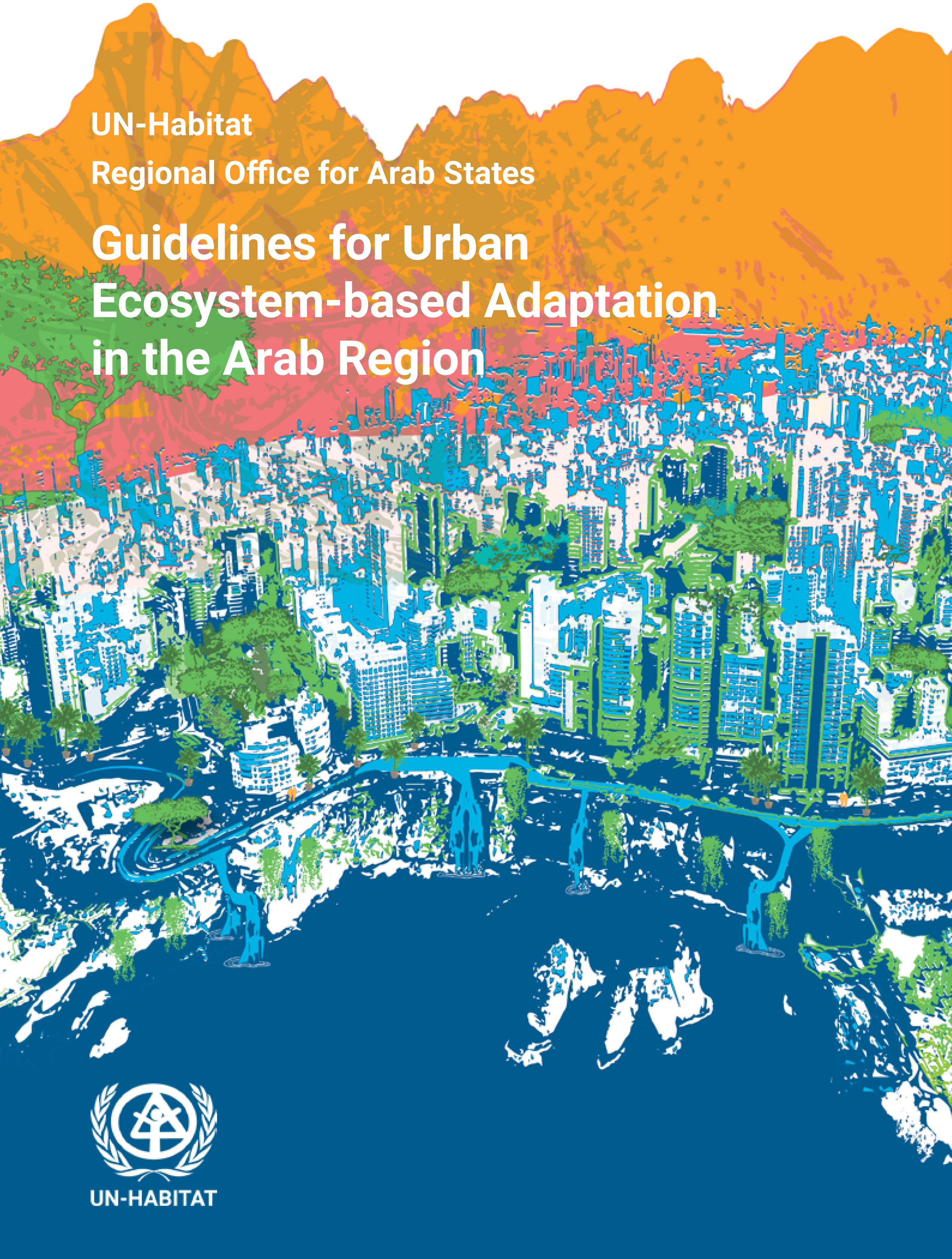
UN-Habitat

Regional Office for Arab States

Guidelines for Urban Ecosystem-based Adaptation in the Arab Region



UN-HABITAT

UN-HABITAT

Guidelines for Urban Ecosystem-Based Adaptation in the Arab Region

United Nations Human Settlements Programme (UN-Habitat)
P.O. Box 30030 00100 Nairobi GPO KENYA

www.unhabitat.org

Front Cover - Illustration: Ana Pastore
Back Cover- Illustration: Omnia Moussa

Acknowledgments

The Guidelines for Urban Ecosystem-based Adaptation in the Arab region is a product of the generous dedication of numerous individuals.

Lead Author
Ehab Eid

Contributors & Reviewers
Gaelle Seif, United Nations Environment Programme, Regional Office for West Asia
Geetha Nayak, United Nations Environment Programme, Regional Office for West Asia
Omnia Moussa, UN-Habitat Regional Office for Arab States
Yara Eissa, UN-Habitat Regional Office for Arab States
Yasmine Mostafa, UN-Habitat Regional Office for Arab States

Visual Design
Ana Luz Pastore Garcia, UN-Habitat Regional Office for Arab States
Omnia Moussa, UN-Habitat Regional Office for Arab States

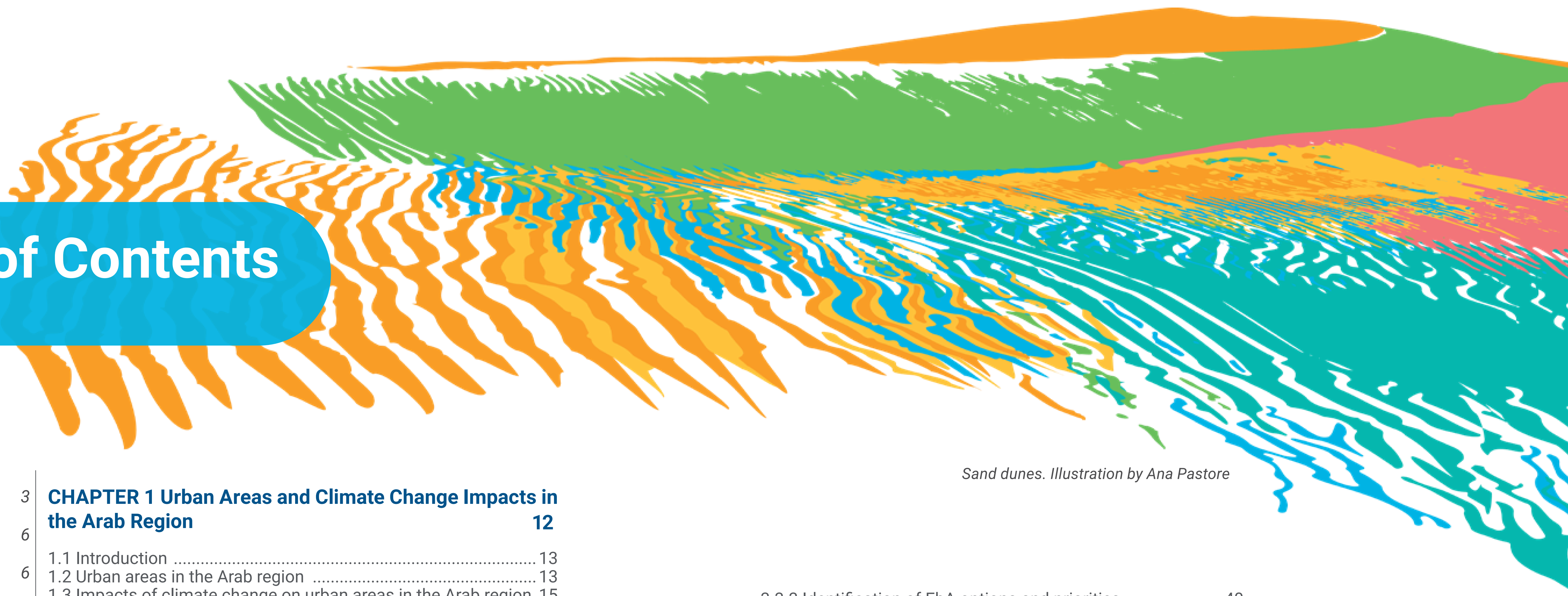
Copy Editor
Prashansa Taneja

Funding
Produced with support from the United Nations Environment Programme

UN environment programme

Oasis in a desert ecosystem. Illustration by Ana Pastore

Table of Contents



Sand dunes. Illustration by Ana Pastore

List of Tables

List of Figures

List of Boxes

River ecosystem in an urban setting. Illustration by Omnia Moussa

Executive Summary

The rapid pace of urbanization in the Arab region, coupled with inadequate planning, has placed significant strain on available natural resources. Soil, air, water, biodiversity, and delivery of ecosystem services face numerous threats and challenges leading to their degradation or loss. Climate change further exacerbates these challenges due to inadequate institutional capacity to assess and address its expected impacts. In addition to climate change, the Arab region faces intermittent waves of conflict-driven displacement in certain states. This forced migration and its resultant refugees place an enormous burden on host countries' resources, including the infrastructure,

A River Ecosystem in the Heart of the City. Artwork: Ana Pastore and Omnia Moussa water, energy, and social services. Given the compounding effects of climate change and other stresses in the Arab region, it becomes imperative to implement comprehensive programmes that can effectively adapt to the impacts and repercussions of climate change.

Nature-based Solutions (NbS) are considered essential tools for effectively conserving, managing, and restoring natural or modified ecosystems that address societal challenges (such as climate change, food security, water security, and natural disasters) while ensuring the well-being of people and biodiversity. Ecosystem-based Adaptation (EbA) is a nature-based solution that helps people adapt to climate change by employing ecosystem and biodiversity services as part of a holistic adaptation strategy. EbA aims to maintain and increase the resilience of ecosystems while reducing the vulnerability of ecosystems and individuals to the adverse impacts of climate change.

