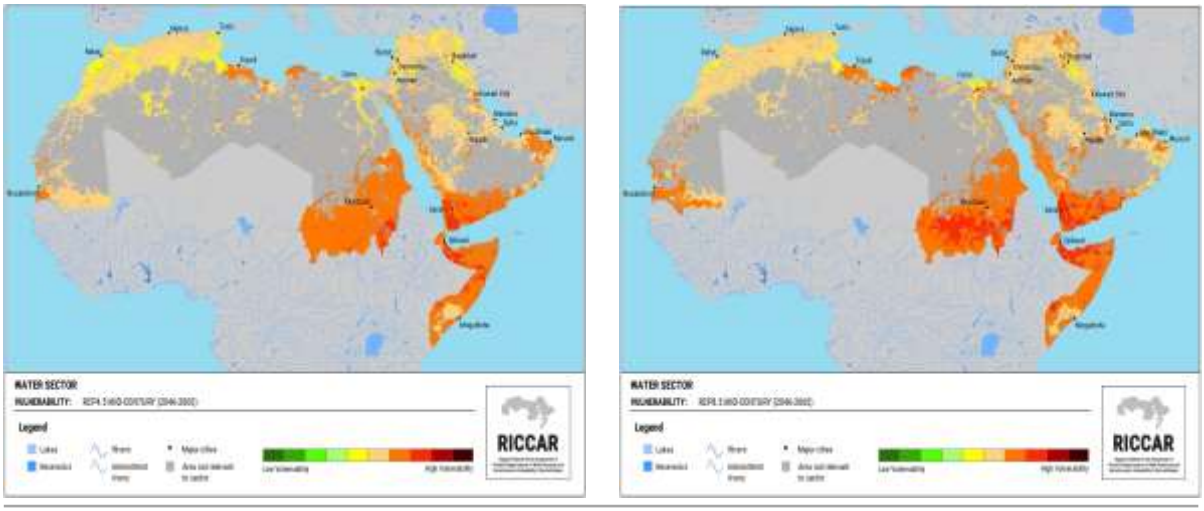
It can be noted in the two figures that, for all future periods and scenarios, vulnerability projections are moderately high, which is in agreement with the expected greater severity of water scarcity in the future. Most of the Arab region is heading towards increasing vulnerability from mid- to end-of-century under a moderate scenario (RCP 4.5), with the exception of the southern areas of the Arabian Peninsula, and the upper Euphrates basin, where vulnerability is projected to decrease. Under the extreme scenario (RCP 8.5), differences in vulnerability are generally modest throughout the years. Areas with the largest vulnerability increase include the central Sahara desert and the southeastern Arabian Desert. Areas with decreasing vulnerability from mid- to end-of-century are the Tigris and Euphrates basin, the Nile headwaters and the southern Maghreb. Highly vulnerable areas are primarily affected by low adaptive capacity conditions, and by having a high correlation with the exposure component (such as areas of the Nile headwaters and around the Gulf of Aden). It should be noted that these outputs are subject to some study limitations, including the use of sensitivity and adaptive capacity indicators representing current rather than future conditions, as explained earlier.

Figure 16. RICCAR impact chain



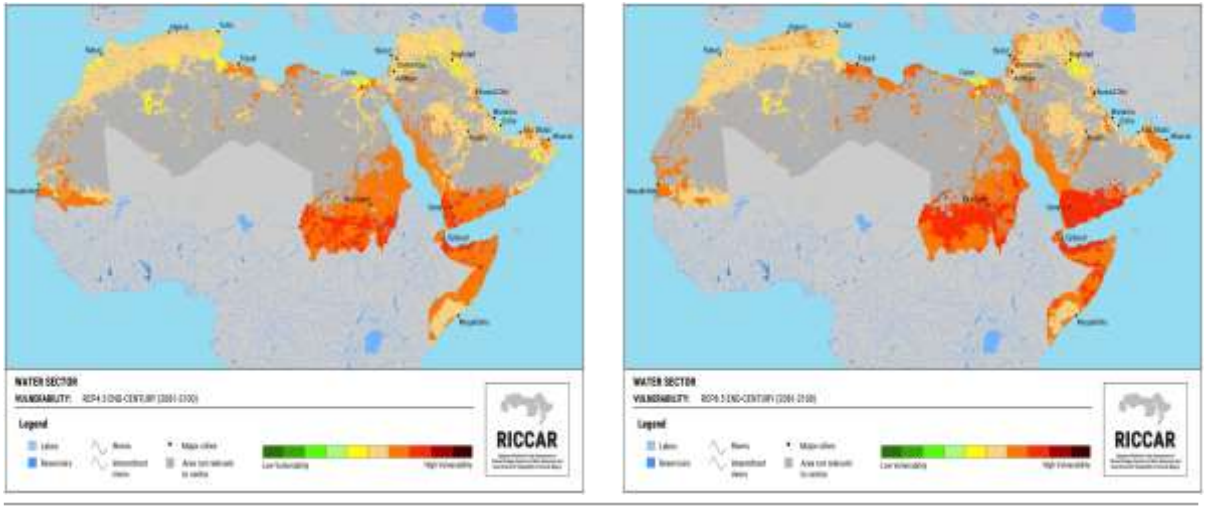
Source: ESCWA and others, 2017b.
* Subsector-specific classification.

Figure 17. Change in water availability: mid-century overall vulnerability



Source: ESCWA and others, 2017a.

Figure 18. Change in water availability: end-of-century overall vulnerability



Source: ESCWA and others, 2017a.

2. Development of national disaster loss databases in the Arab region

The development of national disaster databases is an important step to systematically account for and keep track of weather- and climate-related disaster losses. These databases help generate the information and knowledge necessary for risk estimation, and inform climate change assessment and adaptation, as well as DRR, processes. National disaster databases address and record a number of indicators that help assess both human and economic losses, such as mortalities and injuries, as well as losses in infrastructure and livelihood assets, such as housing, agriculture, livestock, services, and public and private utilities. This information is collected locally with a relatively high degree of detail by national and local authorities, usually working with administrative units and/or municipalities, depending on the size and institutional framework of each country.

As part of the work done by RICCAR, national surveys were conducted for the development of these instruments and databases in selected Arab countries, including Jordan, Lebanon, the State of Palestine, Tunisia and Yemen. This project was implemented by the UNISDR Regional Office for Arab States following the DesInventar methodology, which is publicly available and constitutes an open source tool for building disaster databases. This methodology allows for the homogeneous capturing, analysis, and temporal and spatial graphic representation of information on disaster occurrence, frequency and loss. It has been undergoing continuous development and improvement since nearly two decades ago, when Latin American countries began to build systematic disaster inventory databases.[130] The nationally reported disaster databases used in this chapter were collected under RICCAR but customized by UNISDR for its 2015 Global Assessment Report (GAR) on Disaster Risk Reduction.[131] This dataset, known as the “GAR Universe”, only takes into account disasters triggered by natural hazards, and therefore excludes the records that refer to human-made hazards (such as oil spills, technological disasters, and others).[132] The main focus of the analysis here

is on weather-driven disasters/parameters, and how they can be used to verify the hotspots identified by RICCAR for future climate change impacts in the Arab region.[133]

The collected variables from national disaster loss databases (such as type of hazard, frequency, spatial footprint of disaster frequency, trend analysis, mortality and injuries) are key parameters needed for risk estimation and assessment. The economic costs of disasters can be also calculated based on the physical losses recorded in these databases. Economic evaluation is carried out by converting physical damage (houses damaged, houses destroyed, length of damaged roads, areas of damaged crops, and more) into monetary value, in order to provide a conservative estimate of disaster damage and loss. Moreover, since this methodology converts reported physical damage directly into monetary value, its estimates should be considered part of the direct, rather than indirect, economic loss from disasters. The time-series trends presented in this report change from country to country, depending on the start and end date of each national dataset. The indicator “frequency of disasters” refers to the number of records, which provides a proxy for frequency. However, it should be noted that, while a single record could contain a high number of losses (resulting from intensive disasters such as earthquakes), it will only count as one event. Recurrent and localized floods (as examples of extensive disasters), however, can generate several records, making this hazard appear more frequent than others. The following subsections summarize the key findings of the survey carried out by UNISDR in selected Arab countries for the different indicators used, with a focus on weather-related disasters and background information about major institutional and legal developments.[134]

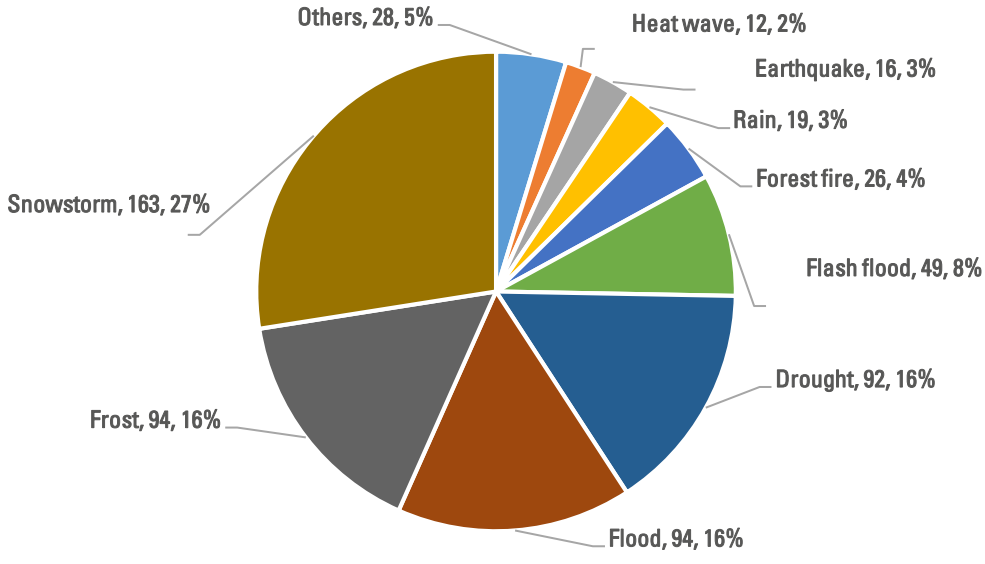
Jordan

The Supreme Council of Civil Defence, General Directorate of Civil Defence Disaster Management, is the body leading DRR efforts in the country and operates based on the 1999 Civil Defence Law. Most of the resources at the national and local levels are directed towards enhancing emergency preparedness and response capacities. A multisectoral integrated institutional approach to DRR is still lacking and needs to be developed. As in many other countries in the region, more efforts are still needed to enhance national and local coordination with respect to DRR, with several cities and municipalities developing local resilience plans. Jordan has been actively reporting on its progress towards the implementation of HFA, and has submitted two national progress reports, in 2013 and 2015.[135]

Disaster loss databases in Jordan show that the country is exposed to several natural hazards, mainly climate-related, including droughts and extreme events such as snow storms, heat waves and flash floods. The ongoing inflow of refugees due to regional conflicts, in addition to the country’s already vulnerable infrastructure and limited natural resources, has added a considerable burden on efforts to strengthen its resilience and reduce disaster risks.

In this national database, the data on hydro-meteorological hazards is based on information gathered from nationally accounted disaster loss databases for the period of 1982-2012. The disaster loss database indicates that, out of a total of 593 disasters recorded during this period, snowstorms are the most frequent in Jordan, accounting for more than one-fourth (163) of the records, followed by frosts, floods and droughts (figure 19).

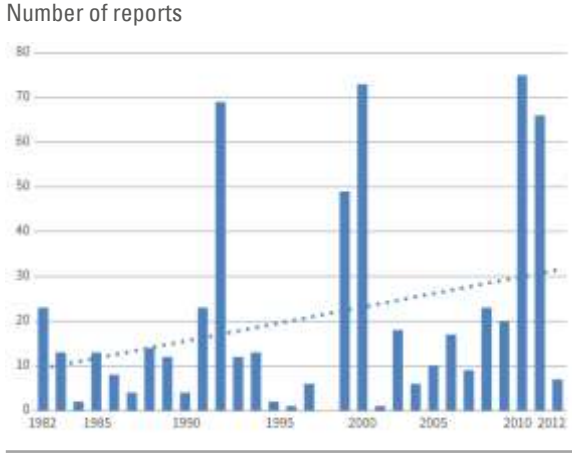
Figure 19. Types and frequency of disasters in Jordan



Source: Adapted from UNISDR 2017a.

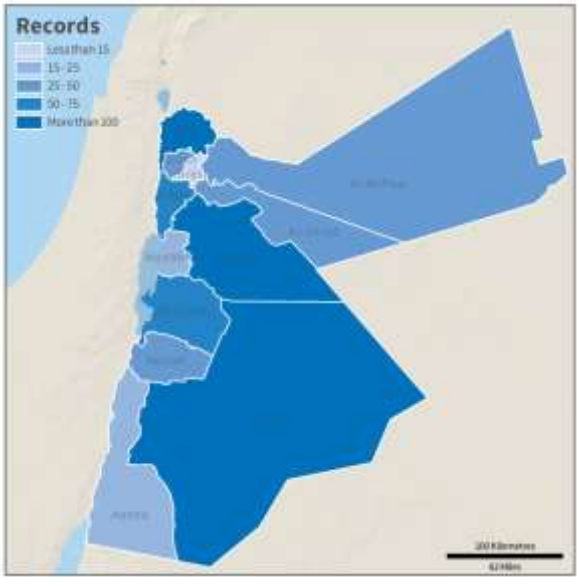
The trend of disaster frequency is increasing, with important fluctuations during different years. As shown in figure 20, four important extremes can be seen in the years 1992 (snowstorms and cold wave), 2000 (essentially drought), 2010 and 2011 (forest fires and frost). In 2010 and 2011, recurrent frosts were observed in several areas of the country. Hydro-meteorological events represent about 97 per cent of the total records. Their geographical distribution (figure **21**) shows that the region of Ma'an experienced the highest number of recorded disasters (98), followed by Amman (89) and Irbid (81). The estimated economic losses amount to $29 million, incurred mainly during this period. Hydro-meteorological events have caused more than 95 per cent of the economic losses, with snowstorms being the most frequent disaster registered in the database and also the most important contributor to overall economic losses, followed by rain and floods. Aqaba and Tafilah were the two most affected governorates in terms of economic losses, as shown in figure 22.

Figure 20. Disaster frequency time-series trend in Jordan



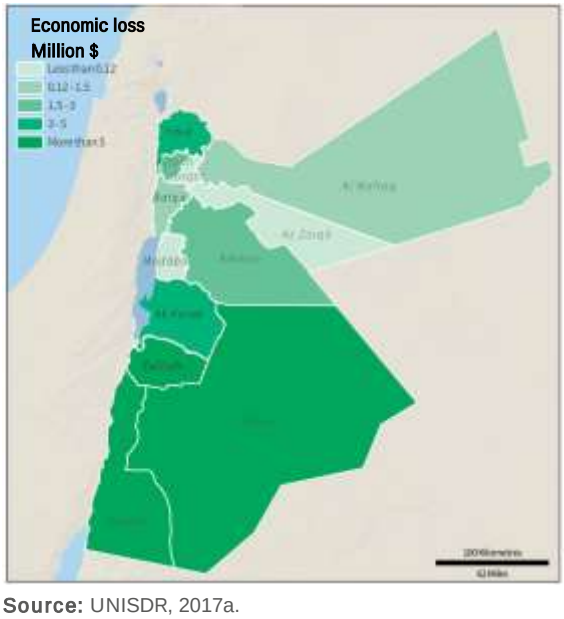
Source: UNISDR, 2017a.

Figure 21. Spatial footprint of disasters in Jordan



Source: UNISDR, 2017a.

Figure 22. Spatial distribution of economic losses from disasters in Jordan



Source: UNISDR, 2017a.

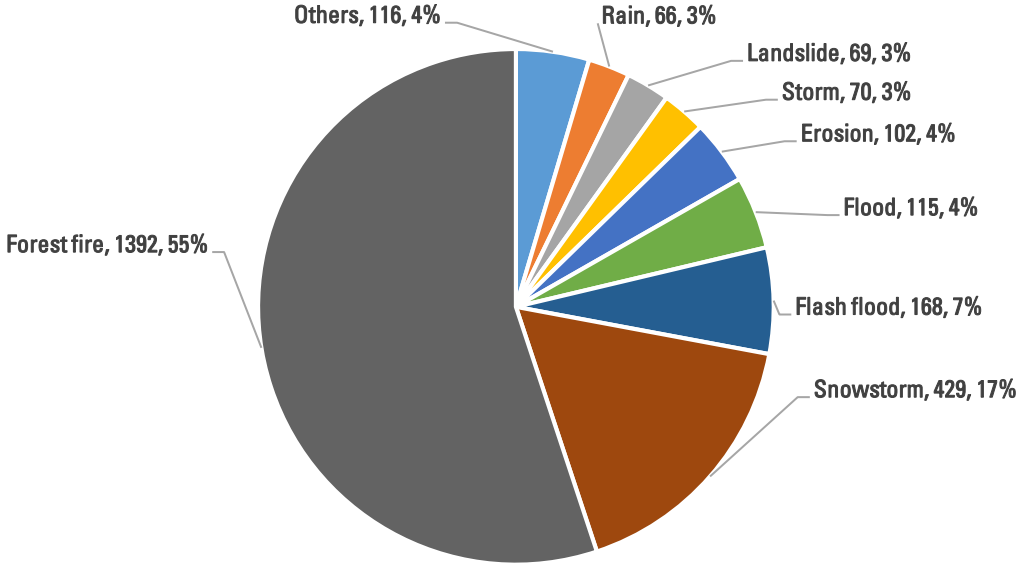
Lebanon

Lebanon is already facing many challenges, due to regional conflicts and the movement of refugees, internal governance issues and insufficient public infrastructure and services. In addition to all of these challenges, Lebanon is usually affected by recurrent natural hazards, such as snow storms, floods, landslides, droughts, forest fires, and earthquakes, resulting in low resilience and high vulnerability across the country.[136]

Major events to hit the country included the intensive rainfall storms of 2002-2003, the major forest fires of 2007-2008 and the extreme floods of 2013. In general, disaster response and coordination was inefficient. In 2009, a Disaster Risk Management (DRM) Unit was established by the Presidency of the Council of Ministers and tasked to coordinate DRR efforts across all sectors. Discussions concerning the establishment of a national disaster management agency are ongoing, based on a draft law addressing this necessity, but still pending the approval of the National Assembly. In 2013, the National Coordination Committee for Disaster Risk Reduction was created, and the National Response Plan and National Disaster Management Strategy were developed.

Lebanon has been reporting on its progress towards the implementation of HFA ever since the biennial national reporting cycle started in 2007.[137] Between 2010 and 2015, the country scaled up its awareness-raising campaigns on risk reduction, enhanced science-policy linkages with respect to disaster risk, engaged and strengthened the capacities of local government and municipalities, and updated its flash flood risk mapping and assessment.

Figure 23. Types and frequency of disasters in Lebanon

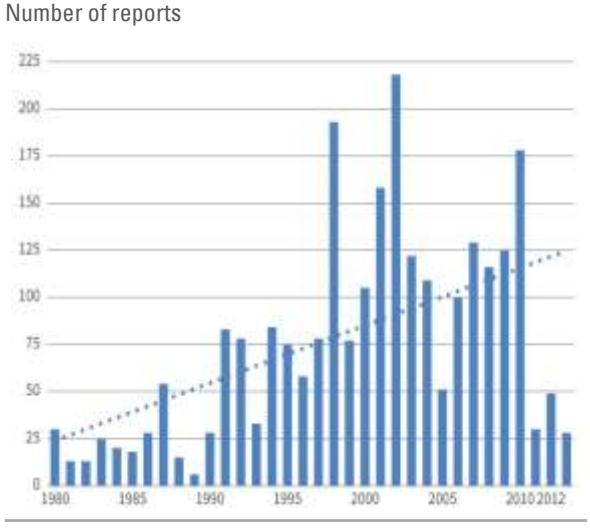


Source: Adapted from UNISDR, 2017a.

Hydro-meteorological events comprised 75 per cent of all records, and caused 100 per cent of mortalities and 86 per cent of the total economic losses, estimated at $48 million during the study period, 1980-2013 (figure 23).

There were important peaks in 1998, 2002 and 2010, as can be seen in the time-series trends, registering up to 218 records, most of them referring to forest fires. Disasters have been more frequent in the governorate of Mount Lebanon, where 749 events were recorded. Over the past three decades, disaster mortality has been low in Lebanon, with a total of 156 people killed since 1980. The overall mortality trend has been decreasing over the years. Disaster mortality in Lebanon has mainly been due to snowstorms, landslides and floods.

Figure 24. Disaster frequency time-series trend in Lebanon



Source: UNISDR, 2017a.

Figure 25. Spatial footprint of disasters in Lebanon

Source: UNISDR, 2017a.

Figure 26. Spatial distribution of economic losses from disasters in Lebanon

Source: UNISDR, 2017a.

In terms of economic losses, disasters such as snowstorms and forest fires remain the main contributors to overall losses in Lebanon. More than one-quarter of economic losses are due to snowstorms, followed by forest fires, erosion (essentially due to heavy rainfall) and floods. The overall trend of economic losses is increasing and has been strongly affected by the damage registered between the years 2001 and 2004. Figure 25 shows that the Akkar, North and Bekaa governorates incurred the highest losses.

State of Palestine

In the State of Palestine in recent years, there have been both extreme heat- and cold-wave events. High population rates, added to unplanned urbanization, a precarious economic and political situation, and a lack of institutional mechanisms for a multisectoral DRR system, have led to conditions of greater vulnerability to disasters and higher risk of climate change impacts.