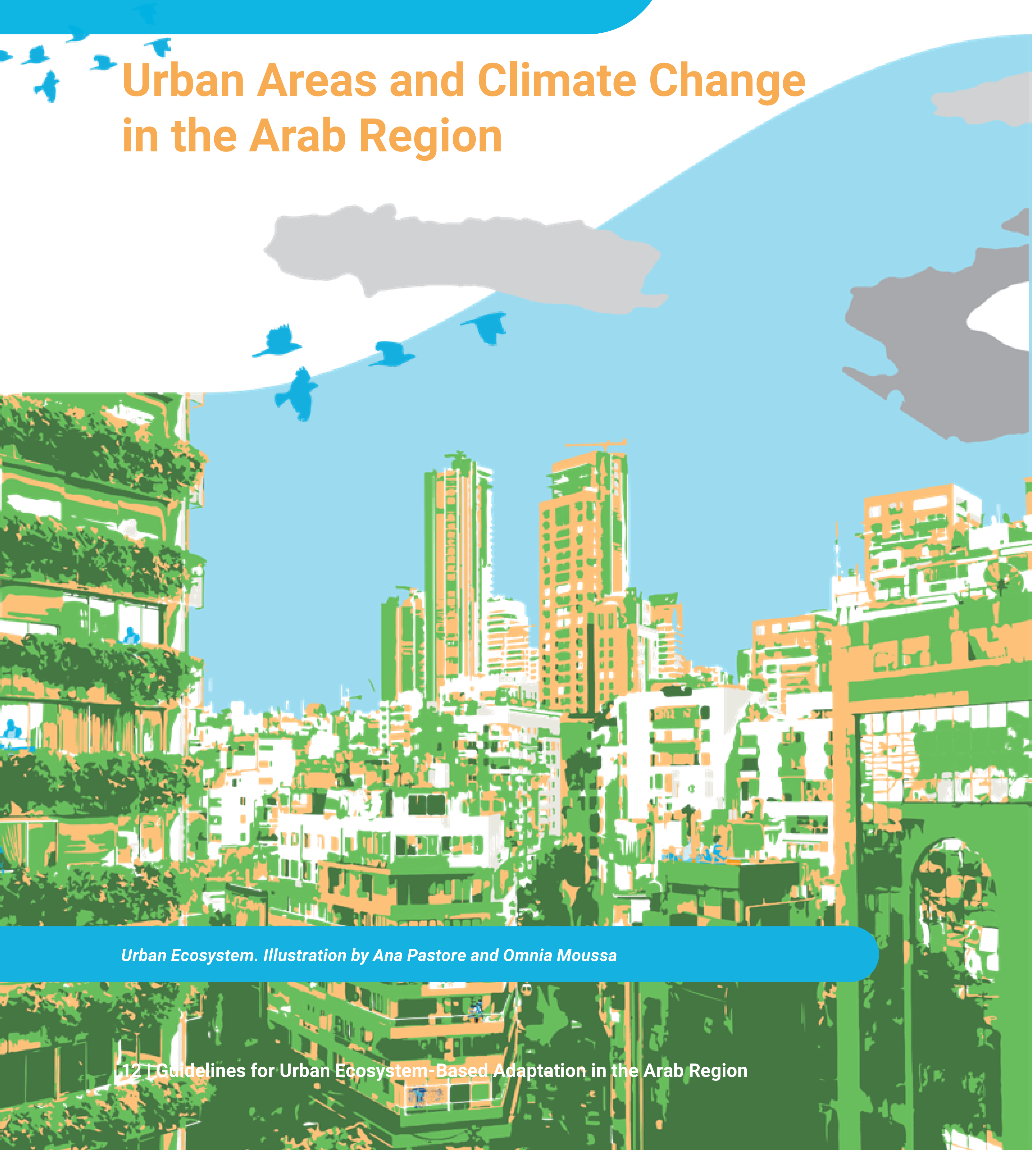
The Guidelines for Ecosystem-based Adaptation in Urban Areas of the Arab Region aim to support the mainstreaming and uptake of the EbA approach in the Arab region. These guidelines contribute to familiarizing urban stakeholders with the EbA approach by presenting relevant definitions, case studies, and examples from urban areas in the Arab region; showcasing EbA as an effective approach to climate change adaptation that can yield multiple co-benefits; providing insight into the drivers and enablers of mainstreaming EbA into development planning; and outlining necessary steps for their integration. These steps include climate change risk and vulnerability, followed by stakeholder engagement, identification of EbA options and priorities, designing adaptation options, raising awareness and knowledge, funding EbA initiatives, implementation of prioritized EbA options, and monitoring and evaluation.

The development of these guidelines has been a comprehensive process, keeping in mind the importance of caterering to a wide range of urban stakeholders, including national and local governments, academics, researchers, urban development practitioners, non-governmental organisations, managers of climate adaptation programs, international organisations, the private sector, and other institutions interested in sustainability practices. Their purpose is to offer valuable insight and support to these entities in their efforts to effectively incorporate EbA measures.

Delal Bridge, a stone bridge over the Khabur river in the town of Zakho, Iraq. Illustration by Omnia Moussa based on photo by Bilal Photography

Chapter 1

Urban Areas and Climate Change in the Arab Region



Urban Ecosystem. Illustration by Ana Pastore and Omnia Moussa

1.1 Introduction

Urban areas house over half of the global population, with projections indicating that this figure will reach 68 per cent by 2050 (United Nations, Department of Economic and Social Affairs, Population Division 2019). In its Sixth Assessment Report, the IPCC indicated that urban areas are responsible for an increasing share of global emissions, estimated at 67- 72 per cent in 2020 (IPCC 2022). A complex set of factors contribute to increasing urban greenhouse gas emissions, including population size and the form and state of urbanization. For instance, the building and construction sector alone accounted for 37 per cent of global energy and process emissions in 2021, and this trend is expected to rise (United Nations Environment Programme, 2022). Another contributor is the transportation sector, accounting for 15 per cent of the world's total greenhouse gas emissions (IPCC, 2022), with road transport being responsible for three-fourths of these emissions (UN-Habitat, 2021).

Urban areas, being major socioeconomic hubs, are highly vulnerable to the impacts of climate change, including sea level rise, floods, heat/cold waves, and intense storms. These impacts affect human health and livelihoods, cause damage to infrastructure, and disrupt the provision of essential services to people living in cities. While the impacts of climate change are indiscriminately affecting all cities, some people are more vulnerable than others. For instance, there are over one billion people living in informal or unplanned urban areas, 70 per cent of which are highly vulnerable to climate change-related hazards due to their limited adaptive capacities. Over the next two decades, at least 136 megacities are projected to experience flooding, and if no mitigation measures are foreseen, coastal flooding alone will result in USD 1 trillion worth of annual damages by 2050 (UN-Habitat, 2021). An influx of climate change refugees will further strain the limited capacities and resources of cities.

The process of rapid urbanization and expansion of urban areas often have negative impacts on the environment, society, and the economy. This has become particularly apparent in recent years, during which time many cities worldwide have witnessed severe flooding resulting in damages to property and endangerment of lives. Rapid and unplanned urbanization also results in further encroachment on natural areas and ecosystems, leading to their degradation and creating even more challenges, such as lack of access to clean water sources, flooding, air quality degradation, and food insecurity. These issues exacerbate the negative social and economic consequences, particularly for impoverished communities that depend on specific ecosystems for their livelihoods and income.

1.2 Urban areas in the Arab region

Arab countries are experiencing rapid urbanization, particularly in the major cities, due to significant population growth in the region. The Arab population has more than quadrupled over the past six decades, growing from 93 million in 1960 to over 464 million in 2022 (World Bank Group, n.d.). With a population growth rate of approximately 2.4 per cent – the highest globally – the Arab population is projected to further increase to 646 million by 2050 (UNDP, 2022). Figure 1 illustrates the percentage of urban population in respect to the total population of the Arab region between 2010 and 2020, showing a constant increase in urban population, which stood at 59 per cent in 2022 (O'Neill, 2023). While urbanization levels vary across Arab countries, they are generally high, ranging between 50 and 85 per cent. This rapid pace of urbanization in the Arab region coupled with inadequate or a lack of planning has placed significant strain on available natural resources.

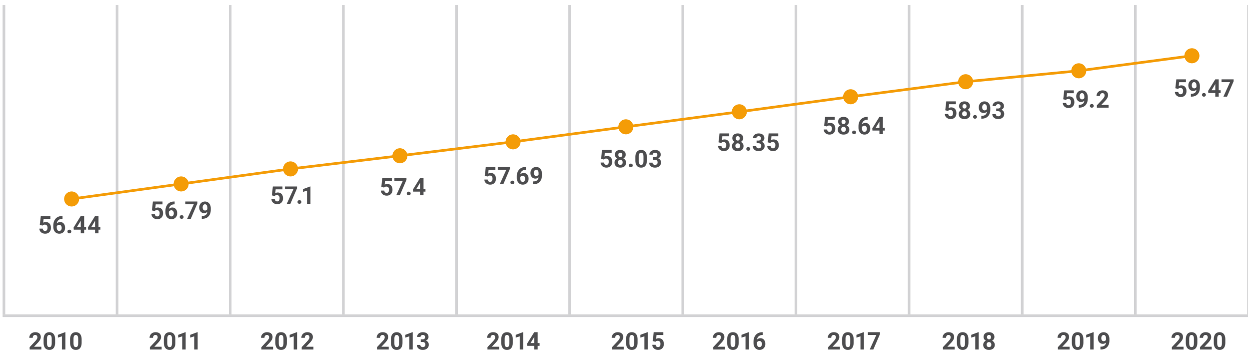


Figure 1: Percentage of the urban population in respect to the total population of the Arab region (O'Neill, 2023)

In a region facing multiple crises and geopolitical conflicts, intermittent waves of internal and external displacement have further strained resources in countries and cities hosting refugees and Internally Displaced Persons (IDPs). For example, the Syrian crisis has resulted in widespread migration and the displacement of over 6.6 million refugees (UN-ESCWA, 2022), while the ongoing crisis in Sudan has resulted in more than 5 million IDPs and refugees (UNHCR, 2023). These challenges are compounded by high levels of poverty experienced by most countries in the region and alarmingly high youth unemployment rates, given that over half of the region's population is under the age of 25. Figure 2 provides more information on conflict and poverty in the Arab region.

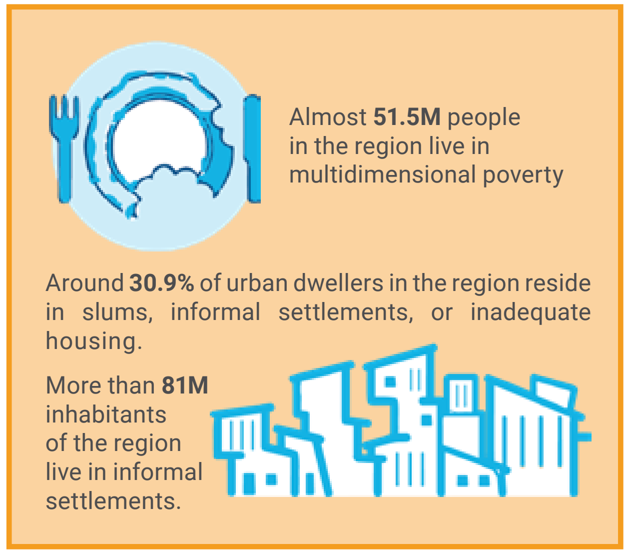


Figure 2: Urban data on conflict and poverty in the Arab region. Sources: UNDP, 2022; UN-Habitat, 2020; UN-ESCWA, 2020

Water scarcity is a significant issue in 19 of the 22 Arab countries, and at least 17 countries are affected by desertification and land degradation (UN-ESCWA, 2022). The current utilization rate of water resources is estimated at 76.6 per cent, compared to a global utilization rate of approximately 7.5 per cent, with the agricultural sector being responsible for 81 per cent of water consumption (Arab Organization for Agricultural Development, 2017; AbuZeid, Alroudy, CEDARE and Arab Water Council, 2014; AbuZeid, Wagdy, Ibrahim, CEDARE and Arab Water Council, 2019). Furthermore, the Arab region suffers from high levels of air pollution, where 11 of the 22 Arab states exceed the world average of airborne particulate matter concentration. Egypt, Kuwait, Libya, Qatar, and Saudi Arabia are among the ten countries with the highest air pollution levels in the world, while Egypt, Iraq, and Saudi Arabia rank among the ten countries with the highest number of air pollution-related deaths (UN-ESCWA, 2020).

1.3 Impacts of climate change on urban areas in the Arab region

Cities in the Arab region are susceptible to numerous climate-induced natural hazards, such as droughts, landslides, sandstorms, wildfires, floods, and heatwaves. Over the past decades, extreme weather events have increased in both frequency and intensity, causing devastating loss of life and property. Statistics reveal that between 1984 and 2014, 50 million people in the region were negatively affected by climate-related disasters that resulted in losses amounting to USD 11.5 billion (Banerjee et al, 2014). Furthermore, the average number of disasters caused by natural hazards in the MENA region has nearly tripled during the past three decades. This rise in frequency, along with the social, political, and economic challenges facing the region in the form of geopolitical conflicts, increased poverty and hunger, rapid urbanization, and population growth, contributes to its heightened vulnerability to the impacts of climate change (Banerjee et al, 2014).

1.3.1. Storms and floods

Floods are the most common of the various natural hazards in the Arab region. The threat of flooding in the Arab region occurs in three major forms depending on geographical and climatic factors: 1) flash floods, referring to the sudden and intense floods often triggered by heavy downpours in short periods, affecting mountainous and desert areas; 2) riverine or wadi flooding which occurs when major rivers/wadis overflow due to excessive rainfall or snowmelt; and 3) coastal flooding that occurs in low-lying coastal areas due to inundation from storm surges and rising sea levels.

Several flood events have occurred in the Arab region, including the 2022 Yemen floods where heavy rain caused extreme flooding in several governorates, affecting tens of thousands of people and causing displacement and loss of life (United Nations, 2022). Similar events involving heavy rainfall have caused urban flooding in the UAE, Egypt and Jordan. Due to lack of disaster preparedness and the limited capacity of stormwater drainage, such events have caused extensive damage to infrastructure, human displacement and loss of life and property (Narayanan, 2022; IFRC, 2024; Namrouqa, 2018).

Storms are considered extreme weather events that sometimes lead to unusual flooding as they generate huge quantities of rainwater in short periods of time. In 2023, Storm Daniel, that formed in the Mediterranean Sea, hit the coastal city of Derna in Libya and caused unprecedented flood water damage to infrastructure and property. The resulting floods swept across the city of Derna, killing thousands of people and destroying almost a quarter of the city. The International Federation of the Red Cross and Red Crescent Societies announced that at least 10,000 people had gone missing. These extreme events are only expected to increase in intensity as global warming increases (Papadimas and Chestney, 2023; Reuters, 2023).

1.3.2. Sea level rise

Sea level rise (SLR) also poses a significant threat to coastal areas in the region, and is expected to displace millions of people. Projections indicate that SLR of just one meter would directly affect 41,500 km2 of coastal land in the Arab region (Arab Forum for Environment and Development, 2009). Several coastal cities in Arab countries are vulnerable to SLR, including Algiers (Algeria), Manama (Bahrain), Alexandria (Egypt), Kuwait, Beirut (Lebanon), Tripoli (Libya), Tangier (Morocco), Qatar, Tunis (Tunisia), and Dubai (the UAE). It is estimated that 3.2 per cent of the Arab population will be directly affected by this phenomenon, compared to the global average of 1.28 per cent. In Egypt, where the majority of agricultural land is located in the Nile Delta, only 1 meter of SLR could negatively affect 12 per cent of the country's agricultural land and 2-4 million farmers (Arab Forum for Environment and Development, 2009; UNDP, 2018). Furthermore, rising sea levels in low-lying coastal areas are projected to cause further displacement as storms introduce saltwater into rivers, thereby degrading aquifers and agricultural land. It is forecasted that over 43 coastal cities in the region will be affected by SLR (Borghesi and Ticci, 2019). In Alexandria, Egypt, for instance, SLR of 0.5 meters could potentially displace 1.5 million residents from their homes (Verner, 2012).

1.3.3. Rising temperatures

According to the Fifth Assessment Report of the IPCC, the Arab region is expected to experience a rise in average annual temperatures ranging from 0°C to 2°C between 2011 and 2041 (IPCC, 2014). Temperatures in the Middle East are already increasing almost twice as fast as the global rate of warming, while the intensity and frequency of heatwaves, which have also increased, are expected to rise by 16 per cent by 2040 (Zittis et al, 2022; Oxfam, 2023). According to a study published in 2021, the Middle East is expected to experience super and 'ultra-extreme' heatwaves in coming years, where temperatures will rise to 56°C and higher for prolonged durations, up to several weeks at a time (Zittis et al, 2021). Many incidents of heatwaves have already occurred in the Arab region, which experienced one of the hottest weeks ever recorded globally, with severe heatwaves affecting millions in July 2023. In 2022, extreme heatwaves affected Iraq, where temperatures exceeded 50°C, leading to government-imposed vacations, power outages, and health concerns especially for outdoor workers (Loveluck and Salim, 2022). The North African heatwave in 2021 has affected Tunisia, which witnessed record-breaking temperatures, causing wildfires and power outages (Reuters, 2022).

Box 1: Urban Heat Islands (UHIs) effect

In addition to rising temperatures, cities experience a unique phenomenon called the Urban Heat Island (UHI) effect, where temperatures in the city are significantly higher than in its surroundings. This phenomenon occurs due to the absorption and re-emission of solar heat by buildings and asphalt, and by other sources such as vehicles, air conditioners, and power stations (U.S. Environmental Protection Agency, 2008). With the increasing frequency of extreme weather events due to climate change, the impact of UHIs is likely to intensify. Increasing green spaces in cities by creating urban parks, forests, and planting trees and vegetation on public streets and rooftops can help mitigate this phenomenon. An increase in green spaces helps by reducing the air temperature through evaporation and by providing shade. Green spaces also have the additional benefits of reduced surface water runoff, carbon sequestration, and improved air quality, and can add to the aesthetic value and cultural significance of a place.

Extremely high temperatures pose significant health risks, particularly to the elderly, children, and those with underlying illnesses. Notably, there is a clear correlation between high temperatures and an increase in deaths related to cerebrovascular disease, ischemia, and other heart conditions, which aligns with findings from similar studies conducted in other regions. Conversely, cold waves can inflict damage on agriculture, infrastructure, and property. For instance, severe cold, heavy snowfall, and cold waves could disrupt entire areas by causing flooding, storm surges, power outages, and road closures (UNESCO, 2021).

1.3.4. Rainfall, drought, and desertification

The Arab region is the most water scarce region in the world, possessing the lowest freshwater resources. The majority of Arab countries suffer from chronic water scarcity and fall below the water poverty line of 1,000 m3 per capita per year (Al-Zubari, 2017). Rural populations, heavily dependent on subsistence agriculture and climate-affected grazing, are particularly vulnerable to changes in rainfall quantities resulting from climate change. The arid climate and limited water resources force countries in the region to rely heavily on food imports to sustain their populations. Some of the poorest countries in the region face the challenge of malnutrition, especially their rural non-agricultural households living in remote areas. North Africa has already experienced significant decreases in rainfall and rainy-day frequency. Rainfall is expected to decrease by up to 50 per cent in the region due to climate change, accompanied by more intense heatwaves and droughts. By the year 2050 the Arab region's water supply will be down to only 15 per cent of what it was in the 1960s (UNDP, 2018). This reduction in water supply is expected to lead to an increase in water and food-borne diseases in addition to serious repercussions for food security (UNESCO, 2021).

Locust infestations, which typically occur after heavy rainfall, are a menace to agriculture and food security in the Arab region. These insects can decimate agricultural lands within a matter of hours and, due to their sheer numbers, swiftly destroy vast areas in a relatively short period. Locust outbreaks are unpredictable, lasting anywhere from 1 to 14 years before entering a period of recession. The consequences of locust attacks are extensive and include crop losses, degradation of topsoil, displacement of rural populations, and desertification (UNESCO, 2021).