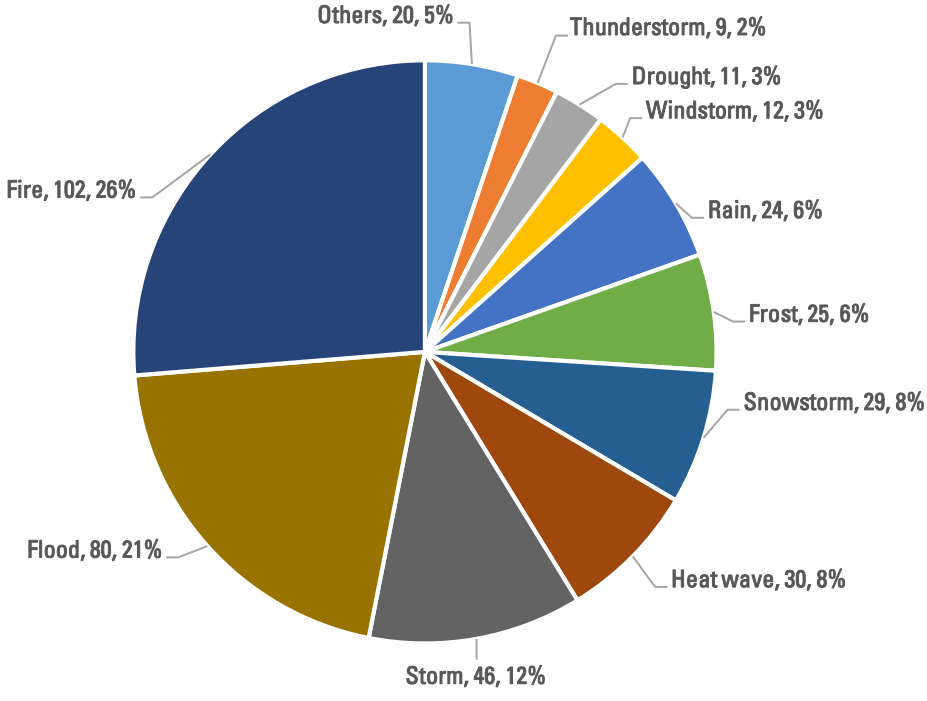
In 2013, a multi-stakeholder DRR committee was tasked to review institutional and legal frameworks, including coordination mechanisms, in order to strengthen risk assessment, management and preparedness. A United Nations Disaster Assessment and Coordination (UNDAC) team conducted a disaster preparedness mission in 2014 and concluded that existing laws on DRR were too limited in scope for broad risk management. Nevertheless, UNDAC recommendations recognized a sound perception of community involvement in the State of Palestine, as well as many good practices at the local level that should be carried forward in strengthening national disaster risk management at the local and national levels. A national mechanism needs to be created through a multi-stakeholder approach. The State of Palestine has been

consistently reporting on its progress towards the implementation of HFA since 2009, and has submitted three biennial reports.[138]

Hydro-meteorological events comprised 99.23 per cent of all records, 69 per cent of total mortality and 92 per cent of total economic losses, estimated at $11 million for the study period of 1980-2013. Out of a total of 388 records, 385 (99.23 per cent) refer to hydro-meteorological events, among which fires and floods remain the most prominent (102 and 80 records respectively). The governorates of Tulkarm and Nablus experienced the highest numbers of records, 51 and 55, respectively (figure 27-29).

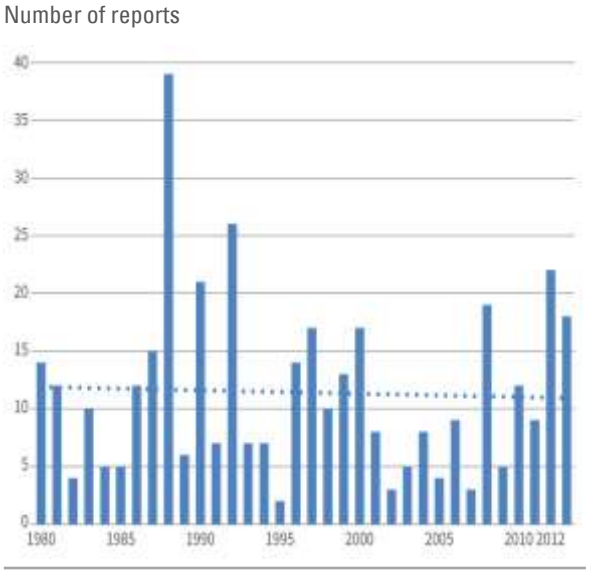
The frequency of disasters remains quite stable with a slightly declining trend. All records refer to extensive disasters. A total of 45 people have been killed by disasters in the State of Palestine, all of them hydro-meteorological events. Frequency is quite variable, with no important peaks, with the exception of 1988, in which 39 events were registered, while the annual average is 11. Economic losses recorded for the State of Palestine are estimated at more than $11.5 million. These losses were caused by two main hazards: storms (almost $8 million) and floods ($2.7 million), which together represent 92 per cent of the total.

Figure 27. Types and frequency of disasters in the State of Palestine



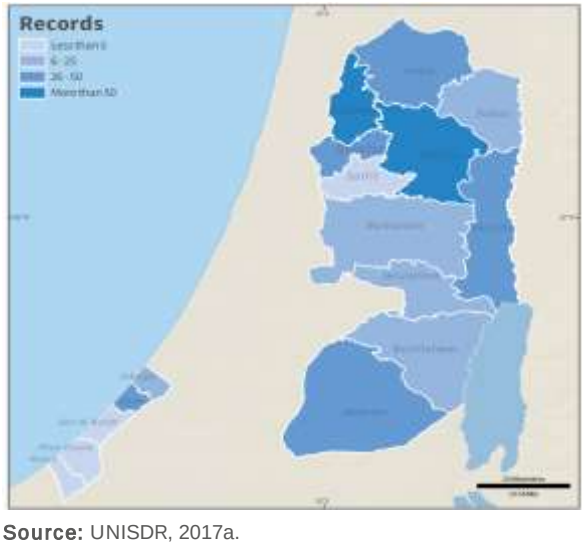
Source: Adapted from UNISDR, 2017a.

Figure 28. Disaster frequency time-series trend in the State of Palestine



Source: UNISDR, 2017a.

Figure 29. Spatial footprint of disasters in the State of Palestine



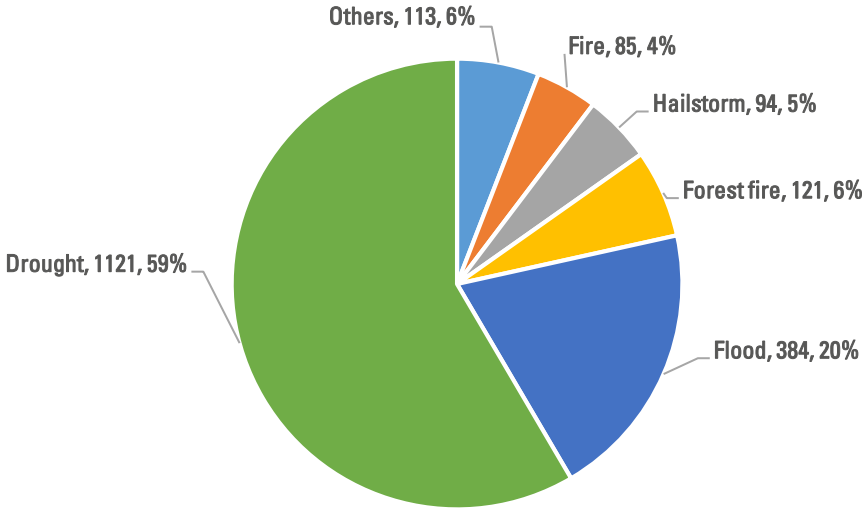
Source: UNISDR, 2017a.

Tunisia

It is important to note that 99 per cent of records in Tunisia's database from 1982 to 2013 are of hydro-meteorological origin. Tunisia is at risk from various weather-related hazards, such as snowstorms, sandstorms, flooding and drought. In 1991, the country created specific legislation aimed at the reduction of risks from natural and human-made hazards. Since then, sectoral policies and laws have been developed in order to tackle the underlying risks of disasters, including those connected to climate change. Tunisia started to report on its progress towards the implementation of HFA in 2011, and has since submitted two national reports.[139] In 2012, Tunisia launched its own national multi-stakeholder platform for DRR, bringing together all stakeholders from the central government, national institutions, civil society and local NGOs, the scientific community and interregional bodies. In addition, the Commission for Sustainable Development and the Rights of Future Generations was established, in accordance with the new Constitution adopted in 2014. This Commission provides a conceptual framework for DRR and vulnerability to climate change.

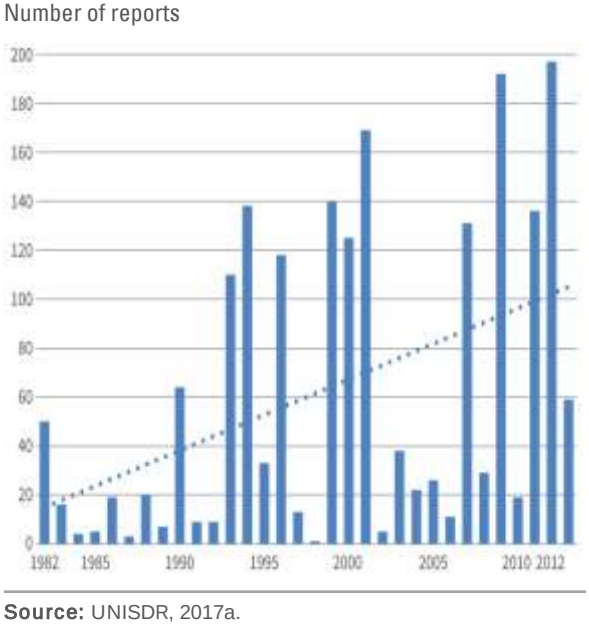
As shown in figure 30-32, the majority of records (out of a total of 1,918) refer to drought (1,121 records), followed by floods (384). The Sfax governorate concentrates most of the recorded disaster mortality, which can be explained by the intense flooding that hit different municipalities in the governorate in September 1982, killing more than 93 people.

Figure 30. Types and frequency of disasters in Tunisia



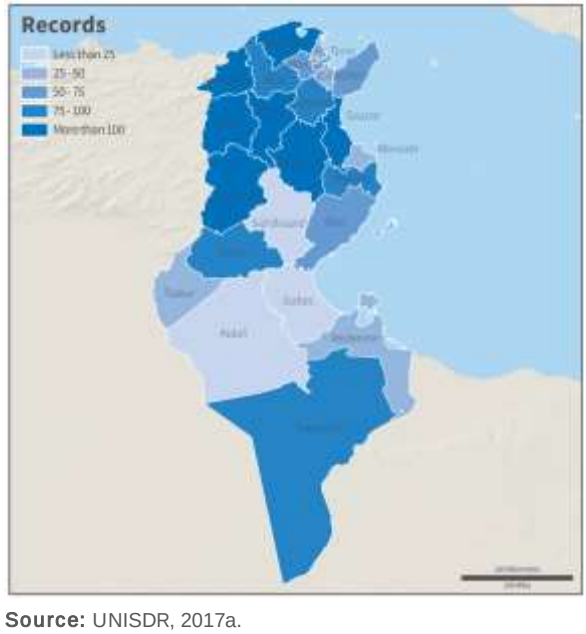
Source: Adapted from UNISDR, 2017a.

Figure 31. Disaster frequency time-series trend in Tunisia



Source: UNISDR, 2017a.

Figure 32. Spatial footprint of disasters in Tunisia



Source: UNISDR, 2017a.

Moreover, in the time-series trend, disaster frequency increased during the years of the reporting period (1982-2012), with some years having more than 170 records, compared to an annual average of 60.

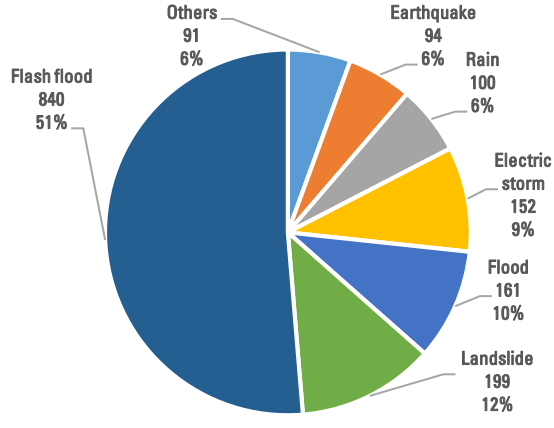
Yemen

Yemen has grown increasingly vulnerable to weather-related disasters over the past two decades as a result of its high population growth, poorly controlled urbanization and unplanned urban development, in addition to its lack of environmental controls. Working under the Ministry of the Interior, the Supreme Council for Civil Defence is the first national body tasked with multisectoral disaster management and disaster response. The General Directorate of Environmental Emergencies, established by the Ministry of Water and Environment in 2004, is the first Government institution designated to take action on various aspects of DRR, such as natural and human-made risks identification, and mapping early warning systems. Yemen has been consistently reporting on its progress towards the implementation of HFA ever since the start of the biennial national reporting cycle in 2007.[140]

Most of the records registered in Yemen's database (figure3336) refer to hydro-meteorological events. Almost 95 per cent (1,533 records) of these events are caused by weather-related hazards. Half of the records (51 per cent, 840 records) refer to flash floods, followed by landslides (12 per cent, 199 records). The timeline shows a drastic increase in the frequency of hydro-meteorological events since 2005, with important peaks in 2007 and 2010, when several disasters (mainly flash floods) hit the country. The spatial distribution (figure **35** 35) shows that disasters have been more frequent in the governorates of Ta'izz, where 184 events were recorded.

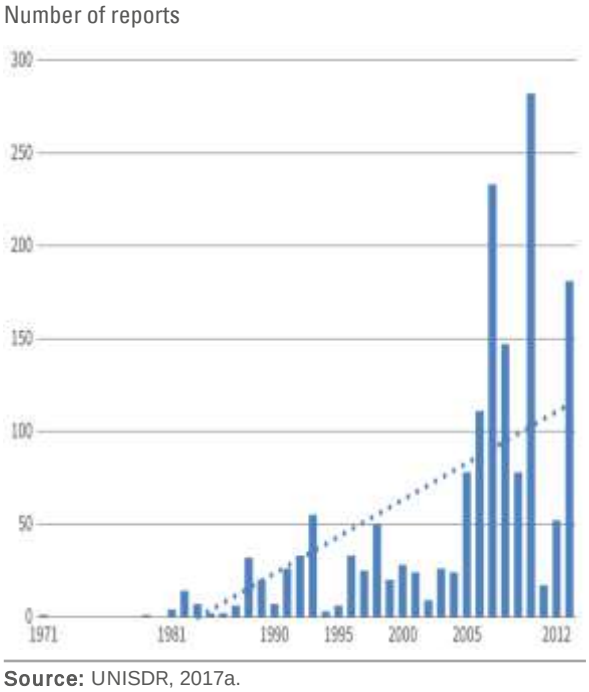
Floods and flash floods combined account for the majority of economic losses (97 per cent, almost $3 billion). Two major floods, in 1981 ($162 million) and 1982 ($975 million), were among the main contributors. The governorate of Aden concentrates most of the economic losses (81 per cent), which are mainly due to the flooding that hit the municipality of Dar Sad in different years. Of these, the 29 March 1982 floods caused the greatest damage. This single event explains the outlier in the time-series trend. Flash floods are the deadliest disasters in Yemen's database, having caused the highest number of mortalities and injuries. Of the total economic losses of $3 billion during the surveyed years (1971-2013), 97 per cent were due to flash flood events.

Figure33. Types and frequency of disasters in Yemen



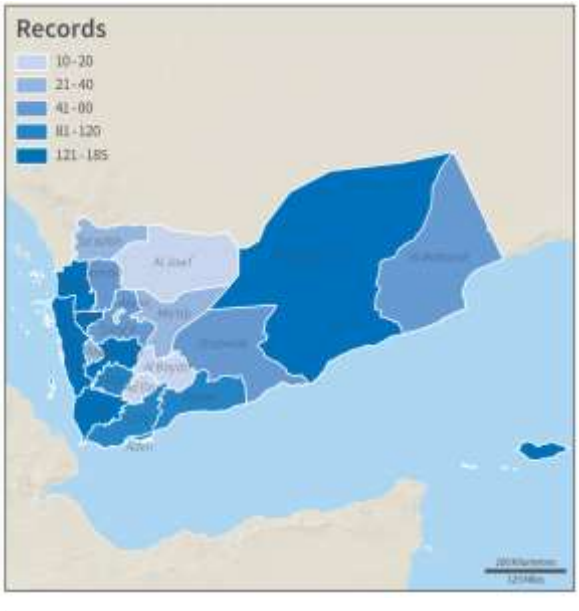
Source: Adapted from UNISDR, 2017a.

Figure 34. Disaster frequency time-series trend in Yemen



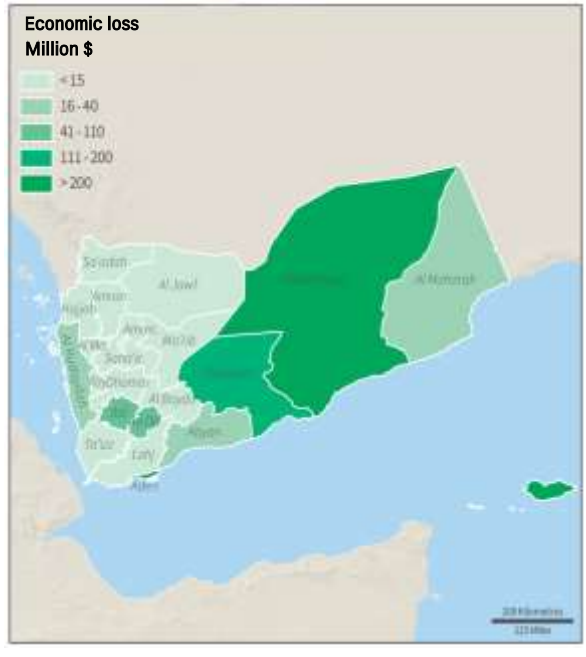
Source: UNISDR, 2017a.

Figure 35. Spatial footprint of disasters in Yemen



Source: UNISDR, 2017a.

Figure 36. Spatial distribution of economic losses from disasters in Yemen



Source: UNISDR, 2017a.

B. Analysis and main findings from disaster loss databases in the Arab region

Table 3 summarizes some of the impacts, in terms of the main human and economic assets indicators by country, for the period covered in each of the five selected Arab countries. For instance, in Jordan, disaster events caused 145 deaths, an estimated 594 damaged houses, and 840 hectares (ha) of damaged crops. In Tunisia, out of a total of 330 people killed by disasters, 258 were killed by floods, while 17,821 houses were destroyed and over 837,000 ha of crops were damaged. It can be noted that the highest human losses, by far, occurred in Yemen (even when comparing similar time periods), while the highest economic losses occurred in Yemen and Tunisia. However, it should be

noted that significant gaps in the collected databases still need to be verified with the authorities concerned in each of these countries. One of these gaps is the lack of exact locations (in geographic coordinates) for recorded events. In order to assess risk effectively, it is crucial to work on a larger scale, and the events as recorded in districts, and sometimes in governorates, are not sufficient in terms of scale. Figure 37 show the hazard frequency and the economic costs of these hazards, for all five countries taken together. It can be noted that weather-related hazards constitute the majority of disasters in the Arab region and are the source of most of the damage, as 83 per cent of all economic losses in the region are caused by floods.

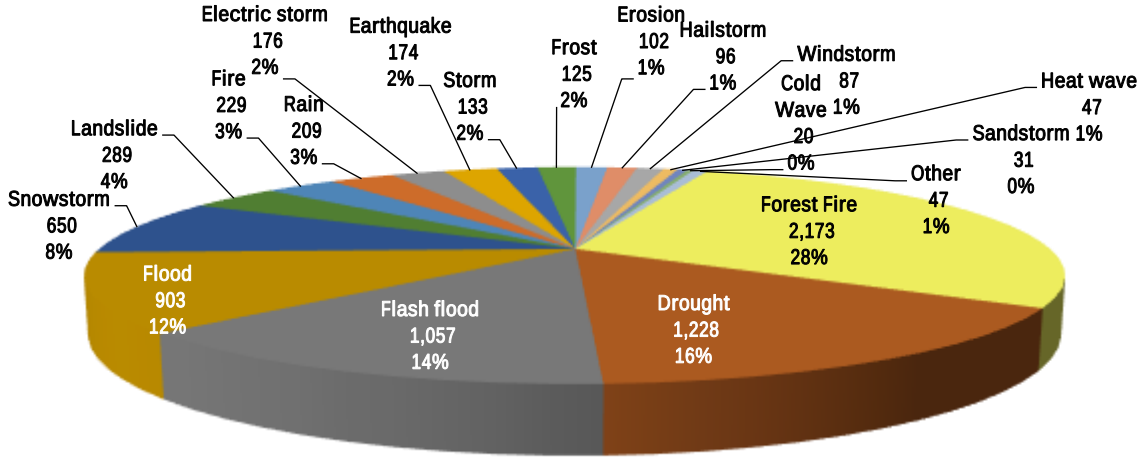
Eastern Mediterranean countries (Jordan, Lebanon and the State of Palestine) are mainly affected by weather-related hazards. Yemen accounts for more than 60 per cent of all disaster-related mortality in the region, approximately evenly divided between geological and climate-related events, which reflects the importance of strengthening the country's resilience to disasters and enhancing its adaptive capacity to cope with climate-related impacts. Disaster frequency, mortality and economic losses are generally on the rise, especially when it comes to small and medium-extensive events like flash floods, floods and forest fires due to increased warming conditions, as a key impact of climate change in the Arab region.

Table 3. Human and economic losses in national disaster loss inventories in selected Arab countries

Country	Data period	Number of events	Number of deaths	Houses destroyed	Houses damaged	Damages in crops (ha)	Total economic loss ($)
Jordan	1982-2012	593	145	83	594	840	29,540,000
Lebanon	1980-2013	2,527	156	181	1,366	17,700	48,870,000
State of Palestine	1980-2013	388	45	65	798	0	11,560,000
Tunisia	1982-2013	1,918	330	17,821	24,728	837,288	684,630,000
Yemen	1971-2013	1,637	4,126	22,392	37,311	20,234	3,023,200,000

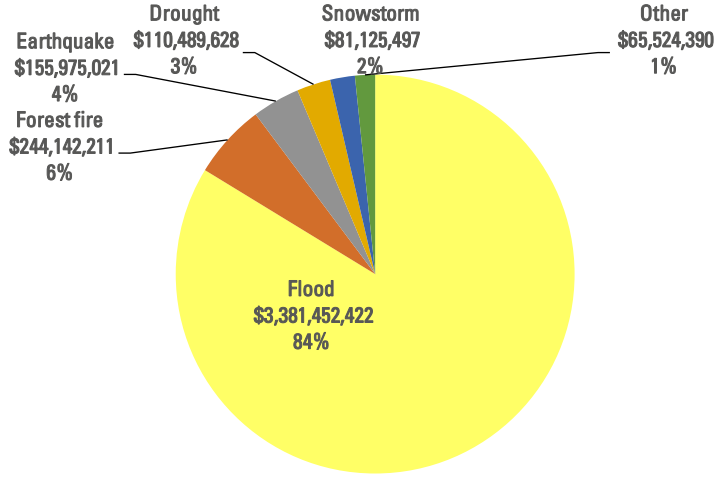
Source: UNISDR, 2017a.