1.3.5. Wildfires

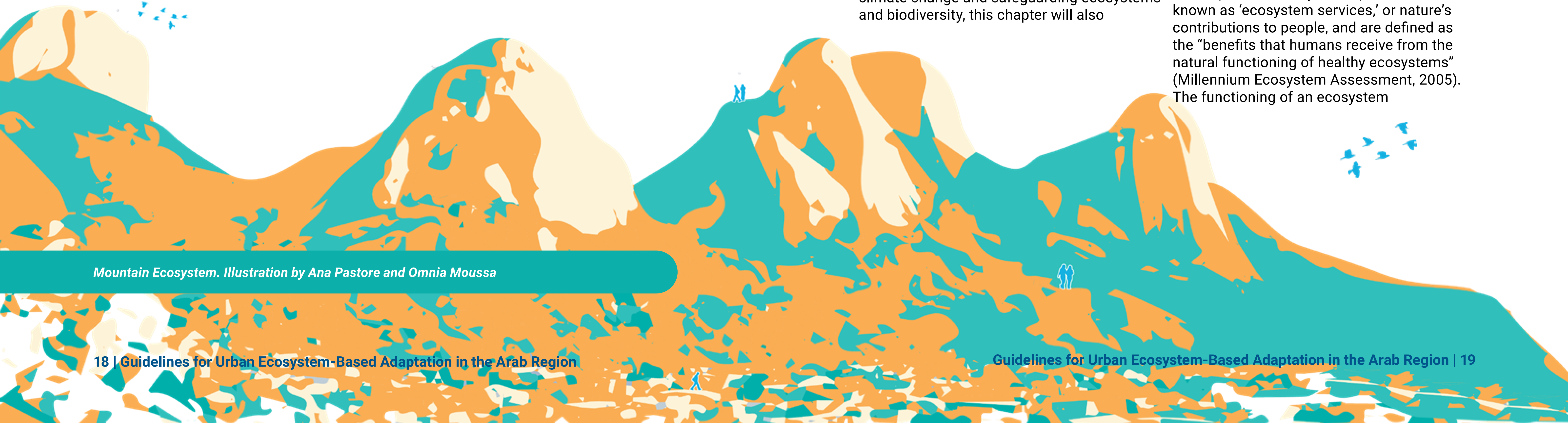
Impacts of climate change in the region, including rising temperatures and high precipitation variability, have exacerbated the risk of wildfires. Higher temperatures and heatwaves create drier conditions, which increases the likelihood of vegetation drying out and becoming more susceptible to ignition. Moreover, altered precipitation patterns lead to more intense and less predictable rainfall events. This can result in extended periods of drought followed by heavy rainfall, contributing to vegetation stress and fuel buildup and increasing the risk of wildfires during dry periods. Several other factors can contribute to more wildfires, such as shifts in vegetation patterns and species composition, as well as human activities like land use changes and population growth which can further influence wildfire dynamics (MacCarthy, Richter, Tyukavina, Weisse and Harris, 2023).

While wildfires play a crucial role in the ecosystem's regeneration process, they also cause significant damage and have both direct and indirect economic impacts. Globally, and in the Arab region, wildfire seasons have become longer. Over the past decade, several countries located in the Mediterranean Basin, including Algeria, Lebanon, Morocco, Syria, and Tunisia, have experienced a series of devastating forest fires (UNDP, 2018). In Algeria, wildfires have burned over 89 thousand hectares in 2021 across 35 states causing loss of plant cover and animal wealth (Algerie Presse Service, 2021). In Morocco, wildfires in 2022 destroyed more than 4660 hectares of forests and woodlands in the northern parts of the country where 1320 families had to evacuate (Kebir, 2022). Meanwhile in Lebanon, the forest area has decreased from 35 per cent in the 1960s to 13 per cent in 2010 due to forest fires (Republic of Lebanon Ministry of Environment and University of Balamand, 2010). Between 2020 and 2021, during summer heatwaves, fires affected hundreds of people in Lebanon and Syria, causing fatalities and displacement (Reuters, 2021).

1.3.6. Sand and dust storms

Sand and dust storms (SDS) – a natural phenomenon in the Arab region exacerbated by climate change – have the potential to detrimentally affect public health, infrastructure, and agriculture, and even lead to fatalities and significant economic losses. Transboundary in nature, SDS can affect regions other than where they originated, which often happen to be dryland areas where vegetation cover is low and wind barriers are few (World Bank, 2019). According to UNEP, dust storms contribute to annual GDP losses of USD 13 billion in the Middle East and North Africa region alone (UNEP, 2016). In the Arab region, Bahrain, Iraq, Kuwait, Saudi Arabia, and Sudan are some of the most affected by SDS, facing severe consequences for public health and the environment.

SDS are the main contributor to poor air quality in Arab countries (Osipov, Chowdhury, Crowley et al, 2022). Consequently, the health sector is the most affected, where SDS increase respiratory illnesses, particularly affecting vulnerable populations like those with chronic respiratory illnesses, children, and the elderly. They also harm visibility, causing transportation disruptions and accidents (Banerjee et al, 2014; World Bank, 2019). Climate change has contributed to an increase in the intensity and frequency of SDS, as well as changes in their historical patterns, through its impacts on precipitation, desertification, and droughts. For example, in Iraq, where SDS have been occurring unexpectedly outside the normal season, the number of days with SDS has significantly increased, from 243 to 272 days per year over the past two decades (Chibani, 2022). Land use and land cover changes are other major contributors to SDS (Chibani, 2022).



Mountain Ecosystem. Illustration by Ana Pastore and Omnia Moussa

Chapter 2

Ecosystems, Ecosystem Services and Ecosystem-based Adaptation

2.1 Introduction

The challenges posed by climate change in the Arab region are both multifaceted and wide-ranging. As projections indicate an exacerbation of climate change's impacts in the future, developing adaptation solutions and implementing actions to respond to current and future impacts is urgently needed. This chapter aims to provide an overview of the various ecosystems and ecosystem services in the region while examining the ways in which climate change affects them. Given the increasing importance of the nature-based approach to adaptation known as Nature-based Solutions or NbS in reducing the ramifications of climate change and safeguarding ecosystems and biodiversity, this chapter will also explore the concept of EbA as an approach that harnesses nature-based solutions and ecosystem services, and highlight its alignment with multilateral environmental agreements and global agendas.

2.2 Ecosystems and ecosystem services

Ecosystems are dynamic complexes of plants, animals, and microorganisms interacting with their environment. Various studies and reports have used different ecosystem classifications; this publication is following the classification of the Millennium Ecosystem Assessment (see Table 1). These ecosystems provide services known as 'ecosystem services,' or nature's contributions to people, and are defined as the "benefits that humans receive from the natural functioning of healthy ecosystems" (Millennium Ecosystem Assessment, 2005). The functioning of an ecosystem determines the supply of ecosystem services (United Nations Environment Programme, 2021). Ecosystem services can be classified into four categories:

1. **Provisioning services:** These involve ecosystems providing humans with resources essential for their well-being and basic needs e.g. food, water, minerals, shelter, biochemicals, and fuel.

2. **Regulating services:** Ecosystems play a crucial role in maintaining environmental balance and providing regulation services to humans. These services include air quality maintenance, climate regulation, water regulation, erosion control, water purification and waste treatment, regulation of human diseases, biological control, pollination, and storm protection.

3. **Cultural services:** These are the non-physical benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic pleasure, recreation, ecotourism, etc. For example, green spaces for hiking, walking, and ecotourism, and natural landscapes such as beaches and seascapes.

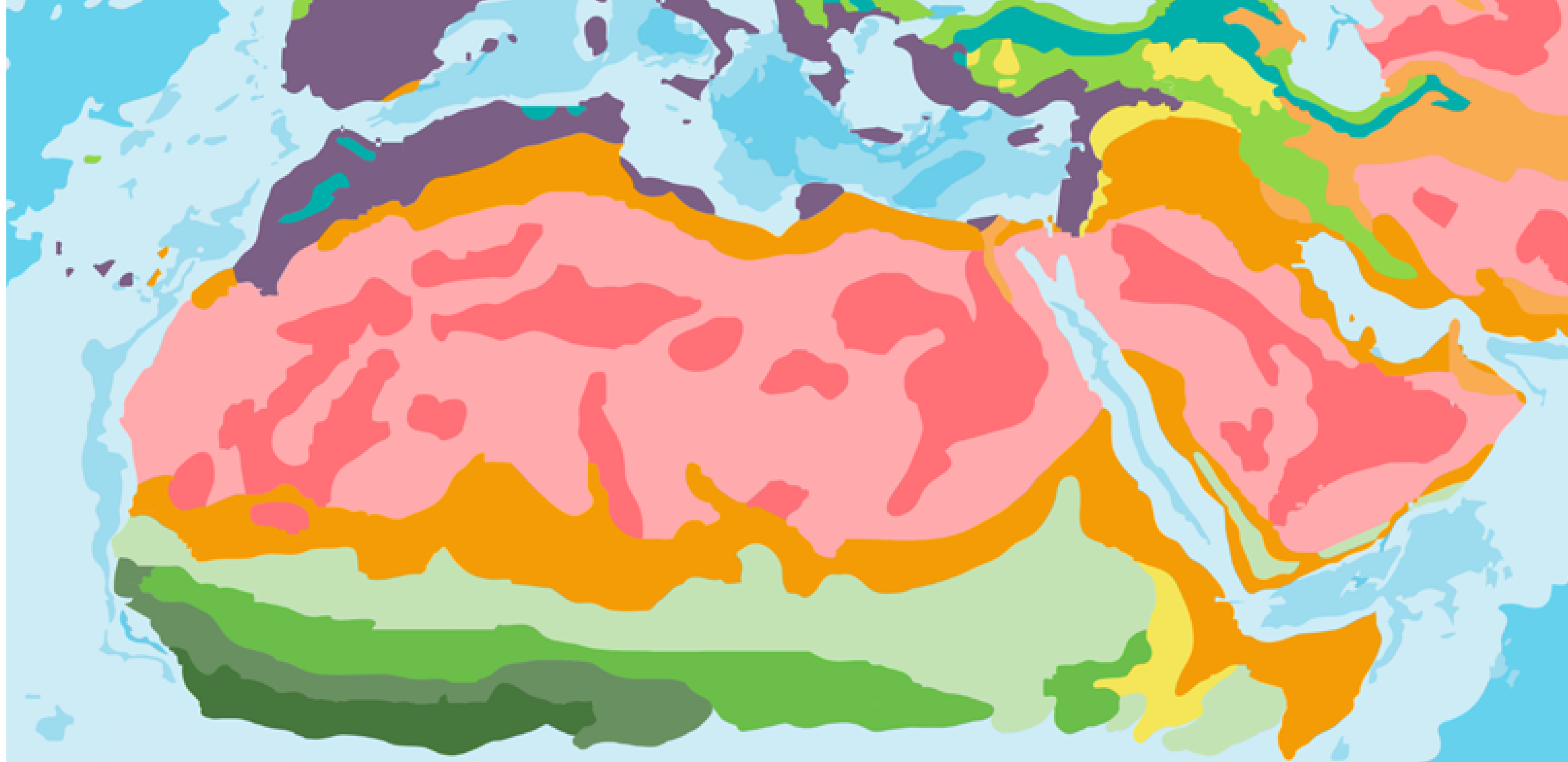
4. **Supporting services:** Ecosystems support the sustainability and vitality of biodiversity, which is essential for human well-being. They provide the necessary conditions and resources for the existence and continuity of biodiversity, such as soil formation and nutrient cycling. Supporting services encompass the fundamental functions required for the production of all other ecosystem services. Unlike provisioning, regulating, and cultural services, the effects of supporting services on people are often indirect, or manifest over an extended period of time. In contrast, changes in one of the other service categories have a more immediate and direct impact on individuals.