Figure 37. Types and frequency of disasters in surveyed Arab countries



Source: Compiled from UNISDR, 2017a.

Figure 38. Economic losses from disasters in surveyed Arab countries (US dollars)



Source: Compiled from UNISDR, 2017a.

C. Linking historical disaster loss database and RICCAR projected extreme indices hotspots and vulnerable areas

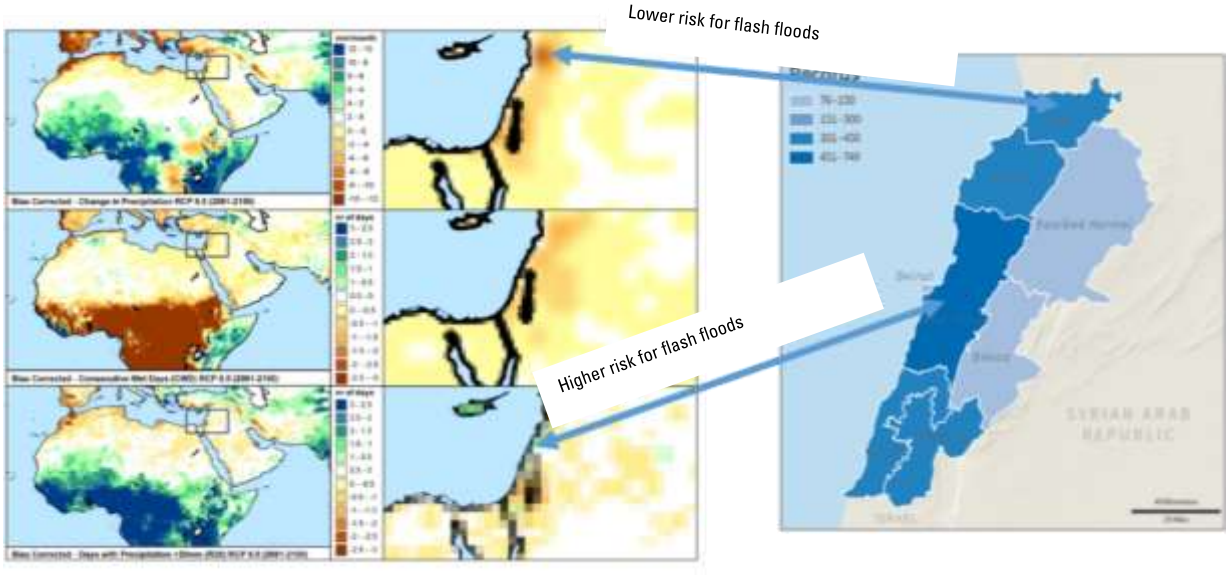
Disaster loss databases can play an important role in climate change analysis by helping to identify hotspot areas, where impacts are higher or disasters happen more frequently than average. The data on disaster losses, although they only reflect the historical record, can be used as evidence for the vulnerability of certain areas and regions to future climate change impacts, using regional climate models such as those used in RICCAR. This will help prioritize actions based on evidence, and provide strong justification for investments in CCA and DRR in certain locations in national development plans. Moreover, RICCAR projected that extreme climate indices and vulnerability maps can be used to identify future risks of related disasters. As shown in the previous section, a better understanding of patterns, trends and quantitative indicators of disaster risk can contribute to improving the process of planning and enhance the efficiency of investments allocated to megaprojects, such as dams or storage and flood protection infrastructure.

For instance, projected precipitation changes and related extreme indicators are important parameters to consider when evaluating flood risk. Two of the parameters of interest in this context are consecutive wet days (CWD)[141] and days with precipitation ≥ 20 mm (R20), which could provide valuable indications about areas prone to floods in the future. This approach was tested, as shown below, by comparing three flood-related variables, projected to the end of the century for the extreme scenario RCP 8.5, namely, change in precipitation, CWD and R20 (from top to bottom as shown in the figures below), with the spatial distribution of disasters mainly due to floods in Lebanon's and Yemen's disaster loss databases.

In Lebanon (figure 30-39), the R20 indicator showed an increase in future projections of the number of days with precipitation higher than 20 mm per day, mainly in Mount Lebanon and around Beirut. It can be noted that disasters have been more frequently recorded in this area in the past, as shown in the figure. A higher risk of flash floods can be expected for these areas in the future, resulting from projected climate change impacts. Yet, a lower risk of flash floods can be predicted for other areas in Lebanon, such as the North and Bekaa governorates.

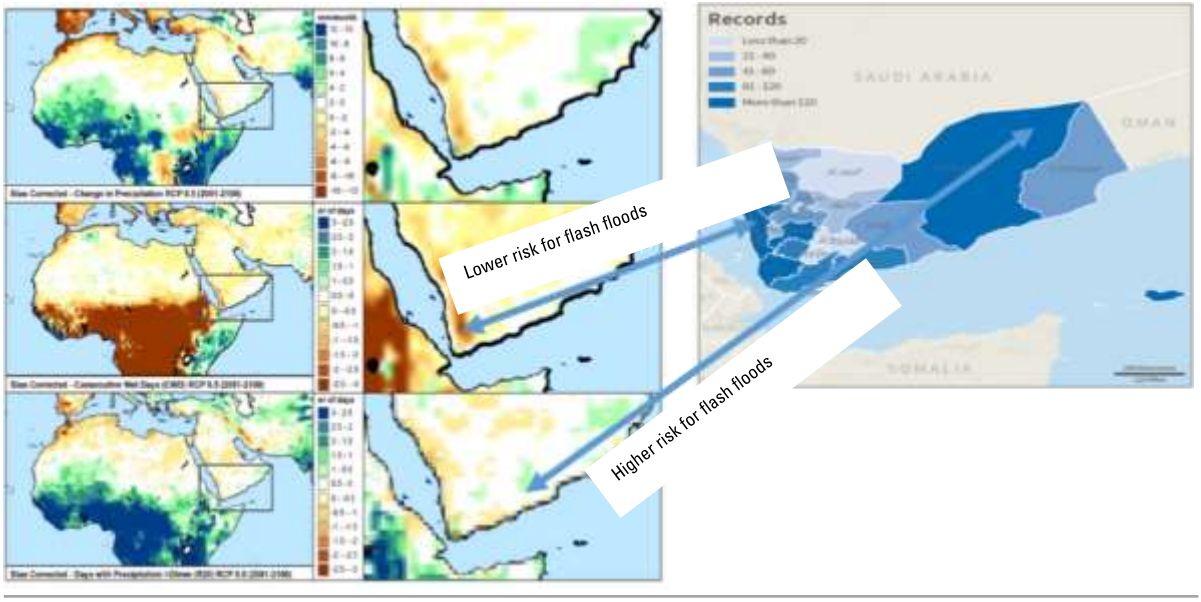
For Yemen, the CWD indicator showed a decrease in future projections, mainly in the western parts of Yemen, such as the Saada and Al-Hudaydah governorates, although they were hit by a large number of disasters caused by floods in the past (figure 40). A lower risk of flash floods can be predicted for these areas in the future, in view of projected climate change impacts. A higher risk of flash floods, however, can be expected for the governorate of Hadhramaut, due to an increase in projected R20 days.

Figure 39. Future projections for flood-related indices in RICCAR (precipitation change, CWD and R20, top to bottom, left) and historical spatial distribution of disasters (right) for Lebanon



Source: Compiled by author.

Figure 40. Future projections for flood-related indices in RICCAR (precipitation change, CWD and R20, top to bottom, left) and historical spatial distribution of disasters (right) for Yemen



Source: Compiled by author.

It is important to note that, in addition to the above-mentioned results, further analysis at the country level is required in order to provide additional observations to validate these results. There is also a need for applying hydrological modelling at the basin scale for these hotspot areas in order to assess potential future flood risk at a much higher resolution. UNISDR has used mathematical models for probabilistic risk assessment to produce hazard maps for river floods, from the global flood hazard and risk assessment approach that was conducted in GAR15 for modelling river floods for major river basins around the globe.[142]

A similar analysis can be carried out for temperature indices in order to assess future risks of extreme events, such as heat waves or very hot days, based on RICCAR projections and historical disaster data associated with these hazards. These results can be used as indications for planners to identify hotspots and decide on the appropriate measures needed to cope with these possible hazards in national strategies, and to map simple risk maps using GIS (based on model projections and identified hotspots). These risk maps can be presented to decision-makers, to help them make informed decisions based on scientific evidence and allocate investments more accurately, in order to adapt to and mitigate climate change impacts, in the light of historical disasters and the losses suffered from such impacts. RICCAR vulnerability outputs can also be used to estimate future disaster loss risk, given the dynamic nature of vulnerability, with its exposure component being mainly based on the evolution of climate change impacts with time until the end of the century. It should be emphasized that, aside from the simple comparison made above between RICCAR's future projections and historical DRR databases, there is a need for further risk-taking in our perspective on modelling climate impacts, in order to provide robust information on impacts from extreme events for the future, as well as their economic consequences, within the context of DRR.

Further investigations were conducted, using GIS and a statistical-based methodology, to test the correlation between RICCAR climate change indices and DesInventar historical events. In order to achieve this, data were gathered, treated and geospatially transformed, first to serve as input for the defined methodology for individual hazards, and then to produce susceptibility/hazard maps for each climate-related hazard. Six susceptibility/hazard maps for floods, torrents, storms, forest fires, heat waves and droughts were produced following European Commission and ISO 31010 guidelines, based on DesInventar historical data, covering the baseline (1986-2005) period of the current study (see figure 41 41 for flood susceptibility/hazard map). These susceptibility/ hazard maps showed a dominance of floods, torrents and storms in the northern parts of the Arab region, while an obvious dominance of forest fires, heat waves and droughts was observed in its southern parts. This can be explained by their climatic zones, which directly influence the probability, intensity and spatial footprint of the hazards under study.

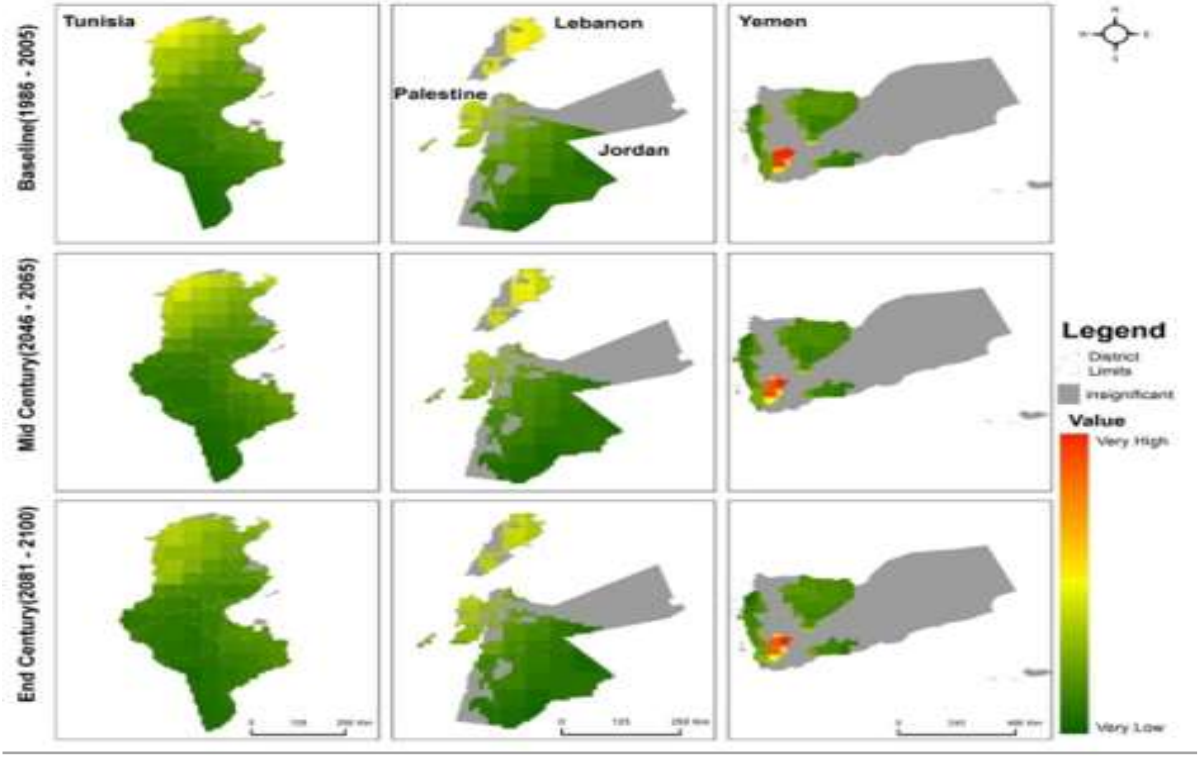
Given the values of RICCAR indices for the baseline period, after sampling and validation, statistical logistic regression was applied to each hazard data set. This method was chosen to find the correlation between RICCAR indices and weather-related hazards. Vulnerable areas based on RICCAR extreme indices for future

projections, as shown earlier in this chapter, were mapped and analysed to investigate the possibility of validating the climate change indices projection maps with future natural hazard susceptibility.

In general, the initial findings of the study show that the projections from 1986 to 2100 indicate a slight decrease in the percentages of high susceptibility levels, with regard to water-related hazards, such as floods, torrents and storms, in the northern parts of the study area, and an increase in its southern parts. On the opposite side, a remarkable increase in the projected percentages of high susceptibility levels for high temperature-related hazards, like forest fires, heat waves and droughts, was observed. High drought susceptibility may apply to as much as 50 per cent of the study area, which is already prone to drought, by the end of the century. This should be taken into consideration, especially in the Arab region, where these hotspots are already vulnerable and suffer from water scarcity at various levels of severity.

The logistic regression-derived equation for drought included the highest number of RICCAR indices (three out of seven) among hazard models. The predictive equations for all other hazards involved two factors, and the flood equation held the CWD indicator as the only explanatory factor.

Figure 41. Comparative map of flood susceptibility, between baseline (1986-2005), mid- and end-of-century periods, for scenario RCP 8.5



Source: Compiled by author.

Table 4. Correlation between extreme climate change indices and weather-related hazards

Climate change indices	Number of significance in logistic models	Explanatory for
Consecutive wet days (CWD)	2	Floods and storms
Rainfall intensity greater than 10 mm/day (R10)	1	Storms
Rainfall intensity greater than 20 mm/day (R20)	2	Torrents and droughts
Consecutive dry days (CDD)	3	Torrents, forest fires and droughts
Maximum temperature greater than 35°C (SU35)	1	Heat waves
Maximum temperature greater than 40°C (SU40)	3	Storms, forest fires and droughts

Source: Prepared by author.

The results obtained show that all seven extreme indices seem to have a correlation with at least one of the hazards and, therefore, play a role in determining the occurrence and/or intensity of the latter. The compilation of these results is shown in table 4. Remarkably, maximum temperature greater than 40°C (SU40) and CDD were the most explanatory factors, introduced in three models involving three hazards. Conversely, R10 (introduced only in storms) and maximum temperature greater than 35°C (SU35) were the least explanatory factors.

This test confirms that historical hazard data represents a starting point for assessing natural hazard susceptibility, and that it is important to use an approach that builds on past records but also takes into account events that may occur in the future, although they do not appear in catalogues or disaster loss databases. Therefore, it is important to tackle climate change when assessing natural hazards, especially those that are weather-related, since climate change continues to affect the natural components that influence their intensity and probability of occurrence. Such an approach allows for better coverage of possible events, and provides improved estimations of the probability of occurrence of each event and associated losses. To better achieve this linkage, the following is recommended:

- Data about daily events should be systematically collected and catalogued in standardized and unified formats. This should be easily accessible and contain metadata;
- Recording the magnitude, location, duration and timing of each hazard or extreme event is a crucial component in the process of documenting and cataloguing damage and losses. Accumulated over time, this data would provide a basis for the calibration and validation of the hazard models needed for a better understanding of the link between CCA and DRR;

- CCA and DRR should unify their methods and standards of work and recording for better and more comprehensive cooperation.

There is a need for improving disaster loss databases by developing the capacity of countries for systematic disaster data collection, interpretation, use and applications, and for enhancing the quality of disaster loss data, especially estimates of economic losses. It is also necessary to implement quality control and validation procedures by linking all climate change databases at the national level. Moreover, there is a need to promote the use of disaster loss databases in policy applications and in the development of CCA strategies and future scenarios, when planning for the required investments to improve the resilience of countries. Ideally, a complete map of disaster losses should be developed for the whole Arab region, to be used as a baseline for modelling future risks due to climate change. This can be done in different stages, by completing maps for each hazard. Such a map would serve as a baseline to visualize what the region is prone to, and could be complemented by developing exposure maps for selected sectors and/or assets, as well as vulnerability maps to each hazard. It should be noted that mapping exposure and vulnerability for the entire Arab region would require exhaustive inventories and studies. Based on the latter's outputs, however, risk maps for each hazard, as well as a multi-hazard map, could eventually be developed for the region.

At the global level, it is essential to integrate disaster loss and climate change databases, as was done in RICCAR for the Arab region, in various global processes, such as DesInventar, IPCC Assessment Reports and GAR, as well as the related SDGs in the 2030 Agenda for Sustainable Development, into one platform managed by the scientific community.

4. Frameworks for Disaster Risk Reduction and Climate Change Adaptation

4. Frameworks for Disaster Risk Reduction and Climate Change Adaptation

A. Comparative analysis of disaster risk reduction, climate change adaptation and water-related Sustainable Development Goals

At the global level, the three frameworks of DRR, CCA and the Sustainable Development Goals support interrelated policies, legal and regulatory framework developments, and reforms. Furthermore, the three frameworks call for integrating decentralized efforts into local development. For example, while participation, monitoring and mediation are best encouraged at the local level, there is still a need for integration, advocacy, awareness-raising and education, as well as for establishing new partnerships and networks for DRR and CCA efforts.[143] Table 5 provides a global comparison between current DRR, CCA and water-related SDGs, as well as their action plans.

The Sendai Framework brings together all current work on disaster risk management. Being the first post-2015 development agreement, it is the basis for an informed and resilient sustainable development agenda. As a voluntary instrument, providing a new approach to disaster risk management policies and operations at the global level, the Sendai Framework represents a shift in the global policy approach: from disaster management to disaster risk management. Indeed, the goal now is to prevent new disasters and to reduce existing disaster risks, through a risk approach to all hazards, involving all of society, across economic, social and environmental policy areas, with the aim of reducing vulnerability and increasing resilience.[144]

The intended national climate action plans, submitted to the United Nations by nearly all countries ahead of the Paris Agreement, will see their status change under the latter. These action plans included INDCs, detailing the contribution each country is willing to make towards reducing global GHG emissions. These INDCs are now set to become NDCs, which will be recorded in a public registry, to be maintained by the United Nations secretariat. An interim registry developed by the latter was launched in 2016, consisting of a public web-based platform, in which countries were able to record their first contributions and manage relevant documentation.[145] It is becoming clear that implementing the Paris Agreement will lead to new alliances and revised roles for some institutions, including GEF, intergovernmental organizations such as the World Bank, and the various United Nations agencies, to effectively respond and help individual countries – especially developing countries – meet their commitments. Such revised roles within and between intergovernmental organizations will influence the future climate change plans and political positions of Arab countries.

The SDGs build upon the success of the eight MDGs, agreed upon in 2000, to halve extreme poverty by 2015, as a midpoint towards eradicating poverty in all its forms. The MDGs focused on the many dimensions of extreme poverty, including low income, chronic hunger, gender inequality, lack of schooling, lack of access to health care, and deprivation of clean water and sanitation, among others. Many countries did not make sufficient progress towards the MDGs, particularly on environmental sustainability, and it became widely recognized that additional work was needed to achieve the ultimate goal of ending extreme poverty in all its forms.[146] Thus, in September 2015, the world's Governments agreed on the 17 SDGs to guide development until 2030. The 17 goals and their associated 169 targets are premised on the belief that inclusiveness, integration and universality can bring about a more sustainable future for all.[147] The process of formulating the SDGs drew upon the views of multiple stakeholders across different sectors and countries. As such, it was consistent with the inclusiveness, integration and universality principles that underpin the SDGs. But the implementation of these goals will require the engagement of all stakeholders, not just those who actively participated in their formulation. Indeed, implementation will necessitate the involvement of cities, businesses and government agencies that may be relatively unfamiliar with the SDGs. This will require user-friendly guidance for newcomers to the SDGs regarding the steps they can take to move towards achieving the goals. While some literature has been published to help stakeholders, it tends to be either sector-specific, without explaining the broader context, or too lengthy to digest in one sitting.[148]

According to the European Commission's Staff Working Document, translating any of the international frameworks into tangible actions should be consistent with other international agreements and processes, including the Sendai Framework, the 2030 Agenda for Sustainable Development, the 2015 Addis Ababa Action Agenda on Financing for Development,[149] the Paris Agreement, the 2016 World Humanitarian Summit,[150] and the New Urban Agenda adopted at the Third United Nations Conference on Housing and Sustainable Urban Development – HABITAT III.[151] For example, the implementation of the Sendai Framework also represents a contribution to the 2030 Agenda for Sustainable Development, through building the resilience of people, ecosystems, infrastructures, policies and planning processes, while taking into account climate-related risks and the need for adaptation. DRR and CCA are critical elements of the sustainable development agenda. In this regard, the 2012 IPCC Special Report suggests that the transformation (through changes in regulatory, legislative, financial, technological, or biological systems) of DRR within the context of climate extremes may be the key to a sustainable and resilient society.[152]

Table 6 illustrates the regional agenda mandates and actions plans of current DRR, CCA and water-related SDGs, respectively.

Table 5. Global agenda mandates and related action plans for DRR, CCA and water-related SDGs

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
Agency involved	UNISDR	UNFCCC	United Nations agencies (such as regional commissions, UN-Water, UNDP, UNEP, FAO and UNESCO)
Policy/mandates	Sendai Framework for Disaster Risk Reduction (2015-2030).	Paris Agreement on Climate Change (2015-2030).	Transforming Our World: the 2030 Agenda for Sustainable Development Goal 1. End poverty in all its forms everywhere; Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture; Goal 6. Ensure availability and sustainable management of water and sanitation for all; Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable; Goal 13. Take urgent action to combat climate change and its impacts.
Priorities of actions	• Understanding disaster risk; • Strengthening disaster risk governance to manage disaster risk; • Investing in DRR for resilience; • Enhancing disaster preparedness for effective response and to "build back better" in recovery,	Article 7. Adaptation • The Paris Agreement establishes a global goal on adaptation – that of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change. It aims to significantly strengthen national adaptation efforts, including through	**1.5.** Build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters. **2.4.** Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
	rehabilitation and reconstruction.	international cooperation. It also recognizes that adaptation is a global challenge faced by all. All Parties should engage in adaptation planning and are expected to submit and periodically update an adaptation communication on their priorities, and their implementation and support needs, plans and actions. Developing country Parties will receive enhanced support for adaptation actions. Article 8. Loss and Damage • The Paris Agreement significantly enhances the Warsaw International Mechanism for Loss and Damage, which will develop approaches to help vulnerable countries cope with the adverse effects of climate change, including extreme weather events and slow-onset events such as sea level rise. The Agreement provides a framework for Parties to enhance	capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality. **11.5.** Significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations. **11.b.** Substantially increase 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 develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels. **13.1.** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. **13.2.** Integrate climate change measures into national policies, strategies and planning. **13.3.** Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
		understanding, action and support with regard to loss and damage. Article 12. Climate change education, training, public awareness, public participation and public access to information are also to be enhanced under the Agreement.	**13.a.** Implement the commitment undertaken by developed-country Parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible. **13.b.** Promote 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.

Source: United Nations, 2015c; United Nations, 2015e; United Nations, 2018a.

Table 6. Arab region mandates and related action plans for DRR, CCA and water-related SDGs

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
Agency involved	League of Arab States, UNISDR, UNDP, UNEP, World Bank	League of Arab States, ESCWA, UNDP, UNEP, World Bank	League of Arab States, ESCWA, UNESCO, World Bank
Policy/mandates	Regional Arab Strategy on Disaster Risk Reduction (2015-2030)	Arab Framework Action Plan on Climate Change (2010-2020)	• Arab Strategy for Water Security in the Arab Region (2010-2030); • Sustainable Development Goals (2015-2030).
Priorities of actions	**Priority 1:** Strengthen commitments for	**Priority 1:** Reduce the risks of climate change and increase the	**Priority 1:** In the medium term (by 2020), raise water use efficiency by 15 to 25 per cent, in order to

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
	comprehensive DRR across sectors. **Priority 2:** Develop capacities to identify, monitor and assess disaster risks. **Priority 3:** Build resilience through knowledge, advocacy, research and trainings. **Priority 4:** Improve accountability for disaster risk management at the subnational and local levels. **Priority 5:** Integrate disaster risk reduction into emergency response, preparedness and recovery.	readiness to confront its potential impacts through programmes of mitigation and adaptation. **Priority 2:** Preserve natural and human resources and ensure a decent standard of living for Arab citizens. **Priority 3:** Enhance the pace of sustainable development in Arab countries, including by achieving the Millennium Development Goals (MDGs). **Priority 4:** Strengthen and build national and regional institutional capacities to deal with issues of climate change and cope with disasters. **Priority 5:** Establish favourable conditions to stimulate the regional and international cooperation necessary to support national programmes.	meet increased water demand and ensure water and food security, and to face future challenges with available water resources and in accordance with the principles of sustainable development. **Priority 2:** Adopt, in the short term (by 2015), integrated water policies which secure water for all sectors, in order to achieve maximum socioeconomic benefits and ensure the implementation of the Millennium Development Goals (MDGs). **Priority 3:** Develop, in the medium term (by 2020), alternative and practical solutions for using non-conventional water-related technology, with a focus on the use of renewable energy in water desalination and water treatment to meet the increasing water demand. **Priority 4:** By 2020, sign permanent agreements on shared water resources in the Arab region, in accordance with the Arab Convention on Shared Water Resources in the Arab Region and international water law. **Priority 5:** In the medium term (by 2020), have each Arab State define a national policy for including CCA in national water policies.

Components	Disaster risk reduction (DRR)	Climate change adaptation (CCA)	Water-related Sustainable Development Goals (SDGs)
Regional and national actions	• Regional Arab Strategy for Disaster Risk Reduction (2015-2030); • Arab Cooperation Agreement in Organization and Facilitation of Relief Operations (2009); • Draft Arab Protocol (2008) on Cooperation for Speedy and Immediate Response within Arab Countries to Transfer Equipment and Expertise in Cases of Disasters, Crisis and Emergencies; • Statutes for the Arab Centre to Prevent Risks from Earthquakes and Other Natural Disasters (2004).	• Regional Action Plan; • National Policies; • National Adaptation Programmes of Action (NAPAs); • Intended Nationally Determined Contributions (INDCs); • National Communication Reports; • National Sectoral Action Plans (on water, food, etc.).	• Regional action plans; • SDG-based development strategies and action plans (national).
Coordination mechanisms	• Regular intergovernmental meetings on disaster risk management (DRM); • Regional/subregional DRM centre (under development); • Joint Committee on Environment and Development in the Arab Region.	• Council of Arab Ministers Responsible for the Environment (CAMRE)/Technical Committees (TC); • Working Group on Climate Change, established by ESCWA.	• Arab Ministerial Water Council (AMWC); • Council of Arab Ministers Responsible for the Environment (CAMRE)/Technical Committees (TC).

Source: League of Arab States, 2010a, 2010b, 2010c; United Nations, 2018a.

B. Considering gender and vulnerable groups in global and regional disaster risk reduction and climate change adaptation strategies

1. Global level

The HFA emphasized the importance of gender perspective for building resilience by calling for integrating gender dimensions into all disaster risk management policies, plans and decision-making processes, including those related to risk assessment, early warning, information management, and education and training.[153] More recently, the Sendai Framework recognized the importance of gender dimensions in DRR, calling for inclusiveness and the engagement of all of society. It states that "a gender, age, disability and cultural perspective should be integrated in all policies and practices, and women and youth leadership should be promoted; in this context, special attention should be paid to the improvement of organized voluntary work of citizens".[154] Furthermore, the Sendai Framework's Priority 4 emphasizes the fact that "women and persons with disabilities should publicly lead and promote gender-equitable and universally accessible approaches during the response and reconstruction phases".[155] It also pays specific attention to categories of individuals regarded as being more vulnerable when shocks or stresses occur. The Sendai Framework highlights the fact that DRR requires an all-of-society engagement and partnership, as well as empowerment and inclusive, accessible and non-discriminatory participation, while paying special attention to people disproportionately affected by disasters, especially the poorest. Children, the elderly and refugees should also be given special attention, as vulnerable groups with the potential to play an influential role in promoting DRR, CCA and the SDGs. Measures to protect refugees from disasters should urgently be developed for the whole Arab region, as they are considered one of the most vulnerable groups to climate change and natural disasters.

In CCA discourse, increasing evidence of the differential impacts of climate change on women and girls in recent decades has led to significant progress in addressing interlinkages between gender and climate change under UNFCCC.[156] The two-year Lima Work Programme on Gender, launched at COP 20 in 2014, aimed to advance gender equality mandates across all areas involved in climate negotiations.[157] It was reviewed and renewed at COP 22 in Marrakech in November 2016, providing an opportunity for parties and observers to further strengthen and advance gender equality under UNFCCC. The Programme refers, in particular, to the affirmations that Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights as well as gender equality, that adaptation should follow a gender-responsive approach, and that capacity-building should be gender-responsive.[158] Recently, the Paris Agreement encouraged parties to consider their commitments to gender equality and intergenerational equity as part of their efforts to respond to climate change. Therefore, while this is not explicitly linked to the term resilience, all the frameworks include promoting the capacities of different groups, particularly women and girls.

Empowering women and promoting gender equality is crucial to accelerating sustainable development. Ending all forms of discrimination against women and girls is not only a basic human right, but it also has a multiplier effect across all other development areas.[159] The SDGs aim to build on previous achievements to ensure gender mainstreaming in national policies and strategies. Therefore, out of the

17 goals that make up the 2030 Agenda for Sustainable Development, Goal 5 was dedicated to gender equality: "Achieve gender equality and empower all women and girls".[160]

2. Arab regional level

The Arab Strategy for Water Security (2010-2030) addressed some of the efforts to enhance knowledge and exchange experience on gender issues in IWRM applications in the Arab region's rural areas, by exchanging best practices and raising awareness on the importance of public participation in water resources management. It is of the utmost importance to involve interested NGOs and civil society organizations working in the field of water resources management and gender issues in rural areas.[161] At the Arab regional level, decision makers are generally well aware of the importance of gender mainstreaming. But in spite of laws, regulations and measures taken regarding gender equity and mainstreaming, local and cultural views and perceptions of gender mainstreaming in IWRM have been difficult to change. The political situation in each country has a considerable impact on the efforts exerted and the progress achieved in gender mainstreaming in IWRM. Discussions focused on the means to promote a culture of gender equality in the Arab region struggle under various limitations, such as illiteracy, especially among women, and traditions that are sometimes opposed to gender equity.[162]

Within the Arab region's DRR community, "gender mainstreaming, cultural diversity, community participation and capacity-building often fall behind. It is essential to collect gender disaggregated vulnerability and capacity-related information in order to identify and better target DRR actions".[163] Furthermore, there are challenges that hinder the creation of strong linkages between the national and local levels. National governments develop laws and regulations with limited input from local governments, who are not sufficiently informed or engaged in their development and implementation. As a result, national plans and decision-making processes often fail to take into consideration the needs of communities and municipalities, and their capacity to implement DRR measures.

C. Existing national mechanisms in the Arab region and stakeholder/actor analysis

Both DRR and CCA have a common goal of risk reduction, but DRR is concerned with ongoing hazards, whereas CCA is primarily concerned with emerging climate change challenges.[164] In terms of institutional structures and awareness, there is a disconnect between DRR and CCA communities. Within most national and local governments, the two communities largely operate in isolation, which can be attributed partly to thematic investments by donors, and partly to existing in-house silos within governments.[165]

Thus, there is no one-size-fits-all approach to plan, implement and monitor CCA and DRR activities. In the Arab region, the specific governance approaches, institutional arrangements and national mechanisms differ from country to country, depending on their sociopolitical, economic and cultural circumstances. To meet the requirements of international frameworks, many Arab countries have increasingly been adopting various national approaches and mechanisms for implementation, reporting and follow-up.

Box 1. Case study: Lebanon's collaborative agenda on disaster risk reduction

Lebanon's agenda on disaster risk reduction (DRR) emphasizes a vertical integration of DRR, from the highest political levels down to the decentralized levels. Nevertheless, it also emphasizes a horizontal integration of DRR across relevant sectors, including health, education and the media, in addition to engagements from the private sector. Lebanon's DRR experience can be attributed to three critical drivers: (a) political will and leadership; (b) local collaboration; and (c) regional and international partnerships. These drivers are enabling the country to achieve strategic direction, momentum and visibility for its DRR agenda at all levels.

(a) Political will and leadership

Since 2003, sustained political interest and commitment from the Prime Minister's Office and the Presidency of the Council of Ministers have given the issue of DRR national visibility and reinforced its importance for all relevant line ministries and decentralized authorities. In 2009, the Office of the Prime Minister, supported by the United Nations Development Programme (UNDP), formulated a project on Strengthening Disaster Risk Management Capacities in Lebanon (2009-2012), with a five-fold objective: (i) establishing a disaster risk reduction and management unit; (ii) developing and implementing a national strategy and systems for DRR; (iii) developing national and local capacities for disaster risk management; (iv) raising public awareness on DRR; and (v) integrating gender equality initiatives at the national and local levels. Establishing a disaster risk management unit within the Prime Minister's Office has made it possible to adopt a strategic vision for DRR early on. The project's high-level positioning has also facilitated prioritized planning and coordination of critical DRR measures to be implemented at the national and local levels and across sectors.

In 2011, an inclusive communications strategy for DRR was adopted by the Prime Minister's Office. It underlines the importance of popularizing DRR by designating it essentially as a people-based approach. The strategy is engaging key stakeholders, namely DRR decision makers (national and local authorities), the media, the general public and educational institutions. Its vision is to induce a behavioural change towards DRR, whereby the country would experience a perception shift from engaging in a culture of disaster response management to embracing a culture of disaster prevention and preparedness.

(b) Local collaboration

Despite the lack of national and decentralized coordinating mechanisms and standard operating procedures for DRR activities, the national government is presently working to channel collaborative energies to create more efficient and accountable structures for disaster risk management, with standard protocols for first responders, local authorities, civil society and communities, and public service providers. At the local level, local responses to small-scale disasters in the recent past have demonstrated positive collaboration between all stakeholders, particularly NGOs, science, research organizations and, most recently, the private sector. For example, the Lebanese Red Cross works effectively to support the local administration, civil society groups and communities to prepare for, and respond to, disasters in a timely manner. It has made significant contributions to developing the capacities of local authorities and communities in responding to, and managing, localized disaster impacts. It is one of the most 'relied upon' networks of volunteers at the local level, in times of disaster.

(c) Regional and international partnerships

The international community in Lebanon (including United Nations agencies, World Bank and donors such as the Swiss Agency for Development and Cooperation) has provided critical support in the conceptualization and initiation of a multi-stakeholder and multi-thematic DRR agenda for the country. The support provided by United Nations agencies and donors has led to concrete results in the areas of capacity development, public awareness-raising and national risk assessment. There is widespread recognition that, as the implementation of national and local plans begins, it will be essential for the implementation phase to engage a different and wider group of donors and regional and international institutions. This diversity will bring new kinds of know-how and expertise to Lebanon.

Source: UNISDR, 2012.

Box 2. Case study: Egypt's disaster risk reduction and climate change adaptation strategies

During the last two decades, Egypt has taken action to advance disaster risk management (DRM). For instance, in 2000, a department dedicated to crisis and disaster management was established at the Information and Decision Support Center (IDSC) of the Egyptian Cabinet of Ministers. Among other responsibilities, the department has a mandate to set up national DRM policies and guidelines.

The National Strategy for Crisis, Disaster Management and Disaster Risk Reduction (2010) is the main guideline for disaster risk management in Egypt. It outlines objectives, priorities and directions for reducing risks from the future challenges of disaster management. Egypt has adopted several strategies to advance progress in mainstreaming DRR, including: (a) the incorporation of disaster risk reduction (DRR) and climate change adaptation (CCA) into land use planning systems at different spatial levels; (b) the integration of disaster planning and prevention into overall national development plans and projects for sustainable development, accompanied by the involvement of supreme committees for crisis management and DRR on a governorate/local level; (c) the inclusion of poverty reduction as part of a DRR strategy; (d) the integration between DRR and CCA, which has been making significant progress in Egypt (for example, the National Strategy for Adaptation to Climate Change was launched in 2012 to mainstream climate-resilient development into different levels of government); and (e) the formulation, currently being explored by the Government, of national disaster management legislation, which is expected to significantly emphasize DRR and include the establishment of a national centre for crisis management and DRR.

More recently, IDSC developed the National Strategy for Adaptation to Climate Change and Disaster Risk Reduction (2010-2030). The Strategy includes plans for risk reduction, mitigation and adaptation across different sectors. The overarching goal of this Strategy is to increase Egypt's flexibility in dealing with climate change risks and disasters, as well as the Egyptian community's ability to absorb, contain, and reduce such risks and disasters across different sectors. The Strategy evaluates the current situation and risks across key sectors, in particular the intersection of coastal zones with water resources and irrigation, agriculture, health, urban areas, housing, roads, and tourism. It recommends integrating sector-specific adaptation plans into each five-year plan and national development programme; enhancing community participation and building a "safety first" culture; promoting regional and international cooperation; and engaging in continuous progress monitoring.

The Strategy identifies the following seven determinants of success in adapting to climate change risks: (a) political will at all levels; (b) the availability of human, financial and natural resources; (c) reform and adjustments of institutional frameworks; (d) amendments to legislation and laws; (e) the strengthening of the national information exchange system; (f) the identification and monitoring, assessment and follow-up of performance indicators; and (g) the development of a national model for social and economic analysis and projections.

The specific framework for adaptation outlined in this Strategy is divided into four phases of execution, consisting of four five-year plans. Proposed operational key measures for the first five-year plan include developing a geographic information system (GIS) monitoring database on coastal zones; developing a regional climate model (RCM); studying the effectiveness of natural protection systems such as dunes; formulating national legislation to enable climate change risk reduction; developing additional regulations for coastal development; and enhancing partnerships between the public and private sectors. The total cost across all sectors is estimated at $7.4 billion.

Sources: UNISDR, 2013b; UNDP and Egyptian Cabinet Information and Decision Support Center, 2011.

At the national level, Arab Governments are developing policy frameworks and various institutional mechanisms to be better prepared for climate change and natural disasters.[166] In contrast to mitigation, which provides global benefits, adaptation benefits are perceived at a regional or local level, and therefore measures are mostly implemented by local actors. At the national level, UNFCCC pursues two work streams, namely, NAPAs and national adaptation plans (NAPs). NAPAs help to identify urgent adaptation needs, as delaying them could increase vulnerability or lead to increased costs of adaptation at a later stage.[167] Additionally, COP 7, in 2001, created LDCF to financially support the preparation and implementation of NAPAs, and an LDC expert group to provide technical support and advice to these countries.[168] A clear and coordinated governance structure is also essential to implement CCA measures. Such a structure must promote high degrees of national, regional and international collaboration among different levels of government, different sectors, both public and private, and civil society organizations. Some Arab countries, such as Egypt, have developed a national adaptation strategy that primarily focuses on agriculture, water resources and coastal areas. Other Arab LDCs, such as Djibouti, the Sudan, and Yemen, have produced NAPAs, which provide a process for LDCs to identify priority adaptation activities.[169]

Within national governments, interministerial coordination is critical because adaptation responses often require actions involving multiple ministries and sectors. Therefore, many Arab countries have established interministerial coordination mechanisms or committees that, for example, have climate change focal points in all relevant ministries. Experts from the private sector, academia and research institutes can also be integrated into these committees as technical advisers. For example, Egypt established a national climate change steering committee by prime ministerial decree in 2007, and Jordan established a national climate change committee by prime ministerial decree in 2001.[170]

DRR is a cross-cutting and complex development issue. It requires political and legal commitment, public understanding, scientific knowledge, careful development planning, responsible enforcement of policies and legislation, people-centred early warning systems, and effective disaster preparedness and response mechanisms. UNISDR's Regional Office for Arab States (ROAS) has invited Arab Governments, through an official note verbale, to appoint national focal points to support the implementation of the Sendai Framework, as called for by the framework itself. Most Arab countries have already appointed national focal points. For example, in Bahrain, the Ministry of the Interior is the focal point, whereas the focal point in Egypt is the Cabinet Information and Decision Support Centre, Crisis Management and DRR Sector (IDSC) and the focal point in Iraq is the Ministry of Environment. UNISDR encourages the establishment of multi-stakeholder coordination mechanisms for DRR, including national platforms, to highlight the relevance, added value and cost benefit of a coordinated and consistent approach to DRR at the national level.[171]

Box 3. Case study: Jordan's National Committee on Climate Change

The Ministry of Environment in Jordan is the national focal point for the United Nations Framework Convention on Climate Change (UNFCCC), and the institution responsible for the national climate change portfolio. In 2001, based on a decision by the Prime Minister, the first step was taken towards a national platform for the integration of multi-stakeholder dialogue and planning on climate change, when Jordan's National Committee on Climate Change (NCCC) was established. The NCCC is considered a voluntary national platform for multi-stakeholder dialogue and planning on climate change. The Committee is under the umbrella of the Ministry of Environment, and is headed by the minister or ministerial delegates. Over the years, representation on the Committee has been reviewed, as has its mandate, to include more stakeholder representatives. The committee now includes 26 members representing 21 stakeholders (10 ministries, 3 public institutions, 4 research and academic organizations, and 4 non-governmental organizations) directly associated with climate change sectors in Jordan. Yet, it still lacks representatives from the Ministry of Finance, the private sector and vulnerable groups.

As the movement grew, a milestone was achieved in Jordan in 2013, namely the launch of the National Climate Change Policy — the first significant revision to the country's environmental policy since 2005. The Policy was formulated to accommodate all national climate change priorities for action, and to provide a highly flexible policy reference point, upon which further strategies and sectoral policies could be based. To paraphrase, the long-term goal of the Policy is to achieve sustainable development in a proactive, climate-risk resilient Jordan. It was made clear that NCCC members would play a crucial role (as change agents) in their entities, and that it would be impossible to develop the Policy and achieve successful climate change sectoral and intersectoral integration without them. This highlights the prerequisites for effective climate change governance and management, namely collaborative and coherent action by participating stakeholders and policymakers who shape and implement mitigation and adaptation policies and action.

Based on the recommendations of the National Climate Change Policy, the Ministry of Environment created its first Climate Change Department in 2014. This Department will act as the institutional hub for coordinating and developing all climate change activities in Jordan, taking into consideration regional and global climate change governance and management systems and initiatives.

A different climate change-related special unit was established in 2012 at the Ministry of Water and Irrigation (prior to the establishment of the climate change department) to follow up on climate change-related issues in the water sector. In addition, two key governmental stakeholders have embedded climate change in other departments, namely, the Ministry of Transport (within the Environment and Transport Division) and the Civil Defense Directorate (within the Disaster Department).

The Climate Change Department is responsible for calling the meetings of the NCCC, and preparing and distributing all pertinent documents before and after meetings. The NCCC sets up specialized thematic legal and technical groups on a permanent and/or ad hoc basis, depending on the discussion theme. Thematic groups are composed of the principal national experts on the topics for which advice is needed.

Recently, there have been growing calls to restructure the current NCCC by establishing an inter-ministerial committee on climate change (IMCCC) to ensure high-level dialogue and coordination. This new committee would be chaired by the Minister of Environment and co-chaired by the secretary-general of the Ministry of Environment. The IMCCC would include high-level representatives such as, for example, the secretary-generals of the Ministry of Water and Irrigation, the Ministry of Energy and Mineral Resources, the Ministry of Planning and International Cooperation, the Ministry of Health, the Ministry of Agriculture, the Ministry of Finance, and the Ministry of Transport. The IMCCC would oversee the work of three technical working groups, namely, the mitigation working group; the vulnerability and adaptation working group; and the greenhouse gas inventory working group. Each working group would be chaired by the secretary-general of the relevant ministry and would report to the IMCCC chair. As the IMCCC secretariat, the Climate Change Department will be dedicated to ensuring its effective coordination and functioning.