The degradation and loss of natural capital have significant adverse consequences and wide-ranging impacts on the environment, society, and the economy, making the conservation and sustainable management of such resources imperative. As natural capital deteriorates, the planet becomes more susceptible to the risk of severe events like floods and droughts. This heightened vulnerability increases the likelihood of conflicts arising from competition over essential resources like food and water, and could result in the displacement and migration of huge populations.

2.4 Impacts of climate change on ecosystems and ecosystem services

The Arab region is home to rich and diverse ecosystems, including deserts, mountains, forests, fresh water, wetlands, marine, and coastal environments, as well as cultivated and urban ecosystems. As climate change continues to intensify, the delicate balance of ecosystems is disrupted, triggering a cascade of effects on the services they offer and affecting human well-being, livelihoods, and the overall sustainability of our planet. Understanding and addressing the impacts of climate change on ecosystems and their services is crucial for devising effective strategies to mitigate and adapt to this complex and far-reaching environmental challenge.

Table 1 displays the ecosystems of the Arab region (per the classification of the Millennium Ecosystem Assessment) and highlights the impact of climate change on the services they provide and on cities and people.



A Map of the ecoregions of the Arab Region. Illustration by Omnia Moussa based on Ville Koisten's adaptation of Dinerstein E. et al. An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm, BioScience, Volume 67, Issue 6, June 2017, Pages 534–545, https://doi.org/10.1093/biosci/bix014

Disclaimer: The map shown is for illustration purposes only and is not an exact representation.

Table 1: The different ecosystems in the Arab region and how climate change impacts each ecosystem's services

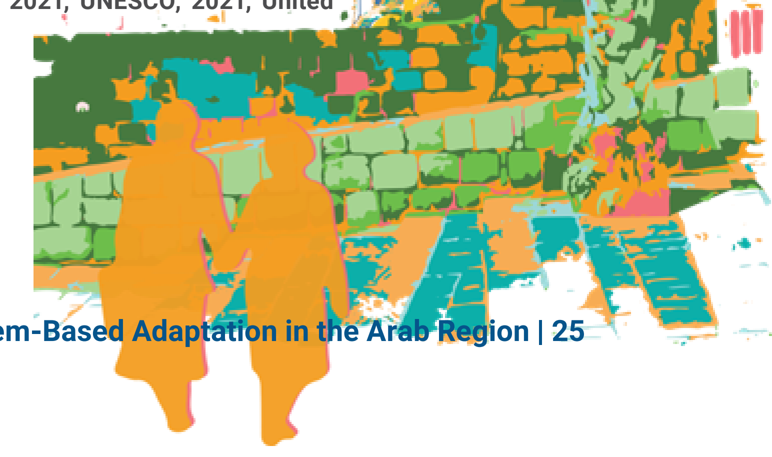
Ecosystem categories and examples from the Arab region	Ecosystem services	Climate change impacts	How they affect the ecosystem services	Impact on cities and people
Marine *Marine ecosystems are found in all countries of the region, e.g. the Socotra Archipelago in Yemen, which is a UNESCO World Heritage Site*	**Provisioning services**: fisheries, building materials **Regulating services**: carbon sequestration and storage, erosion prevention, wastewater treatment, moderation of extreme events **Cultural services**: tourism; recreational, aesthetic, and spiritual benefits **Supporting services**: Maintenance of life cycles for both marine fauna and local species, along with the cycling of elements and nutrients	Sea level rise Marine heatwaves Ocean acidification Biodiversity loss	Adverse impact on food provision, recreation, nutrient cycling, waste processing, protection from natural hazards, and climate regulation, among other services	Threats to human life Threats to land resource

Ecosystem categories and examples from the Arab region	Ecosystem services	Climate change impacts	How they affect the ecosystem services	Impact on cities and people
Coastal *The Arab region has a total 224,000 km of coastline. Coastal cities in the region with a population exceeding 1 million inhabitants include Alexandria, Beirut, Dubai, Jeddah, Abu Dhabi, Doha, Kuwait City, Gaza, Muscat and Tripoli*	**Provisioning services**: food, mangrove, fibre and water **Regulating services**: regulation of climate; protection from coastal erosion, coral bleaching, pollution and disease **Cultural services**: tourism; recreational, aesthetic, and spiritual benefits **Supporting services**: nutrient cycling and photosynthesis	Sea level rise Flooding Coastal erosion and saline intrusion Increased storm surges	Adverse impact on food provision	Loss of life, livelihood, infrastructure damage and/or destruction, and displacement
Inland water *(including rivers, lakes, floodplains, reservoirs, marshes, and wetlands)* *e.g. the Mesopotamian Marshlands in Iraq and Lake Ichkeul in Tunisia*	**Provisioning services**: food, fresh water, fibre and fuel, biochemical products and genetic materials **Regulating services**: water purification and regulation, pollination and seed dispersal, climate regulation (locally through vegetation cover and globally through carbon sequestration) **Cultural services**: recreation and tourism; cultural identity and diversity; cultural landscapes and heritage; indigenous knowledge systems; spiritual, aesthetic, and inspirational services **Supporting services**: soil development (conservation, formation), primary production and nutrient cycling	Habitat loss of freshwater species Longer and more severe periods of low water levels Changes in rainfall patterns and cycles of flooding Extreme weather events, including extreme storms, that can erode riverbanks and wash sediments and pollution into rivers and wetlands	Reductions in water availability, deteriorating water quality, adverse impacts on provision of food and other essentials, cultural and supporting services	Socioeconomic impacts, land degradation, urban water insecurity, adversely impacted recreational activities, and reduced tourism and property values

Ecosystem categories and examples from the Arab region	Ecosystem services	Climate change impacts	How they affect the ecosystem services	Impact on cities and people
Forest *e.g. the coniferous forests of Lebanon*	**Provisioning services**: food, water, fibre, fuel, chemical and medicinal products **Regulating services**: climate regulation, carbon storage, air and water purification, erosion protection, flood mitigation, and protection against coastal erosion and storms **Cultural services**: tourism; recreational, aesthetic, and spiritual benefits **Supporting services**: habitats for flora and fauna, photosynthesis, soil formation, nutrient cycling and pollination	Wildfires Reduced carbon storage Pest outbreaks	Agricultural crop failures decrease the capacity of forests to sequester carbon; altered precipitation patterns and increased temperatures can lead to changes in the duration and amount of water available, degrade soil quality and reduce the productivity of forest ecosystems	Socio-economic impacts, negative effects on human health caused by increased forest fires and decreased availability of medicinal plants, and increased vulnerability of forest-dependent populations relying on forests to meet their needs related to energy, food and health
Dryland *Almost 90 per cent of the Arab region's area is considered arid, semi-arid, or dry subhumid*	**Provisioning Services:** food, fiber, forage, fuelwood, biochemicals and fresh water **Regulating services:** water purification and regulation, pollination and seed dispersal, climate regulation (local through vegetation cover and global through carbon sequestration) **Cultural Services:** recreation and tourism, cultural identity and diversity, cultural landscapes and heritage values, indigenous knowledge systems, spiritual, aesthetic, and inspirational services **Supporting Services:** soil development (conservation, formation), primary production and nutrient cycling	Drought Desertification and soil erosion due to increasing temperatures, reduced and more variable rainfall, and increasingly frequent and severe wind and sandstorms Land degradation (loss of productive land, soil erosion, and decreased vegetation cover)	Increased aridity, prolonged droughts, and changes in precipitation patterns can lead to reduced vegetation cover and increased soil erosion	Dryland-dependent communities face increased vulnerability due to their reliance on rain-fed agriculture and livestock grazing as their primary sources of livelihood. The effects of climate change are expected to exacerbate poverty, as well as increase the risks of food and water insecurity in drylands