Source: Al-Zu'bi, 2016.

Box 4. Case study: Algeria's agenda on disaster risk reduction

The civil protection directorate is the primary actor responsible for coordinating implementation of comprehensive preparedness, response and recovery measures at the national and local levels. (...) Today, a major component of the Civil Protection's mandate is to train and sensitize schools, municipalities and wilayas on preparedness and prevention measures. Algeria has marked the International Day for Disaster Reduction (IDDR) numerous times to raise public awareness and garner media coverage for the issue. An "Open day" is also regularly held to promote awareness whereby a mobile shake table demonstration is used to sensitize students, parents and teachers to critical seismic information and preparedness actions. Since 2010, the Civil Protection has also been conducting trainings at the operational and higher university levels across the country. Training for first aid is currently being conducted at 942 national centers with an emphasis on training women. Based on initial community response to these trainings, the Civil Protection is planning to set up a volunteer scheme responsible for municipalities at risk. Every six months wilayas participate in simulation exercises as part of national preparedness. Each wilaya is responsible for drafting a disaster management plan that is tested and updated as part of these simulations. Detailed disaster management plans have been developed for different hazards, regional and local plans for the organization of emergency relief, prevention and rapid intervention in industrial zones. However, no comprehensive multi-hazard plans have been developed for the country. Algeria has an active civil society sector at the local level but it does not have very well developed capacities for implementing systematic disaster prevention, preparedness, response and recovery measures. It is widely acknowledged that the civil society sector will need to be more involved in national and local decisions on DRR. In this regard, the capacities of civil society need to be strengthened to ensure that DRM efforts are to be realized on the ground. In the absence of systematic civil society contributions to the DRR agenda, the Algerian Red Crescent has been a critical on-the-ground partner to the Civil Protection in organizing sensitization campaigns, trainings and drills, and coordinating response and relief efforts".

Particularly after the Algiers 2001 flooding and the 2003 earthquake, Algeria recognized that expanding urban settlements and infrastructure had to be protected from future losses and made resilient to a range of hazards using a multisectoral approach". The Algerian government "realized early on that successfully implementing and enforcing preparedness, mitigation and preventive measures will require making communities and local authorities aware of risks and strategies to manage them. The Ministry of Education has taken steps to sensitize students, teachers and school authorities to major hazards and preparedness measures. The Ministry is also ensuring that school curriculum integrates an understanding of natural and industrial hazards, and adequate measures to prepare and respond. With support from the Civil Protection, the Ministry has also led a series of national campaigns for raising public awareness on DRR in schools and in communities. In addition, in the aftermath of the 2003 earthquake, the Ministry of Education worked closely with [the] Ministry of Planning and the UN to ensure the implementation of codes and regulations for the structural integrity of schools". Furthermore, "the Ministry of Land-Use Planning and Environment worked closely with UNDP [in] Algeria to integrate DRR into urban planning. This effort was informed by GIS mapping, which is supporting the implementation of risk-sensitive plans across nine wilayas". In addition, "as part of a 2010-2014 program for new highway improvement, transport networks and maritime infrastructure, the Ministry of Public Work established the Algerian Seismic Public Works Code (RPOA) and developed a database to mark major infrastructure at risk from earthquake, fire and flooding. The Ministry purchased equipment to protect against fires and has conducted a pilot study to understand flood risk to major infrastructure".

Source: UNISDR, 2013f.

The Sendai Framework places strong emphasis on the critical role of national platforms in supporting its development, implementation, monitoring and review. This can be achieved through effective coordination at the national level, effective engagement at the local level, and the mobilization of key stakeholders, including the private sector, communities and key technical experts, particularly in the area of climate change. The Sendai Framework also calls for greater support for and investment in the work of national platforms, to allow them to perform their function effectively and increase their legitimacy and accountability at the national level.[172] Furthermore, there have been recent calls to "make women's voices heard by [DRR] decision-makers".[173] In 2014, The Second Arab Conference on Disaster Risk Reduction acknowledged the need for the greater inclusion of women in disaster risk management. Women need to be engaged, beyond token representation in committees and task forces, in more substantive, meaningful and effective participation. This requires creating new spaces for women's experiences, interests, practical and strategic needs to be reflected in policies, and planning and programme implementation at every level, particularly at the community level.[174] For example, in Morocco, in 2007, a DRR programme supported by the Red Crescent started targeting local communities, with a focus on floods. DRR-related material was prepared and distributed, and community teams were formed and trained to respond in case of floods, fires and other disasters. The programme also conducted a vulnerability and capacity assessment that resulted in several community projects: projects to maintain the availability of drinking water, tree planting and projects to reduce pollution.[175] Within the context of DRR, UNICEF's MENA Regional Office is supporting the Jordan Country Office to create and maintain safe learning environments, teach disaster prevention and build a culture of safety and resilience around school communities. UNICEF is working with the Ministry of Education, as well as the United Nations country team and UNISDR, to increase resilience to natural and human-made hazards among Jordan's most vulnerable populations, by improving policies, coordination, planning, information and capacities.[176]

A few Arab countries (including Algeria and Mauritania) have established a multi-stakeholder national platform for DRR, to help provide and mobilize the knowledge, skills and resources required to mainstream DRR into development policies, planning and programmes. These national platforms are key partners in implementing regional and national DRR strategies at the country level, to help build resilient communities.[177]

D. Regional disaster risk reduction and climate change adaptation mechanisms

Over the past decades, a number of Arab regional initiatives, mechanisms, committees, programmes and institutions have been created to address water scarcity, climate change impacts, DRR and sustainable development. There have also been efforts to better inform stakeholders about each topic; increase the knowledge base on synergies between water scarcity, social vulnerability, CCA and DRR; and establish coordination mechanisms to support governance, policy and capacities.

The initiatives, networks and committees listed below can be used to consolidate efforts, expertise and resources, in order to advance DRR- and CCA-related science and technology,

innovation, research, capacity development and knowledge/technology transfer.

A **DRR Arab States coordination network** was established by the UNISDR Regional Office as a community of practice to promote information-sharing and joint action for DRR, at the regional and national levels in the Arab region. It serves as a regional mechanism to discuss DRR issues among international partners working in Arab countries, and to jointly plan the implementation and monitoring of DRR-related activities.[178]

The **League of Arab States Committee on Weather, Climate and Hazards Information Management** is one of the sub-committees established by the Arab Permanent Committee on Meteorology under the umbrella of the League. Delegates from Arab countries, international and regional organizations, academia and the media participated in the committee's first meeting which was held in Amman Jordan from 28 to 29 February 2016.[179] The Committee was set up to provide recommendations on policies, methods and collaborative mechanisms to support early preparation for natural disasters, as well as improved management of post-disaster situations. The work of the Committee is meant to strengthen the pace of sustainable development in Arab countries and to meet the SDGs. It also seeks to build institutional capacity at the national and regional levels, achieve greater resilience for dealing with extreme weather, climate and climate change, and develop improved strategies for managing risks and natural disasters.[180]

The **Making Cities Resilient Campaign** initiated by UNISDR has continued to support cities in managing disaster events. Almost 300 municipalities in the region have joined the campaign (20 per cent of the global participation). Furthermore, disaster loss databases have been established in eight MENA countries, enabling them to collect and analyse disaster data to better assess disaster trends and impacts.[181]

The **Regional Coordination Mechanism/Thematic Working Group on Climate Change** was established in 2010 and seeks to strengthen the results and enhance the impact of United Nations system operations, in support of the Arab region's efforts to address climate change issues. Its objectives should be achieved through effective networking, sharing of information, and output-oriented collaboration efforts, aimed at helping the region achieve the goals set at the outcomes of COPs, as well as climate change related SDGs.[182]

The **Adaptation to Climate Change in the Water Sector in the MENA Region Programme (ACCWaM)** is a regional GIZ project, aiming to improve the capacity of water management institutions in the MENA region to adapt to climate change. ACCWaM is working in cooperation with the AMWC of the League of Arab States, ESCWA, and ACSAD. The key methodological approach of the programme is capacity development at all relevant levels, by working on regional water governance, in national water sectors and through the implementation of measures at the local level.[183]

Regional CCA Framework for the Mediterranean Marine and Coastal Areas: As climate risks extend across territorial boundaries, a cross-border collaborative and coordinated regional approach to adaptation is required, promoting synergies with other multilateral environmental agreements. In 2016, during the 19th Ordinary Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the

Coastal Region of the Mediterranean (Barcelona Convention), the Regional CCA Framework for the Mediterranean Marine and Coastal Areas was endorsed. The UNEP/Mediterranean Action Plan system offers the Framework to policymakers and stakeholders in the Mediterranean region, as a structured outline to facilitate the identification of strategic objectives, strategic directions and priorities for adapting to climate change. The main objective of the Framework is to define a regional strategic approach to increase the resilience of Mediterranean marine and coastal natural and socioeconomic systems to the impacts of climate change, and assist policymakers and stakeholders at all levels across the Mediterranean to develop and implement coherent and effective policies and measures. While developing the Framework, linkages have been maintained with other relevant strategies of the League of Arab States, such as the Arab Framework Action Plan on Climate Change (2010-2020), the Arab Strategy for Disaster Risk Reduction (2020) and the Arab Water Security Strategy (2010-2030).[184]

The **Regional Working Group on the 2030 Agenda for Sustainable Development in the Arab Region** is the successor of the Inter-agency Millennium Development Goals Thematic Working Group and the transitional Post-2015 Thematic Working Group, and is chaired by ESCWA. At the 21st meeting of the Regional Coordination Mechanism in November 2015, members agreed that the Working Group on the 2030 Agenda would be established to replace the earlier groups. The goal of the Working Group is to support the coordination efforts of regional United Nations actors and the League of Arab States, as well as their efforts to adapt, implement, monitor and report on the 2030 Agenda for Sustainable Development. It will seek to harness the collective strength of all the agencies to undertake joint research, consensus-building, capacity-building, advocacy and knowledge exchange, follow up and review, and monitor progress on the new global agenda. It will promote an integrated approach in all its activities, in line with the spirit of the new agenda.[185]

The SDG Data Taskforce, chaired by ESCWA, is the successor of the Task Force on Statistical Coordination. The goal of the SDG Data Taskforce is to develop a strategy for reporting on the SDGs, by coordinating and harmonizing the data generated by all parties reporting on the SDGs and other relevant internationally endorsed frameworks. Coordination efforts, with respect to SDG data and indicators, therefore aim to avoid the failures of the MDG framework, and improve the quality of data (and ultimately of reports and studies based on such data). The Working Group aims to achieve broad consensus on the modalities of producing SDG-related data and indicators, which should include statistical components of United Nations agencies, members of the Regional Coordination Mechanism, national statistical offices, and other regional and subregional statistical agencies.[186]

The **Network on Drought Management for the Near East, Mediterranean and Central Asia (NEMEDECA)** was created in 2002 by the International Centre for Agricultural Research in the Dry Areas (ICARDA), FAO and the *Centre International de Hautes Études Agronomiques Méditerranéennes* (CIHEAM). The Network serves to enhance technical cooperation among national, regional and international organizations concerned with drought in the region. The Network's objectives include promoting risk, vulnerability and impact assessments of drought; preparing and creating drought-preparedness and mitigation plans; and promoting cooperation in planning and

implementing drought-mitigation programmes at the national and regional levels. The NEMEDECA network involves nations in the Arabian Peninsula, Central Asia, Europe's Mediterranean Region, North Africa, the Nile Valley and the Red Sea, and West Asia.[187]

These regional initiatives, working groups, organizations, and others illustrate the commonalities and cross-cutting thematic areas found in DRR and CCA, which are conducting risk and vulnerability assessment; monitoring and climate modelling; facilitating an enabling environment (policy and institutional framework); raising the political profile and stressing the importance of factoring in climate risks into sustainable land-use management and spatial planning; engaging in capacity-building and awareness-raising aimed at different levels, including those of key sectors and policymakers; and integrating CCA, DRR and SDGs into development plans.

These thematic areas reveal the importance and potential of collaboration (as concerns CCA, DRR and SDGs) among scientists, Governments, the private sector and political groups in the Arab region, on such issues as strengthening science exchange; science-policy dialogue; public-private partnerships (PPP); localizing DRR, CCA and SDG plans and actions; strengthening institutional coordination on DRR, CCA and SDGs at all governance levels; and developing capacities, awareness and dissemination.

Box 5. Case study: regional coordination on improved water resources management and capacity-building programme

In 2012, the World Bank and the Global Environment Facility (GEF), in collaboration with the United States Agency for International Development (USAID), the National Aeronautics and Space Administration (NASA) and the Arab Water Council (AWC), launched a regional programme that meets the priorities set by some Arab countries, namely, Egypt, Jordan, Lebanon, Morocco and Tunisia, for improving sustainable water resources management and achieving water and food security, through a project on available water resources, drought, crop yield prediction, floods and forest fires (CAPWATER Project). The programme's objective is to improve water resources, agricultural management and planning, within and across beneficiary countries, based on quantitative and spatial-based decision-making tools using new and advanced technologies (including geographic information systems, data assimilation and modelling techniques). It consists of three components: (a) Improvement of local water resources and agriculture management; (b) capacity-building and project management; and (c) regional integration and cooperation.

Through this programme, the National Council for Scientific Research (CNRS) in Lebanon, the Ministry of Water and Irrigation in Jordan, the National Authority for Remote Sensing and Space Sciences (NARSS) in Egypt, the *Centre royal de télédétection spatiale* in Morocco, and the *Centre régional de télédétection des états de l'Afrique du Nord* (CRTEAN) for the benefit of Tunisia, have joined their efforts to implement the CAPWATER Project.

For instance, the Center for Remote Sensing, at the CNRS, considering the enormous capabilities offered by space-related remote sensing techniques, established the Natural Resources Management Platform and Early Warning System (SuNaR). This platform links CNRS researchers with decision-making parties at the Disaster Risk Management Unit at the Prime Minister's Office, which brings together all ministries and institutions concerned. The project highlights the importance of building human and scientific capabilities to contribute to risk prediction and early warning, which will improve national capabilities and thus prevent disasters and reduce damage.

Source: National Council for Scientific Research and others, 2014.

5. Means of Implementation

5. Means of Implementation

International, regional and subregional cooperation is essential in supporting the efforts of governments and local authorities, as well as communities and businesses, to reduce risks of disaster and adapt to climate change. Arab countries facing specific challenges need support to mobilize resources and enhance capabilities through bilateral and multilateral channels, in order to ensure the adequate, sustainable and timely implementation of DRR and CCA strategies and plans. The role of science and technology, finance, and capacity-building in helping to craft evidence-based policy is gaining prominence, with demand growing for multidisciplinary enquiry to address the complex and interrelated problems of climate change, disasters and sustainable development.

The Sendai Framework represents the overall framework for DRR. Developed with an inclusive and participatory approach, it addresses the post-disaster recovery, rehabilitation and reconstruction phases following a disaster, with the aim to reduce disaster risk by “building back better”. The framework calls for empowering local communities, raising awareness on disaster risks, developing partnerships at all levels and providing financing, technology transfer and capacity-building support, in order to reduce risks of disaster and the number of lives and livelihoods lost to hazards.

The Paris Agreement recognizes that developed and developing countries share common climate-related challenges, but have different abilities to adapt to climate change. The process focuses on national ownership, and calls for the submission of INDCs. The agreement recognizes the need to enhance the adaptive capacities of developing and most affected countries, strengthen their resilience and reduce their vulnerability to climate change.

A. Science and technology

Science and technology activities are mostly undertaken by national publicly funded institutions, such as national research institutes, academic and research institutions and government agencies. However, regional and international coordination is particularly valuable, in view of the large pool of expertise and financial and technical resources it makes available. Collaboration and partnerships are essential to building capacities in Arab countries and establishing a reliable routine to conduct proper measurements on three different scales, namely, at the regional, national and local levels.

The Sendai Framework emphasizes the importance of technology in its four priorities, in particular in priority 1, “understanding disaster risk”. In this regard, advanced technological equipment is needed to undertake pre-disaster risk assessment. This involves developing databases on disasters and creating a wide range of maps on disaster risk, vulnerabilities and exposure to hazards; using GIS and innovations in information and communications

technology; developing a science-policy interface; and transferring technology from scientific and technological stakeholders to policymakers. The framework also calls for promoting technological innovations and the use of global platforms.[188]

To undertake DRR and vulnerability assessments, systematic research and assessment are needed, as are databases drawing on scientific knowledge concerning the hazards themselves, the exposure and vulnerability of the population and the existing infrastructure, among others. In addition, reliable scientific and technical institutions, and specialized teams of professionals knowledgeable in these areas, are also required. The results of research and assessments can be visualized and communicated via an Internet-accessible map viewer, developed specifically to promote hazard awareness among vulnerable communities. These DRR and vulnerability assessments help decision makers identify areas where negative impacts are likely to be greatest, set realistic risk reduction goals, allocate resources effectively, and formulate decisive actions before, during and after a disaster, in order to save lives, reduce losses and support recovery. Mobilizing scientific and technological efforts on DRR and vulnerability assessments, and more importantly on the impacts of weather-related disasters on key economic sectors, can be promoted and coordinated through global and regional platforms. At the global level, UNISDR has established the Scientific and Technical Advisory Group (STAG). In February 2016, the latter published "The Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030".[189] This roadmap promotes collaboration and partnerships with the science and technology community, at different levels, to support the implementation of the Sendai Framework. In November 2016, the League of Arab States launched the Arab Science and Technology Advisory Group (Arab-STAG) for Disaster Risk Reduction to support coordination at the regional level.

The Sendai Framework recognizes the need to strengthen multi-hazard early warning systems, especially by enhancing hydro-meteorological warning services, along with improving emergency preparedness and response plans and operations, to better prepare for hydro-meteorological and climate-related hazards.[190] It also recognizes the need to develop, periodically update and disseminate risk information to decision makers, the general public and communities at risk; and to systematically evaluate, record, share and publicly account for disaster losses. There is a significant need to support the adoption by Arab countries of early warning systems, remote sensing and hazard maps, which require coordination across governance levels among many different actors and agencies. Coordination is needed between hazard data and forecast, risk information, communication and dissemination mechanisms, and preparedness and early response. This can be achieved at the national level (through national meteorological and hydrological services, disaster risk management units and key ministries), at the regional level (through regional centres and agencies and through UNISDR) and at the international level (through the United Nations, WMO, UNESCO, UNISDR, IFRC, partners and bilateral donors such as the World Bank, USAID, the Japan International Cooperation Agency, the European Union and others).

The Paris Agreement recognizes that the development and transfer of technology are

important for strengthening climate change resilience and reducing GHG emissions.[191] Hence, the role of CTCN, established by UNFCCC, becomes essential, namely, to promote relevant technologies, policies and practices, and facilitate their deployment in developing countries, as a response to national requests. CTCN provides access to a diverse global community of climate technology users, providers and financiers from academia, civil society, finance, the private and public sectors, research entities, and others. As of June 2017, 15 Arab countries had already assigned their national designated entities to coordinate with CTCN.[192]

In the Arab region, ETC, established in 2011, seeks to help member States enhance their capacities to develop national management systems; select, develop, transfer, adapt and apply new technologies; and facilitate technology transfer.[193] ETC could play a role in bridging the gap between CTCN and Arab countries, by helping countries formulate and submit their proposals to CTCN, coordinating with nationally designated entities and promoting regional or subregional projects.

The growing demand to address the complex and interrelated problems of climate change, disasters and sustainable development with a multidisciplinary approach is incentivizing the policy-technology dialogue. United Nations member States have recognized that improving science-policy interface to develop evidence-based policy for DRR would contribute to achieving appropriate disaster and climate change vulnerability assessment integration. This approach will require modifications to research, policy and practice, to enable a better bridging of natural and social science, quantitative and qualitative research.

Furthermore, both policy and practice should aim to better ensure that realistic, scientifically verifiable and participatory indicators, scales, indices and knowledge databases are constructed and developed, incorporating as much location-specific future trend information as possible, for scenarios and simulations that enable forward-looking, local-level, assessment-specific as well as short- and long-term decision-making.

Exchanging best practices and lessons learned among Arab countries, in remote-sensing applications and other areas of research and development and innovation, is essential. UNISDR regularly supports the exchange of good practices and challenges in the region. In fact, the implementation of the Sendai Framework will itself result in successful examples of technological development and transfer applications, as well as in changes in behaviour, and bringing new technology from the research to the operational level. To facilitate this exchange, coordination is pivotal at various levels – between individuals, national and regional institutions, and other key actors. Such coordination would strengthen and promote discussions on the potentials of DRR technologies, and further establish scientific networking among young researchers in the region. It would also provide a venue to bring together young researchers, international experts and regional senior researchers working on topics linking DRR and CCA. Moreover, field activities and interactive discussions with national and local stakeholders working on DRR and CCA would bring additional insight into the promotion of related activities in the region. Regional coordination can be achieved and sustained through systematic coordination between UNISDR's Disaster Risk Reduction Arab States Coordination Network; the League of

Arab States' Committee on Weather, Climate and Hazards Information Management; the United Nations Regional Thematic Working Group on Climate Change; and ESCWA's regional SDG working group, as well as other regional mechanisms and academic and research institutions.

B. Finance

The Sendai Framework allocates one of its four priorities, namely, priority 3, to "investing in DRR for resilience", calling for public and private investments in disaster reduction and prevention. The Framework calls for mobilizing international resources, in particular ODA to developing countries, and promoting disaster risk transfer and insurance.194 Measures for disaster risk prevention and reduction are essential to enhance the economic, social, health and cultural resilience of persons, communities and countries and their assets. Such measures are cost-effective and instrumental to saving lives, preventing and reducing losses, and ensuring effective recovery and rehabilitation. Therefore, there is potential in encouraging regional research and studies on best practices, with regard to the financial instruments used for disaster risk transfer and management.