Ecosystem categories and examples from the Arab region	Ecosystem services	Climate change impacts	How they affect the ecosystem services	Impact on cities and people
Island *e.g. the archipelago of Juzur Farasan in Saudi Arabia and the island of Socotra in Yemen*	**Provisioning Services:** Food, raw material, genetic resources, medicinal resources and habitat **Regulating Services:** Gas regulation, climate regulation, coastal protection, water regulation, water supply, soil retention, soil formation, nutrient regulation, waste regulation, pollination, and biological regulation **Cultural Services:** Recreation and tourism, aesthetics, science and education, and spiritual services **Supporting Services:** soil formation and nutrient cycling	Low-lying island systems are under threat from climate change and predicted sea level rise. These in turn are expected to have serious consequences on flooding, coastal erosion, water supply, food production, health, tourism, and habitat depletion	Rising sea levels and increased intensity of storms can degrade natural features like mangroves, coral reefs, and coastal vegetation, and disrupt their ability to provide protection against coastal erosion, storm surges, and flooding	Sea level rise would be devastating to millions of people living on low-lying islands and atolls. The projected changes in temperature and rainfall could disrupt terrestrial and marine ecosystems on most islands, especially small ones. Increased flooding and coastal erosion will have serious consequences for the tourism industry
Mountain *e.g. the Atlas Mountains extending across Northern Africa through Morocco, Algeria and Tunisia*	**Provisioning services:** Fresh water, food, fuel, fibre, timber **Regulating services:** climate regulation, water quantity and quality regulation, air quality regulation, natural hazard regulation, pest regulation, soil retention and pollination **Cultural services:** recreation and tourism; cultural identity and diversity; cultural landscapes and heritage; indigenous knowledge systems; spiritual, aesthetic, and inspirational services **Supporting services:** Soil formation and nutrient cycling	Changes in precipitation More frequent wildfire weather Flooding and sedimentation due to heavy rainfall; increased intensity and frequency of storms	Decrease in underground water levels Decrease in vegetation cover Soil erosion	The increased risk of natural hazards, including landslides, avalanches, and flash floods triggered by climate change, poses a risk to human settlements, infrastructure, and livelihoods in mountainous areas. Vulnerable populations in mountainous areas may also face more poverty, food insecurity, and displacement due to climate change
Cultivated *e.g. oases with cultivated palm trees in Algeria and heat-resistant wheat varieties in Tafilalt in Morocco*	**Provisioning services:** Food, fibre, and fuel production **Regulating services:** Soil retention, pollination, natural control of plant pests, food source and habitat for beneficial insects, water purification and atmospheric regulation **Cultural services:** Aesthetic landscapes **Supporting services:** Soil structure and fertility, nutrient recycling, water provision and genetic biodiversity	Drought Soil erosion and salinization due to rising temperatures, low rainfall levels and sea level rise	Crop damage and shifts in cropping systems and crop diversity Delays in agriculture calendar Water scarcity Alterations in nutrient cycling dynamics	Economic losses Food shortages, increased food prices, and food insecurity for both rural and urban populations reliant on cultivated ecosystems for their food supply Reduced crop productivity and income losses, that can affect the livelihoods of farmers
Urban *(Built environments with high population densities)*	**Regulating services:** Food and water supply **Regulating services:** Urban temperature regulation, air purification, moderation of climate extremes, runoff mitigation, waste treatment, pollination, pest regulation and seed dispersal, and global climate regulation **Cultural services:** Recreation, aesthetic pleasure, cognitive enrichment, architectural heritage, and socialization venues **Supporting services:** Habitat for biodiversity	Increased occurrences of floods and soil erosion due to intense rainfall and more frequent and severe storms; increased vulnerability to heat	Rising temperatures, heatwaves, and changes in precipitation patterns can reduce the cooling effect of vegetation and exacerbate the urban heat island effect, as well as air pollution, and can lead to urban water scarcity	Significant loss of life and property, damage to infrastructure, direct and indirect impacts on public health

Sources: Millennium Ecosystem Assessment, 2005; UNEP, 2021; UNESCO, 2021; United Nations, 2018; FAO, 2014; IUCN, 2010



2.5 Nature-based Solutions and Ecosystem-based Approaches

In 2022, the Fifth Session of United Nations Environment Assembly adopted the definition of Nature-based Solutions (NbS) as "actions to protect, conserve, restore, sustainably use and manage ecosystems" (United Nations Environment Programme (UNEP 2022). These actions address various societal and environmental challenges such as climate change, food security, water security, and natural disasters, while promoting human well-being and biodiversity protection. For example, creating urban parks can help mitigate the heat island effect, while urban wetlands alleviate the negative consequences of flooding, provide spaces for recreational activities, enhance air quality, and improve the economic value of nearby property (Organisation for Economic Co-operation and Development (OECD 2020).

NbS represent a comprehensive concept that has given rise to several interventions that can be implemented simultaneously. As shown in Figure 3, these include:

- Ecosystem-based Adaptation (EbA) solutions: These focus on utilizing biodiversity and ecosystems to help people adapt to climate change as part of a comprehensive adaptation strategy.
- Ecosystem-based mitigation solutions: These focus on preserving natural environments and implementing management strategies that reduce greenhouse gas emissions from ecosystems while enhancing their carbon sequestration capacity.
- Ecosystem-based disaster risk reduction: This approach aims to address all types of disaster risks, and is not limited to those associated with climate change.
- Blue and green infrastructure: This refers to a network of natural and semi-natural areas intentionally designed and managed to provide a wide range of ecosystem services, such as water purification, air quality improvement, and adaptation to climate change.

Ecosystem-based Adaptation (EbA) refers to the incorporation of biodiversity and ecosystem services into a comprehensive adaptation strategy. Its goal is to assist people in adapting to the adverse effects of climate change. Accordingly, its primary objective is to enhance the resilience of ecosystems, decrease the vulnerability of both ecosystems and individuals, and address the negative impacts of climate change (Lo, 2016).

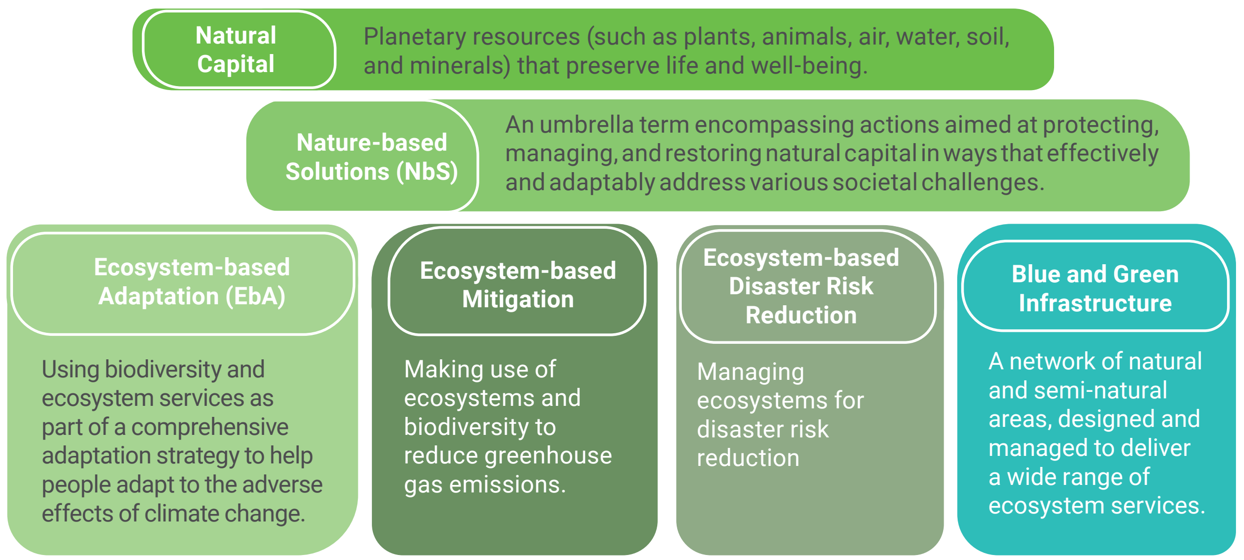


Figure 3: Nature-based Solutions and how they contribute to preserving, enhancing and utilizing natural capital (modified based on Browder et al, 2019)

Some of the applicable methodologies within the framework of EbA include:

- Ecosystem restoration approaches: ecological restoration, environmental engineering, and forest landscape development
- Infrastructure-related approaches: utilization of natural infrastructure and the adoption of a blue/green infrastructure approach
- Ecosystem-based management approaches: integrated coastal area management and integrated water resources or water estuaries management
- Ecosystem protection approaches: this refers to the area protection methodology, including watershed management and protected area management

Figure 4 illustrates the interconnected roles of ecosystems in climate change adaptation and mitigation, and visualizes the dual benefits of EbA for individuals and the environment in combating climate change. Negative climate impacts are depicted in black, while positive impacts are shown in green. Effective ecosystem responses to climate change rely on an integrated approach that maximizes synergistic benefits while minimizing potential harms.