The Paris Agreement acknowledges that developed countries are responsible for providing the financial resources needed to assist developing countries, with respect to mitigation and adaptation to climate change, based on developing countries' priorities. Developed countries are requested to report on their climate-related financial contributions every two years. The agreement also welcomes voluntary contributions from developing countries.[195] Other related COP decisions have entrusted GCF and GEF with the financial mechanisms of the agreement. COP decisions also reiterate the commitment of developed countries to provide $100 billion per year until 2025, with the aim to increase this amount beyond 2025. These contributions will support developing countries based on their needs and priorities, while trying to balance adaptation and mitigation financing.[196]

Both processes call for the mobilization of financial resources from all sources, public and private, domestic and international, and for the promotion of alternative sources of financing. Arab Governments need to upscale their efforts to mobilize financial resources for CCA and DRR, particularly through the mobilization of domestic resources in the context of the national budget. This would require to develop – with support from regional and international agencies – a financing strategy at the national and local levels for disaster risk recovery and response; and to upscale direct, larger-scale and convergent investments for climate adaptation and risk resiliency, supported by the improved integration of climate and disaster risks into regular planning, financing and execution processes.

Arab countries have yet to explore the full potential of blended finance. With regards to DRR and CCA projects, PPPs and green bonds are the most suitable means of blended finance that can attract large investments and achieve results. These tools make public good attractive for private investors. Climate and disaster prevention projects should benefit from these tools. Returns on investment from these projects are not always attractive for the private sector.

PPPs allow the private sector to finance traditionally government-sponsored projects,

thereby enabling risk sharing and benefiting from the management skills, expertise, innovation and efficiency of the private sector. Under a PPP structure, efficiency gains could increase as a result of competitive pressure on procurement, operation and maintenance costs, when undertaken by private operators. Private-sector actors and other stakeholders can contribute greatly to DRR-relevant decision-making processes at all levels. Furthermore, PPPs and other collaborative forms of engagement can take advantage of private-sector expertise, products and services, particularly at local levels. Investment in infrastructure and urban development projects may be leveraged with private capital so as to accelerate resilience-building efforts. In the Arab region, PPP has not reached its full potential and has so far included only a few climate-related projects, such as the Ouarzazate Solar Power Project in Morocco.

Green bonds, also known as climate bonds, are gaining popularity at the global level. They are capital market debt instruments aimed at raising capital in order to fund green projects, such as renewable energy projects, thus contributing to the implementation of mitigation plans by reducing carbon emissions. In 2015 alone, it was estimated that around $42 billion worth of green bonds were issued, increasing the total of outstanding bonds to $200 billion.[197] Green bonds were initially issued in 2007 and 2008 by sovereign entities and multilateral development banks, including the World Bank and the European Investment Bank. By 2013, corporate entities had joined the market, but Arab countries did not tap into these resources. In March 2017, the National Bank of Abu Dhabi issued the first green bonds in the region, worth $587 million, with a five-years maturity, to be listed in the London Stock Exchange.[198] This transaction seeks to answer the call, made by the United Arab Emirates' Ministry of Climate Change and Environment, for the financial sector to support a climate-resilient inclusive green economy. Another untapped means of financing in the Arab region is the green *sukuk* market. Green *sukuk* are Sharia-compliant bonds, combining the features of green bonds and Islamic finance. The demand and the need for such bonds are increasing.

Both processes call for the mobilization of ODA from regional and international sources, including development partners (such as United Nations agencies), multilateral development banks (such as World Bank, European Investment Bank and African Development Bank), and bilateral funding institutions (such as USAID, GIZ and SIDA). These institutions can provide the required technical and financial support to Arab countries to ensure the effective implementation of the Sendai Framework, the Paris Agreement and SDGs. ODA takes the form of loans and grants made on a concessional basis by countries and multilateral institutions to promote economic development and welfare. Donors have committed since 2002 to provide 0.7 per cent of their national income annually to aid.[199] However, ODA from donors has almost never met the international target. At the global level, ODA witnessed a steady increase between 2002 and 2015, increasing from $55 billion to $174 billion.[200] Funds allocated to energy generation from renewable sources made up between 16 and 36 per cent of funds allocated to the energy sector during this period. The amounts allocated to disaster prevention and preparedness are still very low, but they increased significantly from $1.6 million in 2002 to $1.2 billion in 2015. ODA to Arab countries from all sources witnessed an increase between 2008 and 2013, from $813 million to $1.32 billion.[201]

The Arab region hosts nine national and regional funds that can be approached to support the implementation of DRR and CCA projects, the largest being the Arab Fund for Economic and Social Development, the Kuwait Fund for Arab Economic Development, the Saudi Fund for Development and the Islamic Development Bank. National Governments and decision makers in Arab countries have to be aware of these opportunities. Even though ODA inflows from Arab donors decreased from $389 million to $295 million between 2008 and 2013,[202] Arab funds are still relatively unconditional, when compared to the support of developed countries and multilateral agencies.

The financial mechanisms of the climate change adaptation process offer an opportunity for developing countries to tap into international resources to finance adaptation and mitigation projects. GCF, for example, was established by the UNFCCC in 2013 during COP 16, with headquarters in the Republic of Korea, as the main fund for climate change finance. Developed countries pledged to mobilize $100 billion per year by 2020, to be allocated by the GCF to developing countries. The GCF offers financial assistance to build the capacities of developing countries to access funds – through its readiness programme – and provides direct financing to projects implemented by an accredited entity. As of June 2017, the GCF had raised $10.3 billion to support adaptation and mitigation projects in developing countries. Arab countries are encouraged to take advantage of the GCF's readiness programme, and seek accreditation for national entities to be able to access the fund's portfolio. In April 2017, two projects were approved for co-financing by the GCF, namely the Egypt Renewable Energy Financing Framework ($1 billion project) and Morocco's Saïss Water Conservation Project ($220 million project). These have been added to multiple other projects in different countries that were approved in October 2016, including a project for the Development of Argan Orchards in Degraded Environment in Morocco, and.[203]

Insurance has been increasingly advocated as a risk management tool, both by CCA and DRR communities, with recommendations to make use of drought risk insurance indices using seasonal forecasts and climate records, or disaster insurance. Disaster insurance has gained more prominence and popularity, as countries have been moving from post-disaster response to pre-disaster preparation. Different parameters are taken into consideration in such insurance policies. Parametric insurance is one type in which a threshold is determined in the policy; for example, a rainfall threshold.[204] In the Arab region, the uptake and effectiveness of insurance is low, as assets and life insurance are often not favoured, for cultural and religious reasons. Each Arab country has unique risk and vulnerability contexts, and thus the design of insurance services must be context-specific and targeted to particular vulnerable communities. There is a lack of clear assessment and recognition of insurance benefits and costs, in terms of DRR and CCA in existing research. Specifically, there is limited evidence in the Arab region of how current forms of insurance would provide long-term risk reduction. On the contrary, insurance programmes are perceived today as not providing the full potential benefits that risk insurance should offer. However, in 1979, the Islamic Insurance Company was established in the Sudan as the first takaful company. [205] By the mid-1990s, there were seven takaful companies in Bahrain, Jordan, Saudi Arabia, the Sudan and the United Arab Emirates (Dubai). More research is still needed in the Arab region to build on successful examples

and propose tailored insurance scenarios and options responding to various risks and national contexts.[206]

C. Capacity-building

Both the Paris Agreement and the Sendai Framework stress the importance of capacity-building in dealing with climate change issues and disasters, namely, capacity-building in identifying shocks and concerns (anticipatory capacity); capacity-building in responding to events (absorptive capacity); and capacity-building in introducing changes to prevent or lessen future shocks (adaptive capacity).[207] The Paris Agreement pays particular attention to "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change".[208] Meanwhile, the Sendai Framework focuses more on building anticipatory and absorptive capacities. Priority 2 of the Sendai Framework calls for "strengthening disaster risk governance to manage disaster risk", and priority 4 calls for "enhancing disaster preparedness for effective response and to 'build back better' in recovery, rehabilitation and reconstruction".[209]

Capacity-building is a cross-cutting issue between DRR, CCA and sustainable development processes. In capacity-building, identifying stakeholders and development areas is very important. In general, there are several types of capacities, namely, individual capacities (improving the knowledge, skills, attitudes, behaviours and motivations of individuals); organizational capacities (developing management capacities and networks, sharing formal/scientific and non-codified/local knowledge and motivation, responsibilities, and ownership); institutional capacities (developing the regulatory and legal enabling environment for DRR and CCA); technical capacities (developing bio-physical infrastructure); and financial capacities (including incentives, insurance policies and mobilization approaches for public and private funds).

There is a significant need to build the capacities connected to supporting scientific research on risk management, climate change modelling and hydrological modelling in the Arab region. International and regional organizations can play a significant role in mobilizing resources, creating platforms, and exchanging experiences and good practices. There are many academic and research institutions that have significant potential to grow and develop their research portfolios, but this cannot be achieved without regional cooperation, collaboration and support. Linking Arab scientists to global platforms and such scientific networks as CTCN and Climate Outlook Forums, among others, is an important step for capacity-building.

Developing the science-policy interface, and interpreting scientific results to inform policies and enhance resilience in different sectors, is crucial to responding effectively to climate-related hazards. There is a need to provide support – both regionally and internationally – for researchers and scientists in the region, in order to produce consensus-based, user-relevant climate outlook products in real time, to support decision-making processes.

Arab countries need to establish innovative institutional arrangements to develop and define national and regional positions during international negotiations. These arrangements need to be supported with scientific research, and must have the backing

of various national interests in finance, trade, energy, water, poverty reduction and national security, among others. Moreover, synergies, or trade-offs, between different policy objectives need to be defined, in particular between DRR and CCA agendas. There is a need to further develop the Arab Group's capacities in climate change and disaster negotiations, allocate financial resources, and establish a climate change and disaster negotiations team under the umbrella of the League of Arab States. Furthermore, there is a need to build up and strengthen the capacity to identify technology options, make technology choices and operate, maintain and adapt different technologies as appropriate to local and national circumstances.

In addition to this, the Arab region needs capacity-building in its planning processes and practices, for example in the design of settlements, infrastructure, coastal zone development and forest use, in order to achieve sustainable land management, avoid hazardous areas and build safe schools, hospitals and other public facilities.

Governments should raise public awareness on disaster risks and on ways to reduce vulnerability and risks at all levels. Such awareness-raising should focus on the basic concepts of hazard, vulnerability, risk and disaster. This initial step will facilitate the development of policies and the implementation of actions for DRR, as well as the implementation of national and regional policies, strategies and guidelines for mainstreaming DRR in national plans. Public awareness may be raised through educational materials, the organization of community-based or school-based public events on DRR and through social media.

In-depth understanding of the Sendai Framework and the Paris Agreement should be ensured at the local level. The implications, binding and non-binding clauses, need be identified; and action plans need to be developed accordingly. In that regard, the League of Arab States, ESCWA and UNISDR can build the capacities of government officials from Arab countries to negotiate global agendas, understand the implications of these processes and develop national strategies to implement international commitments.

6. Recommendations: Suggested Areas for Improved Policy Coherence across the Disaster Risk Reduction and Climate Change Adaptation Communities

6. Recommendations: Suggested Areas for Improved Policy Coherence across the Disaster Risk Reduction and Climate Change Adaptation Communities

Technical capacities, public awareness and political will are key to making DRR and CCA an underlying principle in all relevant development sectors. The following are the recommendations and key messages to enhance policy coherence and inform decision-making in areas related to DRR and CCA:

- **Adopting an intersectoral approach** at the local level to respond to climate change impacts and disaster risks, one that would involve policymakers from various government sectors, representatives from civil society and academic institutions, the private sector and the media. In the Arab region in particular, flash floods are the costliest disasters, both in terms of their impact on lives, and in terms of economic losses. This highlights the need to focus on the local level. Regional and national mapping exercises should not substitute local efforts and maps;
- **Establishing and continually maintaining a single online database** of past, current and planned DRR, CCA and related projects that have multi-country involvement, to enable Arab countries to collect, analyse and keep up-to-date relevant data, to better assess disaster trends and impacts, and to effectively respond to climate-related hazards. The database should include information on tangible benefits and learning tools used to promote joint planning, evaluation assessments and other activities. UNISDR, in collaboration with other regional and international organizations such as the League of Arab States and ESCWA, can play a major role in mobilizing resources to build regional and national capacities in order to establish and maintain the online database. The RICCAR Regional Knowledge Hub can play a central role in reaching this target, and ensuring synergy between DRR and CCA modelling methodologies and approaches. It is also important to develop high resolution localized data sets on economic value and infrastructure, as well as on digital elevation models for flood hazard mapping. Much of this data (especially infrastructure and economic value) is available in many countries at the municipal level and from tax authorities;
- **Developing a comprehensive risk assessment process**, based on both climate change modelling and disaster loss surveys specific to the Arab region and/or Arab countries, in order to advance regional/national development goals and objectives, and help the national institutions

concerned develop natural hazard risk maps and conduct scientific assessments;

- **Promoting technological innovations and the use of global platforms**, using GIS and innovations in information and communications technology, and developing a science-policy interface to move from modelling and impact assessment to the formulation of national strategies across sectors. In addition, transferring technological approaches from scientific stakeholders to policymakers, on climate change and natural disasters information collection and dissemination, is highly desirable;
- **Making the best use of global platforms while formulating and submitting proposals** to, for instance, CTCN, in order to benefit from technology transfer, and adapt and apply technologies in DRR (for instance, the establishment of early warning systems for various hazards), climate change adaptation and mitigation projects;
- **Establishing regional scientific platforms to jointly address the issues of CCA and DRR**, including sustainable development, water, energy, environment and natural resource policy frameworks, which are currently under development by UNISDR. Such platforms can facilitate the elaboration of outputs and the exploration of synergies, to develop regional policies, action plans and programmes focused on building resilience to disasters in vulnerable areas in the face of climate change. One of the recommendations of the Doha Declaration for the Fifth Global Platform for Disaster Risk Reduction (2017) was that every Arab country should assign a representative (a national academic institution) to the Arab-STAG;
- **Developing a DRR and CCA regional comprehensive action plan (2018-2020)** that would aim to integrate CCA and DRR into national and sectoral plans and policies; prepare more efficient responses through better risk assessment and material coordination; define standards to support risk reduction; enhance and streamline investments in risk reduction, particularly in flood prevention, integrated drought management, critical infrastructure protection and business continuity management; improve information and knowledge-sharing in DRR; and provide opportunities for collaboration within the region, to address transboundary concerns, pool expertise in technical support capacity, promote common standards for DRR within CCA, address knowledge-sharing and research, provide basic risk knowledge for all, and develop mechanisms for monitoring progress;
- **Mainstreaming gender into disaster risk assessments and climate-related policies** by increasing collaboration between different institutions and promoting the exchange of ideas between DRR and CCA stakeholders and existing gender equity mechanisms and women's councils at the regional and national levels;
- **Clearly identifying roles and responsibilities** with respect to risk assessment, risk management and the implementation of DRR and CCA policies and actions, and enhancing governance;
- **Supporting countries in the adoption of remote-sensing techniques for the development of hazard and risk maps** and early warning systems at large, which requires coordination across governance levels among different actors and agencies, by promoting coordination between hazard

data and forecast, risk information, communication and dissemination mechanisms, and preparedness and early response;

- **Mobilizing financial resources from all sources**, public and private, domestic and international, and promoting alternative sources of financing. This can be achieved by developing a financing strategy**,** at the national and local levels, for disaster risk recovery and response, and integrating climate and disaster risks into regular planning, financing and execution processes; and by exploring the potential of disaster insurance and conducting an assessment of the benefits and costs of insurance in the fields of DRR and CCA;
- **Calling upon international and regional support** to mobilize resources to help national and local governments develop tailored financing mechanisms that can respond to national needs and specificities;
- **Exploring the full potential of blended finance**, in particular PPPs and green bonds for DRR and CCA projects. Moreover, there is a need to mobilize ODA from regional and international sources, including development partners, and to increase the funds allocated to disaster prevention and preparedness.

Arab countries are also encouraged to take advantage of the GCF's readiness programme, and seek accreditation for national entities to be able to access the fund's portfolio;

- **Supporting the efforts of the League of Arab States and its capacity** to implement the Sendai Framework and the Arab Strategy for Disaster Risk Reduction (2015-2030);
- **Enhancing public awareness of disaster risks, and of ways to reduce vulnerability and risks at all levels and to build resilience**. This can be achieved by improving the availability, accuracy and accessibility of information through knowledge-sharing, advocacy, research and training; by making information on risk accessible to all stakeholders through educational material, curricula, and public awareness and advocacy campaigns; and by developing regional, national, and local early-warning systems and networks, as well as effective dissemination mechanisms;
- **Developing capacities** to deal with climate change impacts and disasters in the Arab region, supporting scientific research and developing negotiation capabilities in global meetings and events.

Bibliography

Abu Awad, Abdel Qader, and others (2010). Disaster risk reduction and climate change adaptation workshop, Report. Amman: International Federation of Red Cross and Red Crescent Societies. Available at http://climatecentre.org/downloads/files/reports/DRR%20and%20CCA%201-5%20August%202010%20workshop%20report.pdf.

Adger, W. Neil (1999). Social vulnerability to climate change and extremes in coastal Vietnam. *World Development*, vol. 27, No. 3 (February), pp. 249-269.

Adger, W. Neil, and others (2007). Assessment of adaptation practices, options, constraints and capacity. In *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Martin L. Parry and others, eds. Cambridge: Cambridge University Press. Available at www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf.

Allen Consulting Group (2005). *Climate Change Risk and Vulnerability: Promoting an Efficient Adaptation in Australia, Final Report*. Canberra: Australian Greenhouse Office, Department of the Environment and Heritage.

Arab Development Portal (2017). ADP Database. Available at http://arabdevelopmentportal.com/data. Accessed on 22 May 2017.

Arora, Rachna, and others (2015). Climate Resilient Disaster Risk Reduction (CRDRR): mainstreaming climate change adaptation and DRR in local planning: experiences and approaches from two Indian coastal states, the state of DRR at the local level: A 2015 report on the patterns of disaster risk reduction actions at local level. Geneva: United Nations Office for Disaster Risk Reduction. Available at www.unisdr.org/campaign/resilientcities/assets/documents/privatepages/Climate%20Resilient%20Disaster%20Risk%20Reduction%20(CRDRR)%20Mainstreaming%20Climate%20Change.pdf.

Bruce, James P., I.D. Mark Egener, and David Noble (2006). *Adapting to Climate Change: A Risk-Based Guide for Ontario Municipalities*. Ontario. Available at www.coastalchange.ca/download_files/external_reports/Bruce_(2006)_AdaptingtoClimateChange_ARisk-basedGuideforONMunicipalities.pdf.

Caribbean Disaster Emergency Response Agency (CDERA) (2009). The integration of disaster risk reduction and climate change adaptation in the CDERA participating states, Nineteenth meeting, 14-15 May. Available at www.cdema.org/bm2009/BM09-19-8.6_Discussion_Paper_on_Integration_of_DRR_and_CCA_for_the_CDERA_PS.pdf.

Center for International Climate and Environmental Research (CICERO) (2008). Many strong voices: outline for an assessment project design. CICERO Report, 2008:05. Oslo. Available at https://brage.bibsys.no/xmlui/bitstream/handle/11250/191954/CICERO_Report_2008-05.pdf?sequence=1&isAllowed=y.

Climate Bonds Initiative (2018). Explaining green bonds. Available at www.climatebonds.net/market/explaining-green-bonds. Accessed on 20 May 2018.

Climateprediction.net (2018). Climate Science, Regional Climate Models. Available at www.climateprediction.net/climate-science/climate-modelling/regional-models/. Accessed on 25 May 2018.

Coppola, Damon P. (2015). *Introduction to International Disaster Management*. Oxford: Butterworth-Heinemann.

Davies, Mark, Katy Oswald, and Tom Mitchell (2009). Climate change adaptation, disaster risk reduction and social protection. In *Promoting Pro-Poor Growth: Social Protection*. Paris: Organisation for Economic Co-operation and Development.

Davoudi, Simin (2012). Resilience: A Bridging concept or a dead end? *Planning Theory and Practice*, vol. 13, No. 2, pp. 299-307 (June).

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (2013). *Mainstreaming Climate Change Adaptation: In National Policies, Strategies and Action Plans, Egypt*. Bonn.

_____ (2014). *A Framework for Climate Change Vulnerability Assessments*. Bonn.

Dickson, Eric, and others (2012). Urban risk assessments: understanding disaster and climate risk in cities. Urban Development Series, No. 70982. Washington, D.C.: World Bank. Available at http://documents.worldbank.org/curated/en/659161468182066104/pdf/709820PUB0EPI0067926B09780821389621.pdf.

El-Raey, Mohamed (2009). Impact of climate change: vulnerability and adaptation: coastal areas. In *Arab Environment: Climate Change – Impact of Climate Change on Arab Countries*, Mostafa K. Tolba and Najib W. Saab, eds. Beirut: Arab Forum for Environment and Development.

Environmental Integrity Group (EIG) (2016). Gender and climate change. New York: United Nations Framework Convention on Climate Change. Available at www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/189_278_131169909431888382-EIG%20submission_gender%20and%20climate%20change%20final%20clean.pdf.

European Commission (2010). Risk assessment and mapping guidelines for disaster management. Commission Staff Working Paper. Brussels. Available at https://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf.

_____ (2016). Action plan on the Sendai framework for disaster risk reduction 2015-2030: A disaster risk-informed approach for all EU policies. Commission Staff Working Document. Available at http://data.consilium.europa.eu/doc/document/ST-10415-2016-REV-1/en/pdf.

Ferris, Elizabeth, and Daniel Petz (2013). *In the Neighborhood: The Growing Role of Regional Organizations in Disaster Risk Management*. Washington, D.C.: The Brookings Institution.

Forino, Giuseppe, and others (2014). Disaster risk reduction and climate change adaptation policy in Australia. *Procedia Economics and Finance*, vol. 18, pp. 473-482.

Forino, Giuseppe, Jason von Meding and Graham J. Brewer (2015). A conceptual governance framework for climate change adaptation and disaster risk reduction integration. *International Journal of Disaster Risk Science*, vol. 6, No. 4 (December), pp. 372-384.

Gama, Stella, Priyanka Teeluck, and Janna Tenzing (2016). Strengthening the lima work programme on gender: perspectives from Malawi and the CBD, October. London: International Institute for Environment and Development. Available at http://pubs.iied.org/pdfs/10165IIED.pdf.

Abdel-Gawad, Shaden (2014). *Third Arab Water Forum: "Together towards a Secure Arab Water", 09-11 December 2014, Final Report*. Cairo: Arab Water Council. Available at http://arabwatercouncil.org/3rdAWF/files/report.pdf.

Abdel Gelil, Ibrahim (2014). History of climate change negotiations and the Arab countries: the case of Egypt. Climate Change and Environment in the Arab World, Research Report, July. Beirut: Issam Fares Institute for Public Policy, and International Affairs. Available at www.aub.edu.lb/ifi/public_policy/climate_change/ifi_cc_texts/Documents/20140723_Abdel_Gelil.pdf.

Gerdes, Ellen (2011). Adaptation to climate change in the water sector in the MENA region (ACCWaM). GIZ Regional Technical Cooperation Programme, Management Report, vol. 1 (November). Bonn: Deutsche Gesellschaft für Internationale Zusammenarbeit. Available at www.accwam.org/Files/ACCWaM_Management_Report_Vol._1.pdf.

Gero, Anna, Kristie Méheux, and Dale Dominey-Howes (2011). Integrating community based disaster risk reduction and climate change adaptation: examples from the Pacific. *Natural Hazards and Earth System Sciences*, vol. 11, pp. 101-113.

Global Environment Facility (GEF) (2018). Climate Change Adaptation, Least Developed Countries Fund – LDCF. Available at www.thegef.org/topics/least-developed-countries-fund-ldcf. Accessed on 20 May 2018.

Global Facility for Disaster Reduction and Recovery (GFDRR) (2010). GFDRR Programs: Disaster Risk Reduction Building Resilience in Changing Climate. Washington D.C. Available at http://gfdrr.org/sites/gfdrr/files/publication/GFDRR_Building_Resilience.pdf.

Gonsalves, Julian, and Priyanka Mohan (2011). *Strengthening Resilience in Post-Disaster Situations: Stories, Experience and Lessons from South Asia*. Ottawa: International Development Research Centre.

Green Climate Fund (GCF) (2018). Projects and Programmes Database. Available at www.greenclimate.fund/projects/browse-projects. Accessed on 25 May 2018.

Guild, Robert, and Ikuko Matsumoto (2013). Moving from risk to resilience: sustainable urban development in the Pacific. August. Manila: Asian Development Bank. Available at www.adb.org/sites/default/files/publication/30367/moving-risk-resilience.pdf.

Haddad, Abdul-Majeid (2009). Regional priorities of UN Thematic Working Group on Climate Change, launching of MENA technical assistance programme, 13-14 May. Available at http://siteresources.worldbank.org/INTMENAINFRENCH/Resources/Haddad.pdf.

Hemming, Debbie, and others (2007). *Impacts of Mean Sea-Level Rise Based on Current State-of-the-Art Modeling.* Exeter: Hadley Centre for Climate Prediction and Research.

Hinchberger, Bill (2017). Disaster insurance against climate change attracts African countries. *Africa Renewal,* May-July. Available at www.un.org/africarenewal/magazine/may-july-2017/disaster-insurance-against-climate-change-attracts-african-countries.

Al Hmoudi, Abdulla, and Zeeshan Aziz (2015). A Guideline for implementing major elements of EWS in the Arab Region: case studies in the UAE. In *Disaster Management and Human Health Risk IV*, S.M Sener, C.A. Brebbia and O. Ozcevik, eds. Billerica: WIT Press.

Al Hmoudi, Abdulla, Mohamed El-Raey and Aziz Zeesha (2015). Integrated elements of early warning systems to enhance disaster resilience in the Arab Region. *Journal of Geodesy and Geomatics Engineering*, vol. 2, pp. 73-81.

Huxtable, Josie, and Nguyen Thi Yen (2009). *Mainstreaming Climate Change Adaptation: A Practitioner's Handbook*, 1st ed. Vietnam: CARE International.

Inter-Agency Task Force on Climate Change and Disaster Risk Reduction (2004). Disaster risk reduction tools and methods for climate change adaptation. Geneva: United Nations Office for Disaster Risk Reduction. Available at www.unisdr.org/we/inform/publications/5654.

Intergovernmental Panel on Climate Change (IPCC) (2001). Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change: Glossary of Terms. Geneva. Available at www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=689.

_____ (2007). Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC): Glossary A-D. Geneva. Available at www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html.

_____ (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press.

_____ (2014a). *Climate Change 2014: Synthesis Report - Contribution of Working Groups I, II and III to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC)*, Rajendra K. Pachauri and Leo Meyer, eds. Geneva. Available at www.ipcc.ch/report/ar5/syr/.

_____ (2014b). Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Geneva. Available at www.ipcc.ch/report/ar5/.

International Federation of Red Cross and Red Crescent Societies (IFRC) (2007). Annual Report 2007: Red Cross Red Crescent disaster risk reduction and climate change. Available at www.climatecentre.org/downloads/files/reports/AR%202007%20FINAL%20REPORT.pdf.

Kelman, Ilan (2015). Joint action on climate change: Facts and figures. Science and Development Network (SciDev.Net). Available at www.scidev.net/global/climate-change/feature/joint-action-climate-change-facts-figures.html.

Kelman, Ilan, J.C. Gaillard, and Jessica Mercer (2015). Climate Change's Role in Disaster Risk Reduction's Future: Beyond Vulnerability and Resilience. *International Journal of Disaster Risk Science*, vol. 6, No. 1, pp. 21-27.

Khan, M. Mansoor, and M. Ishaq Bhatti (2008). Islamic banking and finance: on its way to globalization. *Managerial Finance*, vol. 34, No. 10, pp. 708-725. Available at https://doi.org/10.1108/03074350810891029.

Klein, Richard, Robert Nicholls, and Frank Thomalla (2003). Resilience to natural hazards: how useful is this concept? *Global Environmental Change Part B: Environmental Hazards*, vol. 55, Nos. 1-2, pp. 35-45.

Kuchment, Lev S. (2004). The hydrological cycle and human impact on it. In *Water Resources Management*, Arjen Y. Hoekstra and Hubert H.G. Savenije, eds. Oxford: Encyclopedia of Life Support Systems.

League of Arab States (LAS) (2007). The Arab Ministerial Declaration on Climate Change. Cairo. Available at http://css.escwa.org.lb/SDPD/1164/MinisterialdeclarationonCC.pdf.

_____ (2010a). *The Arab Framework Action Plan on Climate Change (2010-2020)*. Cairo. _____ (2010b). *The Arab Strategy for Disaster Risk Reduction 2020*. Cairo.

_____ (2010c). *Arab Strategy for Water Security in the Arab Region: to Meet the Challenges and Future Needs for Sustainable Development – 2010-2030*. Cairo.

League of Arab States, and United Nations Office for Disaster Reduction (UNISDR) (2009). Progress in reducing disaster risk and implementing Hyogo Framework for Action in the Arab Region, executive summary. Cairo; Geneva. Available at www.unisdr.org/files/14463_ImplementationoftheHyogoFrameworkEn.pdf.

_____ (2015). *The Outcomes of the Arab Region Meeting on the Implementation of the Sendai Framework for Disaster Risk Reduction, 8-10 November*. Cairo. Available at www.unisdr.org/files/45951_reportenarabmeetingontheimplementat.pdf.

_____ (2017). Doha Declaration for the 5th Global Platform for Disaster Risk Reduction (Arabic). Available at www.unisdr.org/files/52869_finalamendeddeclarationfinalversion.pdf.

Liang, Xu, and others (1994). A simple hydrologically based model of land surface water and energy fluxes for general circulation models. *Journal of Geophysical Research*, vol. 99, No. D7.

Mabey, Nick, and others (2011). *Degrees of Risk: Defining a Risk Management Framework for Climate Security*. London: Third Generation Environmentalism (E3G).

McClean, Denis (2014). Make women agents for resilience, 16 September. Available at http://reliefweb.int/report/world/make-women-agents-resilience.

McGray, Heather, Anne Hammill, and Rob Bradley (2007). *Weathering the Storm: Options for Framing Adaptation and Development*. Washington, D.C.: World Resources Institute. Available at http://pdf.wri.org/weathering_the_storm.pdf.

Mediterranean Agronomic Institute of Zaragoza (IAMZ) (2018). NEMEDCA Network, Research Networks. Available at www.iamz.ciheam.org/research/networks/nemedca. Accessed on 15 May 2018.

Mirkin, Barry (2010). Population Levels, Trends and policies in the Arab Region: challenges and opportunities. Arab Human Development Report, Research Paper Series. New York: United Nations Development Programme. Available at http://mait.camins.cat/ET2050_library/docs/med/arab_population.pdf.

Mitchell, Tom, and Maarten van Aalst (2008). Convergence of disaster risk reduction and climate change adaptation. London: Department for International Development. Available at www.preventionweb.net/files/7853_ConvergenceofDRRandCCA1.pdf.

Mitchell, Tom, and others (2010). Climate smart disaster risk management. Strengthening Climate Resilience Series. Brighton: Institute of Development Studies. Available at https://assets.publishing.service.gov.uk/media/57a08b3440f0b652dd000b6c/SCR_DRM.pdf.

Mogelgaard, Kathleen, Heather McGray, and Niranjali Manel Amerasinghe (2015). What does the Paris Agreement mean for climate resilience and adaptation? 23 December. Available at www.wri.org/blog/2015/12/what-does-paris-agreement-mean-climate-resilience-and-adaptation.

National Bank of Abu Dhabi (NBAD) (2017). NBAD launches first Green Bond in the Middle East, 30 March. Available at www.nbad.com/en-ae/about-nbad/overview/newsroom/2017/30-03-2017.html.

National Council for Scientific Research (CNRS), and others (2014). Establishment of natural resources management platform and early warning system, 30 September. Beirut. Available at www.rciwrm-awc.org/Files/Meetingen_2014-10-14_02-45-56-250382.pdf.

Nelitz, Marc, Samantha Boardley, and Russell Smith (2013). *Tools for Climate Change Vulnerability Assessments for Watersheds*. Edmonton: Canadian Council of Ministers of the Environment. Available at www.ccme.ca/files/Resources/water/climate_change/pn_1494_vat.pdf.

Nett, Katharina (2016). Financing for resilience: 3 lessons to be learned in climate finance, 5 January. Available at www.climate-diplomacy.org/news/financing-resilience-3-lessons-be-learned-climate-finance.

Noeske, Tiffany, Apiradee Treerutkuarkul, and Leila Uotila (2014). *Asian Disaster Preparedness Center (ADPC): Impact 2013*. Thailand. Available at www.adpc.net/igo/category/ID574/doc/2014-bFVi0M-ADPC-Impact_2013_Web_Version.pdf.

Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR) (2012). Risk Management Process in Climate Change Adaptation. Available at http://climateontario.ca/doc/factsheets/RiskManagmentProcess-Final.pdf.

Organisation for Economic Co-operation and Development (OECD) (2009). *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance*. Paris. Available at www.oecd.org/env/cc/44887764.pdf.

_____ (2018). OECD.Stat, Aid Database. Available at http://stats.oecd.org/Index.aspx?QueryId=58196#. Accessed on 20 May 2018.

Osman-Elasha, Balgis (2010). Climate change adaptation: options and good practices for the Arab Region. Available at www.arabclimateinitiative.org/knowledge/background/Balgis_CC_Adaptation-AG-Clean2.pdf.

Papathoma-Köhle, Maria, Catrin Promper, and Thomas Glade (2016). A common methodology for risk assessment and mapping of climate change related hazards — implications for climate change adaptation policies. *Climate*, vol. 4, No. 1, pp. 1-23.

Penman, Jim, and others (2006). 2006 IPCC guidelines for national greenhouse gas inventories: overview. Geneva: Intergovernmental Panel on Climate Change. Available at www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/0_Overview/V0_1_Overview.pdf.

Peters, Katie, and others (2016). 'Resilience' across the post-2015 frameworks: towards coherence? ODI Working Paper, November. London: Overseas Development Institute. Available at www.odi.org/sites/odi.org.uk/files/resource-documents/11085.pdf.

Prabhakar, S.V.R.K. (2014). Harnessing synergies between climate change adaptation and disaster risk reduction: pertinent issues, success cases and way forward. Hayama, Japan: Institute for Global Environmental Strategies. Available at www.iges.or.jp/isap/2014/PDF/roundtable/Harnessing%20Synergies%20Between%20Climate%20Change%20Adaptation%20and%20Disaster.pdf.

PreventionWeb (2015). Datasets, understanding disaster risk data. Available at www.preventionweb.net/risk/datasets. Accessed on 10 March 2018.

_____ (2018a). Jordan: National Progress Reports. Available at www.preventionweb.net/english/countries/asia/jor/. Accessed on 14 March 2018.

_____ (2018b). Lebanon: National Progress Reports. Available at www.preventionweb.net/english/countries/asia/lbn/?x=6&y=5. Accessed on 14 March 2018.

_____ (2018c). Morocco: National Progress Reports. Available at www.preventionweb.net/english/countries/africa/mar. Accessed on 16 January 2018.

_____ (2018d). State of Palestine: National Progress Reports. Available at www.preventionweb.net/english/countries/asia/pse/. Accessed on 14 March 2018.

_____ (2018e). Tunisia: National Progress Reports. Available at www.preventionweb.net/english/countries/africa/tun/. Accessed on 14 March 2018.

_____ (2018f). Yemen: National Progress Reports. Available at www.preventionweb.net/english/countries/asia/yem/?x=15&y=3. Accessed on 4 January 2018.

Rivera, Claudia (2014). Integrating climate change adaptation into disaster risk reduction in urban contexts: perceptions and practice. PLOS Currents Disasters, 15 January. Available at www.ncbi.nlm.nih.gov/pmc/articles/PMC3893352/#ref34.

Rogelj, Joeri, and others (2016). Paris agreement climate proposals need a boost to keep warming well below 2°C. *Nature*, vol. 534 (June), pp. 631-639.

Saito, Norio (2013). Mainstreaming climate change adaptation in least developed countries in South and Southeast Asia. *Mitigation and Adaptation Strategies for Global Change*, vol. 18, No. 6, pp. 825-849.

Schipper, Lisa (2014). Disasters, climate change and development: Reducing risk by tackling the drivers of vulnerability. Discussion Brief. Stockholm: Stockholm Environment Institute. Available at www.sei.org/mediamanager/documents/Publications/Climate/SEI-DB-2014-Climate-change-DRR.pdf.

Schipper, Lisa, and Mark Pelling (2006). Disaster risk, climate change and international development: Scope for, and challenges to, integration. *Disasters*, vol. 30, No. 1, pp. 19-38.

Schipper, Lisa, and others (2014). Climate change and disaster risk reduction, Background Paper Prepared for the 2015 Global Assessment Report on Disaster Risk Reduction. Stockholm: Stockholm Environment Institute. Available at www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/SEI,%202014.pdf.

Schröter Dagmar, and the ATEAM Consortium (2004). Global change vulnerability — assessing the European human-environment system. Potsdam: Potsdam Institute for Climate Impact Research. Available at https://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/schroeter.pdf.

Shamsuddoha, Md, and others (2013). Establishing links between disaster risk reduction and climate change adaptation in the context of loss and damage: policies and approaches in Bangladesh. Loss and Damage, June. Bangladesh: International Centre for Climate Change and Development. Available at https://assets.publishing.service.gov.uk/media/57a08a3740f0b649740004ae/bangladesh-risk-policy.pdf.

Smith, Timothy F., and others (2010). Towards enhancing adaptive capacity for climate change response in South East Queensland. *The Australasian Journal of Disaster and Trauma Studies*, vol. 2010-1.

Tessema, Selome M. (2011). Hydrological modeling as a tool for sustainable water resources management: a case study of the Awash River Basin, May. Stockholm: Royal Institute of Technology. Available at www.diva-portal.org/smash/get/diva2:416594/FULLTEXT01.pdf.

Thomalla, Frank, and others (2006). Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. *Disasters*, vol. 30, No. 1, pp. 39-48.

Tolba, Mostafa K., and Najib W. Saad (2009). *Arab Environment: Climate Change – Impact of Climate Change on Arab Countries*. Beirut: Arab Forum for Environment and Development.

United Nations (2015a). Addis Ababa Action Agenda of the Third International Conference on Financing for Development. Outcome document adopted at the Third International Conference on Financing for Development and endorsed by the General Assembly, 13-16 July, Addis Ababa. New York.

_____ (2015b). Millennium Development Goals (MDGs). Available at www.un.org/millenniumgoals/. Accessed on 30 May 2018.

_____ (2015c). *Paris Agreement*. Available at http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.

_____ (2015d). Sendai declaration of local and subnational governments: ensuring enhanced resilience to disasters in the urban world, Third United Nations World Conference on Disaster Risk Reduction, 14-18 March, Sendai, Miyagi, Japan. Available at www.uclg.org/sites/default/files/sendai_declaration_lr_governments_0.pdf.

_____ (2015e). Sendai Framework for Disaster Risk Reduction – 2015-2030. Framework adopted at the Third United Nations World Conference on Disaster Risk Reduction, Sendai, Miyagi, Japan, 14-18 March. Available at https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf.

_____ (2018a). Sustainable Development Knowledge Platform, Sustainable Development Goals (SDGs). Available at https://sustainabledevelopment.un.org/?menu=1300. Accessed on 30 May 2018.

_____ (2018b). United Nations Treaty Collection, Chap. XXVII, Environment. Available at https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-7-d&chapter=27&clang=_en.

United Nations Children's Fund (UNICEF) (2011). Middle East and North Africa. UNICEF Humanitarian Action for Children. Available at www.unicef.org/hac2011/files/HAC2011_4pager_MENA_rev1.pdf.

United Nations Department of Humanitarian Affairs (UNDHA) (1994). Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation. World Conference on Natural Disaster Reduction, Yokohama, Japan, 23-27 May. Available at www.unisdr.org/files/8241_doc6841contenido1.pdf.

United Nations Development Programme (UNDP) (2010). *Mapping Climate Change Vulnerability and Impact Scenarios: A Guidebook for Sub-National Planners*. New York.

_____ (2012). Strengthening synergies between governance of disaster risk reduction and climate change adaptation in Jordan with a view to reduce poverty. Framework for Action and 3-Year Action Plan, Final Report. Available at www.undp.org/content/dam/jordan/docs/DRR/Plan_Of_Action.pdf.

_____ (2015). *Human Development Report 2015: Work for Human Development*. New York.

_____ (2018). Goal 5: gender equality. Available at www.undp.org/content/undp/en/home/sustainable-development-goals/goal-5-gender-equality.html.

United Nations Development Programme (UNDP), and Egyptian Cabinet Information and Decision Support Center (IDSC) (2011). *Egypt's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction*. Available at www.climasouth.eu/docs/Adaptation011%20StrategyEgypt.pdf.

United Nations Development Programme (UNDP), and United Nations Environment Programme (UNEP) (2011). *Mainstreaming Climate Change Adaptation into Development Planning: A Guide for Practitioners*. UNDP-UNEP Poverty-Environment Initiative.

United Nations Development Programme Regional Bureau for Arab States (UNDP-RBAS) (2013a). Arab Climate Resilience Initiative. New York. Available at www.arabclimateinitiative.org. Accessed on 10 May 2018.

_____ (2013b). *Water Governance in the Arab Region: Managing Scarcity and Securing the Future*. New York. Available at www.undp.org/content/dam/rbas/doc/Energy%20and%20Environment/Arab_Water_Gov_Report/Arab_Water_Gov_Report_Full_Final_Nov_27.pdf.

United Nations Economic and Social Commission for Western Asia (ESCWA) (2008). Thematic Working Group (TWG) on food security in the Arab Region: terms of reference. Available at www.unescwa.org/sites/www.unescwa.org/files/page_attachments/terms_of_reference.pdf.

_____ (2011). *Assessing the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region: A Methodological Framework for Pursuing an Integrated Assessment*. E/ESCWA/SDPD/2011/1. Beirut.

_____ (2014). Sustainable Development Goals… An Arab Regional Perspective. 17 March. E/ESCWA/SDPD/2014/WG.1/1/Rev.

_____ (2015). *Climate Projections and Extreme Climate Indices for the Arab Region. Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR)*. E/ESCWA/SDPD/2015/Booklet.2. Beirut.

_____ (2017). Regional Cooperation for Climate Change Adaptation in the Arab Region. 6 February. E/ESCWA/SDPD/2017/IG.1/5.

_____ (2018a). 2030 Agenda for Sustainable Development. Available at www.unescwa.org/tags/2030-agenda-sustainable-development. Accessed on 4 June 2018.

_____ (2018b). ESCWA Technology Center. Available at www.unescwa.org/escwa-technology-center. Accessed on 4 June 2018.

_____ (2018c). The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR). Available at www.unescwa.org/climate-change-water-resources-arab-region-riccar. Accessed on 1 June 2018.

_____ (2018d). SDG Data. Available at www.unescwa.org/about-escwa/regional-coordination-mechanism/working-groups/2030-agenda-sustainable-development/sdg. Accessed on 15 May 2018.

United Nations Economic and Social Commission for Western Asia (ESCWA), and others (2017a). *Arab Climate Change Assessment Report: Main Report*, E/ESCWA/SDPD/2017/RICCAR/Report. Beirut.

_____ (2017b). *Arab Climate Change Assessment Report: Technical Annex*. E/ESCWA/SDPD/2017/RICCAR/Report/Annex. Beirut.

United Nations Environment Programme (UNEP), and Mediterranean Action Plan (MAP) (2017). *Regional Climate Change Adaptation Framework for the Mediterranean Marine and Coastal Areas*. Athens. Available at http://wedocs.unep.org/bitstream/id/56761/rccaf_eng.pdf.

United Nations Framework Convention on Climate Change (UNFCCC) (n.d.). The nine work areas of the Nairobi work programme. Bonn. Available at https://unfccc.int/resource/docs/publications/09_nwp_wp_9areas_en.pdf.

_____ (2006). *United Nations Framework Convention on Climate Change: Handbook*. Bonn. Available at https://unfccc.int/resource/docs/publications/handbook.pdf.

_____ (2007a). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*. Bonn. Available at https://unfccc.int/resource/docs/publications/impacts.pdf.

_____ (2007b). The Nairobi work programme: on impacts, vulnerability and adaptation to climate change. Booklet. Bonn. Available at https://unfccc.int/files/adaptation/sbsta_agenda_item_adaptation/application/pdf/nwp_brochure.pdf.

_____ (2008) Integrating socio-economic information in assessment of impact, vulnerability and adaptation to climate change. Background Paper. Port of Spain, 10-13 March. Available at https://unfccc.int/files/adaptation/sbsta_agenda_item_adaptation/application/pdf/background_paper_tt_web.pdf.

_____ (2009). National Adaptation Programmes of Action (NAPAs). Available at https://unfccc.int/topics/resilience/workstreams/national-adaptation-programmes-of-action/introduction?middle=j. Accessed on 4 June 2018.