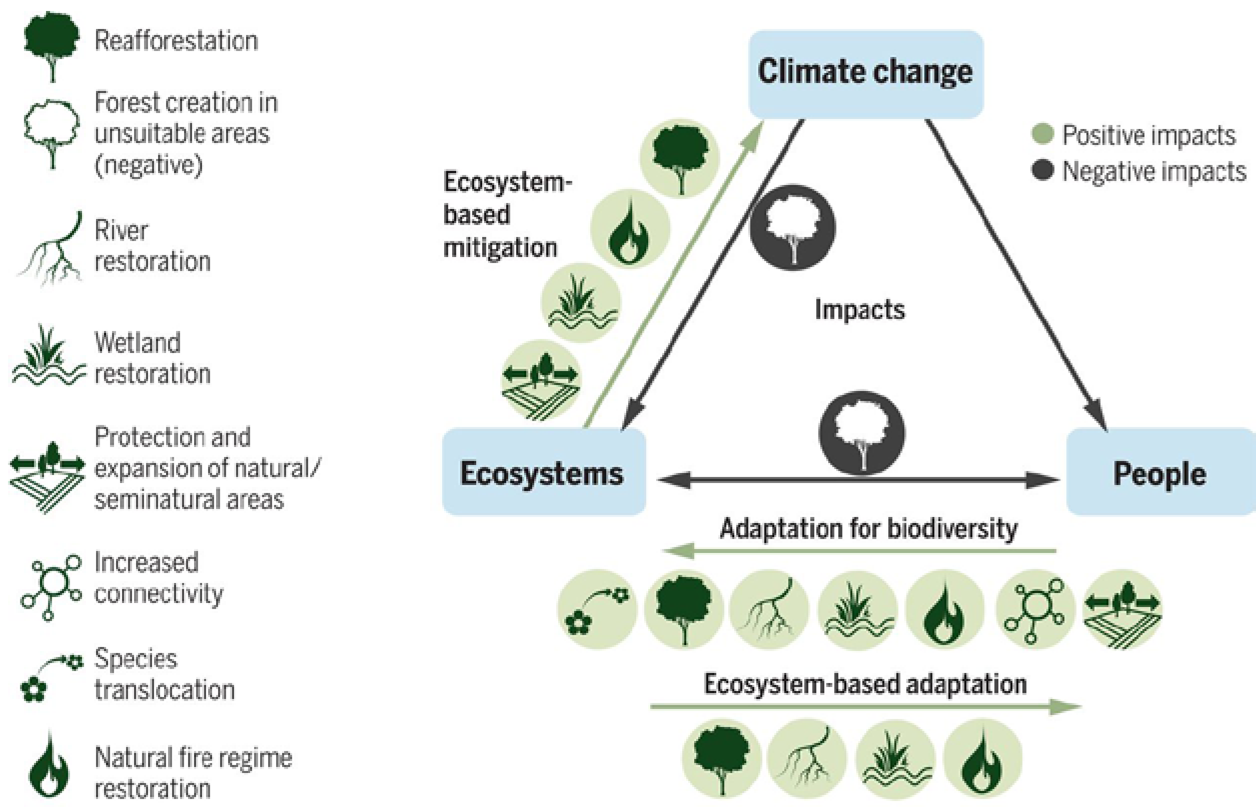


Figure 4: The role of ecosystems in climate change adaptation and mitigation (Morecroft et al, 2019)

2.6 Rationale for EbA

Ecosystems and human societies are interdependent, and ecosystems can play a pivotal role in managing the escalating risks posed by climate change. EbA is a promising approach that uses the power of nature and natural ecosystems to adapt to the impacts of climate change. It was first officially defined as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change," with the aim of maintaining and increasing the resilience and reducing the vulnerability of ecosystems and people against the impacts of climate change (Secretariat of the Convention on Biological Diversity, 2009). The four essential components of EbA include harnessing biodiversity and ecosystem services with the purpose of **helping people** so that they can **adapt to climate change** within **a broader adaptation framework** (UNEP-WCMC and UNEP, 2019). EbA works with the following core principles:

1. Harnessing natural services: EbA leverages the natural abilities of ecosystems to provide protection, regulation, and resilience against climate change impacts. This can include using mangroves for coastal protection, restoring forests for flood control, and promoting wetlands for water purification.

2. Community-based approach: EbA emphasizes engaging local communities in the design and implementation of solutions, ensuring they are culturally appropriate, sustainable, and meet their specific needs.

3. Holistic perspective: This approach recognizes the interconnectedness of ecosystems and their services, and aims to address multiple challenges like climate change adaptation, biodiversity conservation, and economic development simultaneously.

The concept of EbA is among several others that promote the conservation, wise use, and restoration of biodiversity and ecosystems as a means of climate change adaptation based on the assessment of risks and vulnerabilities of a socioecological system. However, the EbA approach is unique in that it sees both people and ecosystems as equally important assets to safeguard (CBD, 2018).

EbA provides several benefits by serving as a cost-effective approach that relies on ecosystems' natural dynamics to address the impacts of climate change, making it ideal to experiment with in situations where limited funds are available for the implementation of costly, large-scale, 'grey' infrastructure. Unlike some complex infrastructure, natural solutions are less prone to degradation over time and can adapt to changing conditions. Additionally, EbA can be coupled with grey infrastructure, helping prolong the lifetime of engineered interventions (CBD, 2018). EbA can address multiple challenges simultaneously, providing social, economic and cultural co-benefits for local communities as well as for biodiversity and climate mitigation. Some of these co-benefits include: enhanced quality of life, health and well-being of urban dwellers; better access to food and water; economic returns through the generation of green jobs; higher land value associated with better aesthetics; ecosystem and biodiversity restoration; better air quality; less energy consumption; reduced UHI effect; and opportunities for recreation and tourism, among others. Furthermore, EbA's implementation necessitates the engagement of local communities, thereby helping to conserve traditional knowledge and practices as well as foster ownership and responsibility for the long-term sustainability of solutions (Secretariat of the Convention on Biological Diversity, 2009; GIZ, 2022).

Box 2: Dune-forming reed fences to combat sea-level rise in the Nile Delta, Egypt

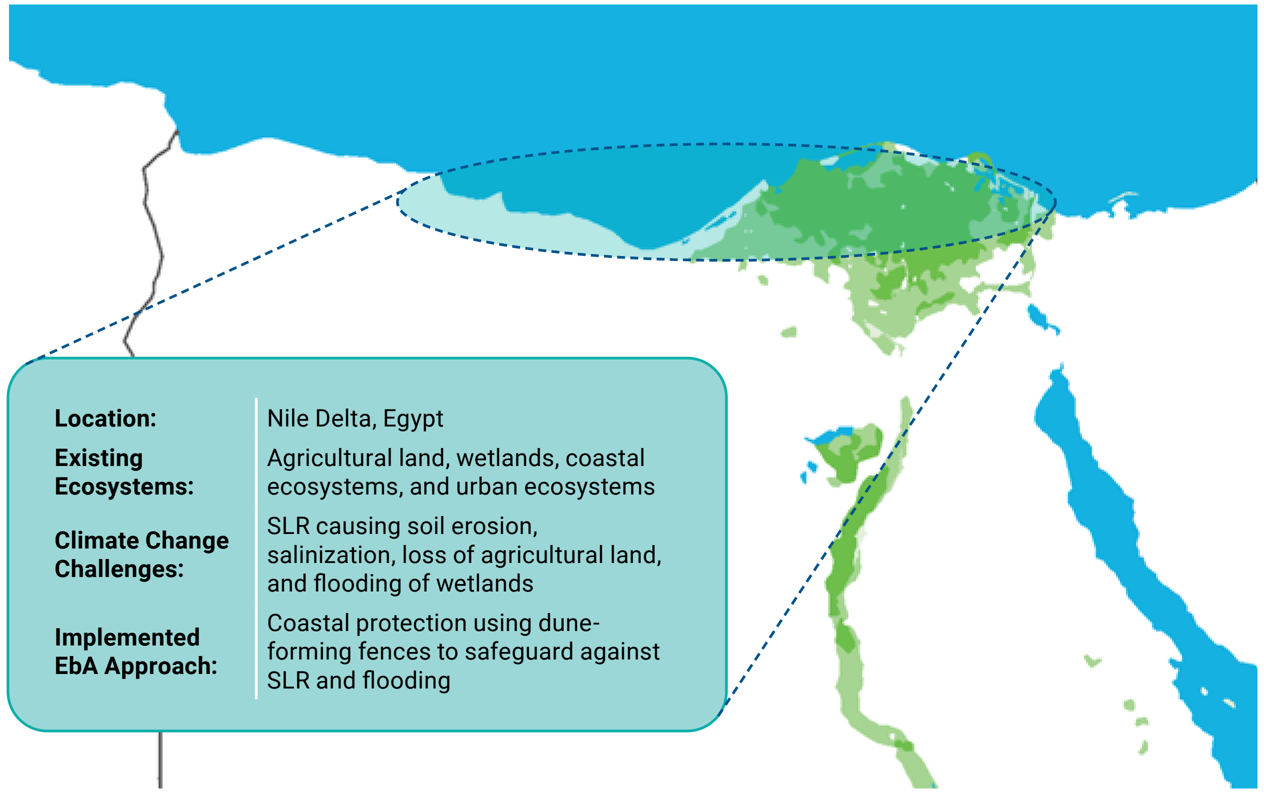


Figure 5: Map of Nile Delta and Norh coast of Egypt

The Nile Delta in Egypt, a region with 18 million inhabitants, is a significant wetland region that provides crucial environmental, social, and economic services. The Delta region, latitudinally spanning 160 kilometres with a coastline spanning approximately 270 kilometres, is one of the world's most vulnerable areas to climate change impacts, especially SLR. Moreover, the region is experiencing sinking due to different factors, including SLR, neo-tectonic lowering, sediment compaction, and reduced sediment regeneration caused by upriver dam construction. This persistent submergence has far-reaching consequences, as the majority of Egypt's population resides in the Nile Delta and Valley region. Infrastructure, cultural heritage sites, and economic and agricultural activities are also at significant risk. Additionally, the continuous loss of arable land, and decline in freshwater availability due to the transformation of the region into saline arid land, are clear indications of the negative impacts of climate change. Farmers are being forced to abandon their land or resort to importing sand to mitigate the effects of

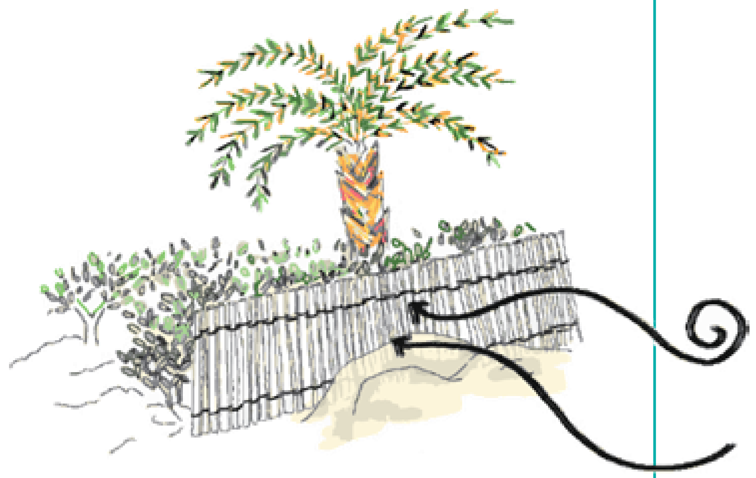


Figure 6: Sketch of the dune-forming reed fences
Credit: Alik Mikaelian, UNDP, 2022

SLR. Therefore, without measures to mitigate the adverse impacts of climate change, it is projected that the Nile Delta will face severe water scarcity, leading to massive food shortages and potentially displacing 7 million people as climate migrants/refugees by 2100.