_____ (2011). Report of the Conference of the Parties on its Sixteenth Session, Held in Cancun from 29 November to 10 December 2010: Addendum. 15 March. FCCC/CP/2010/7/Add.1.

_____ (2012). Report of the Conference of the Parties on it Seventeenth Session, Held in Durban from 28 November to 11 December 2011: Addendum. 15 March. FCCC/CP/2011/9/Add.1.

_____ (2013). Report of the Conference of the Parties on its Eighteenth Session, Held in Doha from 26 November to 8 December 2012. 28 February. FCCC/CP/2012/8.

_____ (2014a). Lima work programme on gender. December. Available at https://unfccc.int/files/meetings/lima_dec_2014/decisions/application/pdf/auv_cop20_gender.pdf.

_____ (2014b). Report of the Conference of the Parties on its Nineteenth Session, Held in Warsaw from 11 to 23 November 2013: Addendum. 31 January. FCCC/CP/2013/10/Add.1.

_____ (2015). Adoption of the Paris Agreement. Conference of the Parties, Twenty-First Session, Paris, 30 November to 10 December 2015. 12 December. FCCC/CP/2015/L.9/Rev.1.

_____ (2016). Paris Agreement: moving forward on national climate action plans, 9 March. Available at https://cop23.unfccc.int/news/paris-agreement-moving-forward-on-national-climate-action-plans.

_____ (2018a). Adaptation. Available at https://unfccc.int/topics. Accessed on 4 June 2018.

_____ (2018b). Cancun Adaptation Framework. Available at https://unfccc.int/adaptation/items/5852.php.

_____ (2018c). INDCs as Communicated by Parties. Available at www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx. Accessed on 4 June 2018.

_____ (2018d). Least Developed Countries (LDC) Fund. Available at https://unfccc.int/process/bodies/constituted-bodies/least-developed-countries-expert-group-leg/ldc-portal/least-developed-countries-ldc-fund.

_____ (2018e). Overview – Loss and Damage Workstream, multilateral process milestones and technical work on loss and damage. Available at https://unfccc.int/topics/resilience/workstreams/loss-and-damage/overview-of-the-multilateral-process-milestones-and-technical-work-on-loss-and-damage. Accessed on 4 June 2018.

_____ (2018f). Paris Agreement – Status of Ratification. Available at https://unfccc.int/process/the-paris-agreement/status-of-ratification. Accessed on 4 June 2018.

United Nations General Assembly (2015). Transforming our World: The 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly, Seventieth session. 25 September. A/RES/70/1.

_____ (2016). Outcome of the World Humanitarian Summit. Report of the Secretary-General. Seventy-first session. 23 August. A/71/353.

United Nations Human Settlements Programme (UN-Habitat) (2012). *The State of Arab Cities 2012: Challenges of Urban Transition*, 2nd ed. Nairobi.

United Nations Office for Disaster Risk Reduction (UNISDR) (2007). *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters - Extract from the final report of the World Conference on Disaster Reduction* (A/CONF.206/6). Geneva. Available at http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf.

_____ (2008a). Climate change and disaster risk reduction. Briefing Note 01 (September). Geneva. Available at www.unisdr.org/files/4146_ClimateChangeDRR.pdf.

_____ (2008b). Regional synthesis report on HFA implementation in Asia and Pacific. Interim Report: July 2007 – September 2008. Bangkok. Available at www.preventionweb.net/english/hyogo/gar/background-papers/documents/Chap5/Regional-reports/Asia-Pacific/UNISDR-ASIA-regional-report-on-progress.pdf.

_____ (2009). *2009 UNISDR Terminology on Disaster Risk Reduction*. Geneva. Available at www.unisdr.org/we/inform/publications/7817.

_____ (2010). *United Nations International Strategy for Disaster Risk Reduction (UNISDR) Secretariat Evaluation: Final Report*. Geneva. Available at www.unisdr.org/files/12659_UNISDRevaluation2009finalreport.pdf.

_____ (2011a). *2011 Global Assessment Report (GAR) on Disaster Risk Reduction: Revealing Risk, Redefining Development*. Geneva.

_____ (2011b). *At the Crossroads: Climate Change Adaptation and Disaster Risk Reduction in Asia and the Pacific - A Review of the Region's Institutional and Policy Landscape*. Geneva.

_____ (2012). *Making Lebanon Resilient – Achieving Disaster Risk Reduction in the Arab States: Good Practice Country Brief*. Cairo: UNISDR Regional Office for the Arab States.

_____ (2013a). Aqaba declaration on disaster risk reduction in cities, Aqaba. 21 March. Available at www.preventionweb.net/files/31093_aqabadeclarationenglishfinaldraft.pdf.

_____ (2013b). Egypt Risk Profile. Available at www.unisdr.org/partners/countries/egy. Accessed on 9 May 2018.

_____ (2013c). *The First Arab Conference for Disaster Risk Reduction: Executive Report, 19-21 March*. Aqaba. Available at www.preventionweb.net/files/32958_arabconferencereportfinal.pdf.

_____ (2013d). *Global Assessment Report (GAR) on Disaster Risk Reduction: From Shared Risk to Shared Value - The Business Case for Disaster Risk Reduction*. Geneva.

_____ (2013e). *Implementation of the Hyogo Framework for Action: Summary of reports 2007-2013*. Geneva.

_____ (2013f). *Making Algeria Resilient – Achieving Disaster Risk Reduction in the Arab States: Good Practice Country Brief*. Cairo: UNISDR Regional Office for the Arab States

_____ (2013g). Overview of disaster risk reduction in the Arab Region. Factsheet. Geneva. Available at www.preventionweb.net/files/31693_drrfactsheetarabregionfinal.pdf.

_____ (2014a). Sharm El Sheikh declaration on disaster risk reduction. Adopted at the Second Arab Conference on Disaster Risk Reduction, 14-16 September. Sharm El Sheikh, Egypt. Available at www.unisdr.org/files/42726_42726sharmdeclarationpublicationfin.pdf.

_____ (2014b). Thematic note on DRR terminology and concepts, prepared for the DRR Swiss NGO Platform, 9 September 2011. Available at www.drrplatform.org/images/DocPub/TerminologyConcepts.pdf.

_____ (2015a). Global Assessment Report (GAR) Database. Available at www.desinventar.net/DesInventar/main.jsp?countrycode=g15. Accessed on 1 June 2018.

_____ (2015b). *Global Assessment Report (GAR) on Disaster Risk Reduction 2015 – Making Development Sustainable: The Future of Disaster Risk Management*. Geneva.

_____ (2015c). *Implementing the Hyogo Framework for Action in the Arab Region: Executive Summary – Regional Synthesis Report 2005–2015*. Geneva.

_____ (2015d). *Reading the Sendai Framework for Disaster Risk Reduction 2015-2030*. Geneva.

_____ (2015e). *Science is Used for Disaster Risk Reduction: UNISDR Science and Technical Advisory Group (STAG) Report*. Geneva.

_____ (2016a). Making Cities Resilient: My City is Getting Ready – about the Campaign. Available at www.unisdr.org/campaign/resilientcities/home/about. Accessed on 20 May 2018.

_____ (2016b). The science and technology roadmap to support the implementation of the Sendai framework for disaster risk reduction 2015-2030, 29 February. Available at www.unisdr.org/files/45270_unisdrscienceandtechnologyroadmap.pdf.

_____ (2017a). *Disaster Loss Data and Linkage to Climate Change Impacts for the Arab Region. RICCAR Technical Report*, E/ESCWA/SDPD/2017/RICCAR/Technical Report.3. Beirut: United Nations Economic and Social Commission for Western Asia.

_____ (2017b). Third Arab Preparatory Conference on Disaster Risk Reduction, 30 April – 1 May. Doha. Available at www.preventionweb.net/events/view/52869?id=52869.

_____ (2018a). The Global Platform for Disaster Risk Reduction. Available at www.unisdr.org/we/coordinate/global-platform. Accessed on 15 May 2018.

_____ (2018b). Making Cities Resilient. Available at www.unisdr.org/we/campaign/cities. Accessed on 10 May 2018.

_____ (2018c). National Platforms. Available at www.unisdr.org/we/coordinate/national-platforms.

_____ (2018d). Terminology. Available at www.unisdr.org/we/inform/terminology.

United Nations Office for Disaster Risk Reduction (UNISDR), and Arab Network for Environment and Development (RAED) (2011). *An Overview of Environment and Disaster Risk Reduction in the Arab Region: A Community Perspective*. Geneva. Available at www.unisdr.org/we/inform/publications/23612.

United Nations Office for Disaster Risk Reduction (UNISDR), and United Nations Development Programme (UNDP) (2012). *Disaster Risk Reduction and Climate Change Adaptation in the Pacific: An Institutional and Policy Analysis*. Geneva. Available at www.unisdr.org/files/26725_26725drrandccainthepacificaninstitu.pdf.

Venton, Paul, and Sarah La Trobe (2008). *Linking Climate Change Adaptation and Disaster Risk Reduction*. Teddington: Tearfund. Available at www.preventionweb.net/files/3007_CCAandDRRweb.pdf.

Verner, Dorte (2012). *Adaptation to A Changing Climate in the Arab Countries: A Case for Adaptation Governance in Building Climate Resilience*. MENA Development Report. Washington, D.C.: World Bank.

Wahlstrom, Margareta (2012). Gender and a leading role for women in disaster risk reduction. United Nations Office for Disaster Risk Reduction. Available at www.unisdr.org/we/advocate/gender.

Wisner, Ben, and others (2004). *At Risk: Natural Hazards, People's Vulnerability and Disasters*. London: Routledge.

World Bank (2009). Poverty and climate change: reducing the vulnerability of the poor through adaptation. Working Paper No. 52176. Washington, D.C.

_____ (2010). *Poor Places, Thriving People: How the Middle East and North Africa Can Rise Above Spatial Disparities - Overview*. MENA Development Report. Washington, D.C.

_____ (2011). Climate Disaster Risk Management in Arab Countries. Washington, D.C. Available at http://siteresources.worldbank.org/INTMENA/Resources/mini-chapter_Adaptation_to_a_Changing_Climate_in_the_Arab_Countries_Draft_for_comments.pdf.

_____ (2014a). *Natural Disasters in the Middle East and North Africa: A regional Overview*. Washington, D.C.

_____ (2014b). *Turn Down the Heat: Confronting the New Climate Normal*. Washington, D.C.

_____ (2014c). Water in the Arab world: from droughts to flood, building resilience against extremes, 21 March. Available at www.worldbank.org/en/news/feature/2014/03/20/floods-and-droughts-in-mena.

World Meteorological Organization (WMO) (2015). Towards substantially reduced disaster risk in 2030. *WMO Bulletin*, vol. 64, No. 2. Available at https://public.wmo.int/en/resources/bulletin/towards-substantially-reduced-disaster-risk-2030-0.

_____ (2016). League of Arab states addresses climate-related hazards, 4 March. Available at https://public.wmo.int/en/media/news/league-of-arab-states-addresses-climate-related-hazards.

World Resources Institute (WRI) (2018). What is an INDC? Available at www.wri.org/indc-definition. Accessed on 4 June 2018.

World Vision (2017). Disaster Risk Reduction Toolkit: DRR and CCA Integration into ADP. Available at www.wvi.ngo/disaster-risk-reduction-and-community-resilience/disaster-risk-reduction-toolkit. Accessed on 4 June 2018.

Al-Zu'bi, Maha (2016). Jordan's climate change governance framework: from silos to an intersectoral approach. *Environment Systems and Decisions*, vol. 36, No. 3, pp. 277-301.

Endnotes

Chapter 1

1. Wisner and others, 2004.
2. Coppola, 2015.
3. United Nations Department of Humanitarian Affairs, 1994.
4. United Nations Office for Disaster Risk Reduction, 2007.
5. Coppola, 2015.
6. United Nations, 2015e.
7. Center for International Climate and Environmental Research, 2008; United Nations Framework Convention on Climate Change, 2006.
8. Penman and others, 2006.
9. Global Environment Facility, 2018.
10. McGray, Hammill and Bradley, 2007.
11. Penman and others, 2006; McGray, Hammill and Bradley, 2007.
12. Penman and others, 2006.
13. United Nations, 2015c.
14. Mogelgaard, McGray and Amerasinghe, 2015.
15. Arora and others, 2015.
16. UNISDR, 2009.
17. UNISDR and UNDP, 2012.
18. United Nations, 2015e.
19. Shamsuddoha and others, 2013.
20. Intergovernmental Panel on Climate Change, 2007.
21. Guild and Matsumoto, 2013.
22. Gonsalves and Mohan, 2011.
23. Papathoma-Köhle, Promper and Glade, 2016.
24. Adger and others, 2007.
25. Papathoma-Köhle, Promper and Glade, 2016.
26. Noeske, Treerutkuarkul and Uotila, 2014.
27. Schipper, 2014.
28. Prabhakar, 2014.
29. Kelman, Gaillard and Mercer, 2015; Caribbean Disaster Emergency Response Agency, 2009.
30. Peters and others, 2016.
31. Davoudi, 2012.
32. UNFCCC, 2015.
33. UNISDR, 2009.
34. Klein, Nicholls and Thomalla, 2003.
35. Peters and others, 2016.

36. UNFCCC, 2015.
37. United Nations, 2015d.
38. UNISDR, 2016a.
39. UNFCCC, 2015; United Nations, 2015e.
40. United Nations General Assembly, 2015.
41. Thomalla and others, 2006.
42. Deutsche Gesellschaft für Internationale Zusammenarbeit, 2014; UNFCCC, 2007a.
43. Bruce, Egener and Noble, 2006.
44. Mabey and others, 2011.
45. Ontario Centre for Climate Impacts and Adaptation Resources, 2012.
46. Bruce, Egener and Noble, 2006.
47. UNFCCC, 2007a.
48. United Nations Development Programme, 2010.
49. Climateprediction.net, 2018.
50. Tessema, 2011.
51. Inter-Agency Task Force on Climate Change and Disaster Risk Reduction, 2004.
52. PreventionWeb, 2015.
53. World Vision, 2017.
54. UNISDR, 2009.
55. World Vision, 2017.
56. European Commission, 2010.
57. Prabhakar, 2014.
58. UNFCCC, 2018e.
59. UNFCCC, 2011.
60. UNFCCC, 2012.
61. UNFCCC, 2013.
62. UNFCCC, 2014b.
63. UNISDR, 2007.
64. UNISDR, 2018a.
65. IPCC, 2012.
66. UNISDR, 2013e.
67. IPCC, 2014a.
68. International Federation of Red Cross and Red Crescent Societies, 2007.
69. Mitchell and van Aalst, 2008; Huxtable and Thi Yen, 2009; Organisation for Economic Co-operation and Development, 2009; UNDP and UNEP, 2011; Saito, 2013.
70 UNFCCC, n.d.
71. UNFCCC, 2007b.
72. Rivera, 2014.

Chapter 2

73. UNDP, 2015.
74. United Nations Human Settlements Programme, 2012.
75. World Bank, 2010.

76. Mirkin, 2010.
77. UN-Habitat, 2012.
78. ESCWA and others, 2017a.
79. Arab Development Portal, 2017.
80. World Bank, 2014c.
81. UNFCCC, 2007a; World Bank, 2009.
82. United Nations Development Programme Regional Bureau for Arab States, 2013b.
83. Intergovernmental Panel on Climate Change, 2014b.
84. ESCWA and others, 2017a
85. World Bank, 2014b.
86. El-Raey, 2009.
87. UNISDR, 2013g.
88. World Bank, 2014a, 2011.
89. UNISDR, 2008a.
90. UNISDR, 2010.
91. IPCC, 2012.
92. Tolba and Saad, 2009.
93. UNISDR, 2011a, 2013d.
94. IPCC, 2012.
95. Adger, 1999.
96. Schipper and Pelling, 2006; Mitchell and van Aalst, 2008; Mitchell and others, 2010.
97. World Bank, 2014c.
98. World Bank, 2014a.
99. Ibid.
100. RICCAR is implemented through a collaborative partnership involving the League of Arab States, the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD), the United Nations Economic and Social Commission for Western Asia (ESCWA), the Food and Agriculture Organization of the United Nations (FAO), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Swedish Meteorological and Hydrological Institute (SMHI), the Cairo Office of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme Regional Office for West Asia (UNEP/ROWA), the United Nations Office for Disaster Risk Reduction (UNISDR), the United Nations University Institute for Water, Environment and Health (UNU-INWEH), and the World Meteorological Organization (WMO). This initiative also receives the financial support of the Swedish International Development Cooperation Agency (SIDA) and the German Federal Ministry for Economic Cooperation and Development (BMZ).
101. ESCWA, 2014.
102. UNISDR, 2007.
103. League of Arab States and United Nations Office for Disaster Reduction, 2009.
104. UNISDR, 2014a.
105. UNISDR, 2015c.
106. United Nations, 2015e.
107. World Meteorological Organization, 2015.
108. United Nations, 2015e.
109. League of Arab States, 2010b.
110. Ibid.

111. Ferris and Petz, 2013.
112. League of Arab States and UNISDR, 2015.
113. UNISDR, 2017b.
114. LAS and UNISDR, 2017.
115. Rogelj and others, 2016.
116. Nett, 2016.
117. UNFCCC, 2018f.
118. UNFCCC, 2018c.
119. Haddad, 2009.
120. League of Arab States, 2010a.
121. Abdel Gelil, 2014; Al-Zu'bi, 2016.
122. League of Arab States, 2007.
123. League of Arab States, 2010c.

Chapter 3

124. ESCWA, 2015.
125. Hemming and others, 2007.
126. ESCWA, 2015.
127. For more details, see ESCWA and others, 2017a.
128. Liang and others, 1994.
129. Adger and others, 2007.
130. UNISDR, 2017a.
131. UNISDR, 2015b.
132. UNISDR, 2015a.
133. Further details about the global initiative for disaster data collection, including the DesInventar methodology, are available at www.desinventar.net/index_www.html.
134. UNISDR, 2017a.
135. PreventionWeb, 2018a.
136. UNISDR, 2012.
137. PreventionWeb, 2018b.
138. PreventionWeb, 2018d.
139. PreventionWeb, 2018e.
140. PreventionWeb, 2018f.
141. Maximum annual number of consecutive days with daily precipitation ≥1 mm.
142. UNISDR, 2017a.

Chapter 4

143. UNISDR, 2011b.
144. European Commission, 2016.
145. UNFCCC, 2016.
146. United Nations, 2015b.
147. United Nations General Assembly, 2015.
148. United Nations, 2018a.

149. United Nations, 2015a.
150. United Nations General Assembly, 2016.
151. European Commission, 2016.
152. IPCC, 2012.
153. Wahlstrom, 2012.
154. United Nations, 2015e.
155. Ibid.
156. Gama, Teeluck and Tenzing, 2016.
157. UNFCCC, 2014a.
158. Environmental Integrity Group, 2016.
159. UNDP, 2018.
160. United Nations, 2018a.
161. League of Arab States, 2010c.
162. Abdel-Gawad, 2014.
163. UNISDR, 2013g.
164. UNISDR and UNDP, 2012.
165. IPCC, 2012.
166. UNISDR, 2013c.
167. UNFCCC, 2009.
168. UNFCCC, 2018d.
169. Osman-Elasha, 2010.
170. GIZ, 2013.
171. UNISDR, 2018c.
172. Ibid.
173. McClean, 2014.
174. Ibid.
175. Abu Awad and others, 2010.
176. United Nations Children's Fund, 2011.
177. UNISDR, 2018c.
178. UNISDR, 2013g.
179 WMO, 2016.
180. Ibid.
181. UNISDR, 2018b.
182. Haddad, 2009; Wisner and others, 2004.
183. Gerdes, 2011.
184. United Nations Environment Programme and Mediterranean Action Plan, 2017.
185. ESCWA, 2018a.
186. ESCWA, 2018d.
187. Mediterranean Agronomic Institute of Zaragoza, 2018.

Chapter 5

188. United Nations, 2015e.
189. UNISDR, 2016b.

190. United Nations, 2015e.
191. United Nations, 2015c.
192. https://www.ctc-n.org/.
193. ESCWA, 2018b.
194. United Nations, 2015e.
195. United Nations, 2015c.
196. UNFCCC, 2015.
197. Climate Bonds Initiative, 2018.
198. National Bank of Abu Dhabi, 2017.
199. Developed countries have committed, since the first International Conference on Financing for Development (Monterrey, 2002), to providing 0.7 per cent of their gross national income annually as ODA. This commitment was reiterated at the second (Doha, 2008) and third (Addis Ababa, 2015) International Conferences on Financing for Development.
200. OECD, 2018.
201. Ibid.
202. Ibid.
203. Green Climate Fund, 2018.
204. Hinchberger, 2017.
205. Takaful is a form of insurance compliant with Islamic Law (Sharia).
206. Khan and Bhatti, 2008.
207. Peters and others, 2016.
208. UNFCCC, 2015; United Nations, 2015c.
209. United Nations, 2015e.

Since 2005, several global processes have called for an integrated approach to climate change adaptation (CCA) and disaster risk reduction (DRR). Calls to pursue this integration were intensified, with the adoption of three main and interrelated agendas, namely the 2030 Sustainable Development Agenda, the Sendai Framework for Disaster Risk Reduction (2015-2030) and the Paris Agreement on Climate Change. While the CCA and DRR communities follow separate paths, bridging the gap between them entails both opportunities and challenges. Similarities between the two communities need to be exploited and differences investigated in order to achieve synergies in dealing with all aspects of weather-related hazards and disasters, assessment tools, institutional arrangements and means of implementation to achieve synergy between the two agendas.

This seventh issue of the Water Development Report of the Economic and Social Commission for Western Asia (ESCWA) focuses on bridging the gap between CCA and DRR communities within the context of scarcity in the water sector in the Arab region at large. It attempts to link historical disaster loss databases with the projected extreme indices hotspots and vulnerable areas that resulted from the joint United Nations and League of Arab States Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR). The report utilizes the science-based information generated from regional climate modelling, hydrological modelling, vulnerability assessment and analysis of the disaster loss databases to inform measures and actions on CCA and DRR at the regional and national levels as well as climate change negotiations at the global level. To improve policy coherence across CCA and DRR communities in the Arab region, there is a need for increased regional and country-level efforts to overcome the continuing challenges related to climate change, natural hazards and water security, which hinder the achievement of sustainable development in the region.

17-00800