An EbA project is being implemented to protect 69 kilometres along the coastline in five hotspots in the Delta region. The project employs a solution that has been used by indigenous communities in the region for many years, which is installing dune-forming fences in specific locations. These fences, made from reed, a locally sourced natural material, are strategically placed in the direction of prevailing winds to capture and stabilize blown sand, and naturally form dunes that increase resilience to saltwater intrusion, erosion, storm surges and tsunami waves (UNESCO, 2021). At only a 10 per cent completion stage, the dikes were able to block an unexpected sea surge in 2020. The project is part of an Integrated Coastal Zone Management (ICZM) plan that aims at making the area's economic, social and agricultural activities climate-resilient. The engagement of different stakeholders, including local farming and fishing communities, coast guards, research centres, and government entities, contributed to the success, ownership, and sustainability of the project.[1]

Figure 7: Dune-forming reed fences in Nile Delta. Credit: Alik Mikaelian, UNDP, 2022

1 Sources: Mikaelian, A. (2022, July 31). Learning from local ingenuity – how simple reed fencing has unlocked a solution to rising sea levels in Egypt. Retrieved from United Nations Development Programme: https://www.undp.org/egypt/blog/learning-local-ingenuity-how-simple-reed-fencing-has-unlocked-solution-rising-sea-levels-egypt - Stanley, J. D., & Clemente, P. (2017). Increased Land Subsidence and Sea-Level Rise Are Submerging Egypt's Nile Delta Coastal Margin. Gsa Today, 4-11. - UNDP. (2021, June 13). Protecting the Nile Delta. Retrieved from United Nations in Egypt: https://egypt.un.org/en/131231-protecting-nile-delta - UNDP Egypt. (2017, November 2). Enhancing climate change adaptation in the north coast and Nile delta regions in Egypt. Retrieved from Green Climate Fund: https://www.greenclimate.fund/document/enhancing-climate-change-adaptation-north-coast-and-nile-delta-regions-egypt# - UNESCO. (2021). UNESCO DRR Atlas. Retrieved from UNESCO DRR Atlas: https://unesco-arab-drratlas.com/en/case-studies

2.7 Ecosystem-based Adaptation in multilateral environmental agreements and global agendas

The importance of ecosystems and ecosystem services has been emphasized in several Multilateral Environmental Agreements (MEAs) such as the Convention on Biological Diversity, the Sendai Framework for Disaster Risk Reduction (SFDRR) (2015-2030), and the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). Other multilateral environmental conventions reflect the interconnectedness between ecosystem management, climate change, and disaster risk reduction.

In recent years, all global and regional commitments, including the 2030 Agenda for Sustainable Development, the Paris Agreement, and the SFDRR, have called for 1) accelerating sustainability, 2) enhancing human development resilience through adaptation and disaster risk management programs, and 3) providing entry points for the broader implementation of EbA and disaster management approaches (Convention on Biological Diversity, 2018).

In light of these multilateral agreements, the term "urban biodiversity" has emerged, which refers to the diversity and richness of living organisms (including genetic diversity) and habitats found within and on the fringes of human settlements. It includes:

1. Remnants of natural landscapes (such as remnant forests);
2. Traditional agricultural landscapes (such as meadows, arable land and areas suitable for cultivation);
3. Urban and industrial landscapes (such as city centres, residential areas, industrial complexes, railway areas, parks, and recreational spaces and gardens).

Utilizing EbA contributes to the achievement of several Sustainable Development Goals (SDGs), as they play a crucial role in promoting sustainability across various sectors, including agriculture, forestry, energy, and water. EbA also contributes to social justice, education, and livelihood diversification.

EbA initiatives can directly contribute to the achievement of the following SDGs:

The New Urban Agenda, adopted worldwide in 2016, serves as a collective vision for a more sustainable and improved future. It sets forth guidelines and principles for the planning, construction, development, management, and enhancement of urban areas. The issue of environmental sustainability, including ecosystem and biodiversity protection, is a fundamental consideration within the framework of the New Urban Agenda, which advocates for the development of cities that prioritize the safeguarding, preservation, restoration, and enhancement of their ecosystems, water systems, natural habitats, and biodiversity.

The New Urban Agenda comprehensively addresses urban adaptation and resilience from various angles, encouraging urban actors to integrate EbA into adaptation plans, policies, programs, and actions to enhance the resilience of urban populations. To address the potential impacts of uncontrolled rapid urbanization on ecosystems, the New Urban Agenda handbook introduces various design tools and strategies that can be utilized to incorporate natural elements into the plans of built environments and cities. The aim is to establish a healthy and sustainable urban environment that preserves the ecosystems that foster biodiversity both within the city and its surroundings. These tools and strategies include green spaces, wetlands reconstruction and river-side vegetation, all of which aim to mainstream the principle of "designing with nature."

Box 3: Drought early warning system in Lebanon to support long-term drought risk management

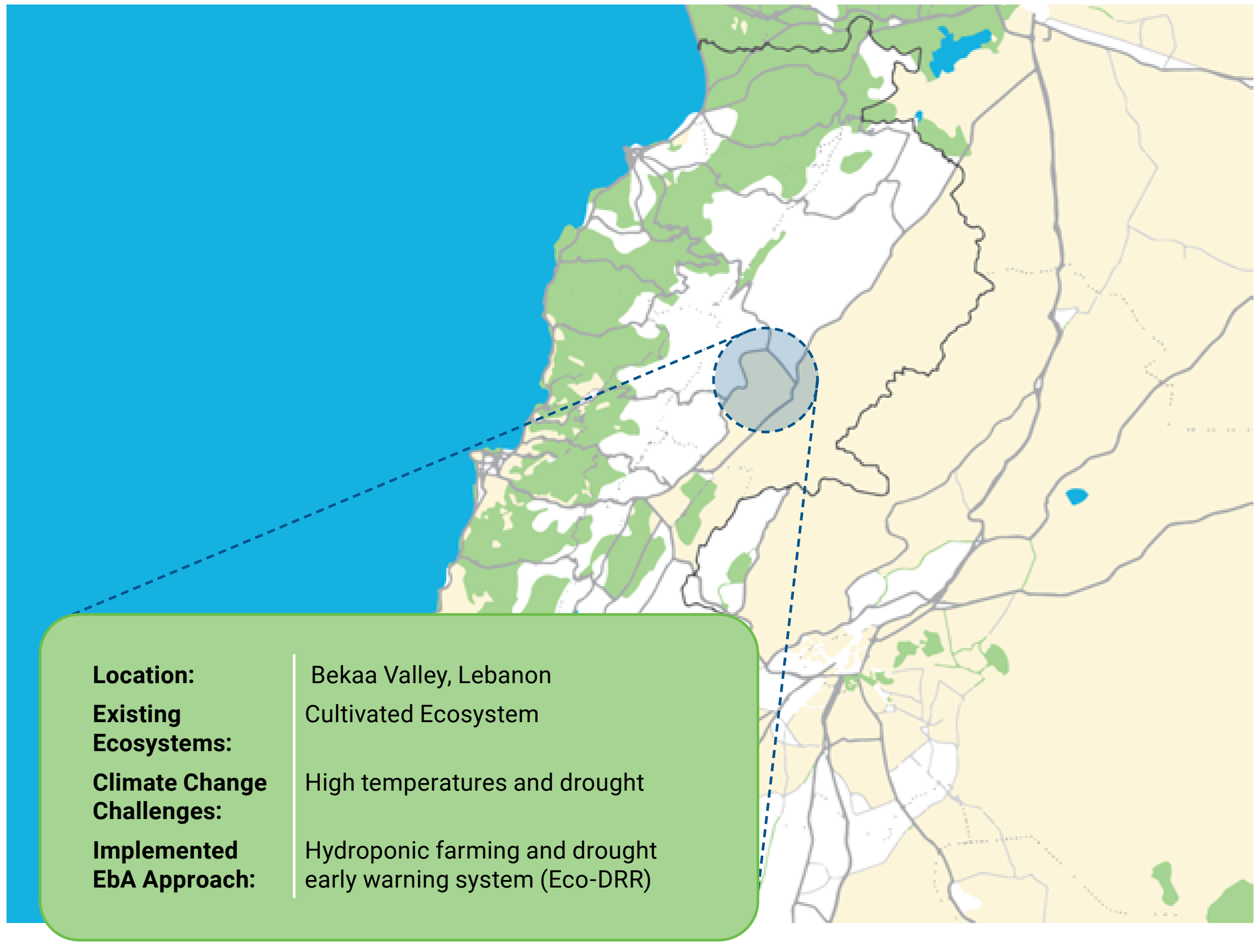


Figure 8: Map of Bekaa Valley in Lebanon

Drought will continue to negatively affect agriculture and water resources in Lebanon. Projections of future climate scenarios indicate a continued rise in aridity, accompanied by heightened severity and frequency of droughts, particularly in central Lebanon. The agricultural sector will bear the brunt of these extreme conditions, resulting in a decrease in crop production and adversely impacting farmers' livelihoods. The Lebanese Agricultural Research Institute (LARI) has created weather forecasting facilities and developed a nationwide drought management system for Lebanese farmers. Throughout the years, LARI has established various means of communication with farmers, beginning with text messages as a means of communication in 2008. In 2015, LARI introduced a smartphone application to serve as a comprehensive platform for sharing information including weather forecasts, alerts regarding extreme weather conditions, vital updates on agricultural practices, efficient irrigation techniques, and guidance on pest and disease management.

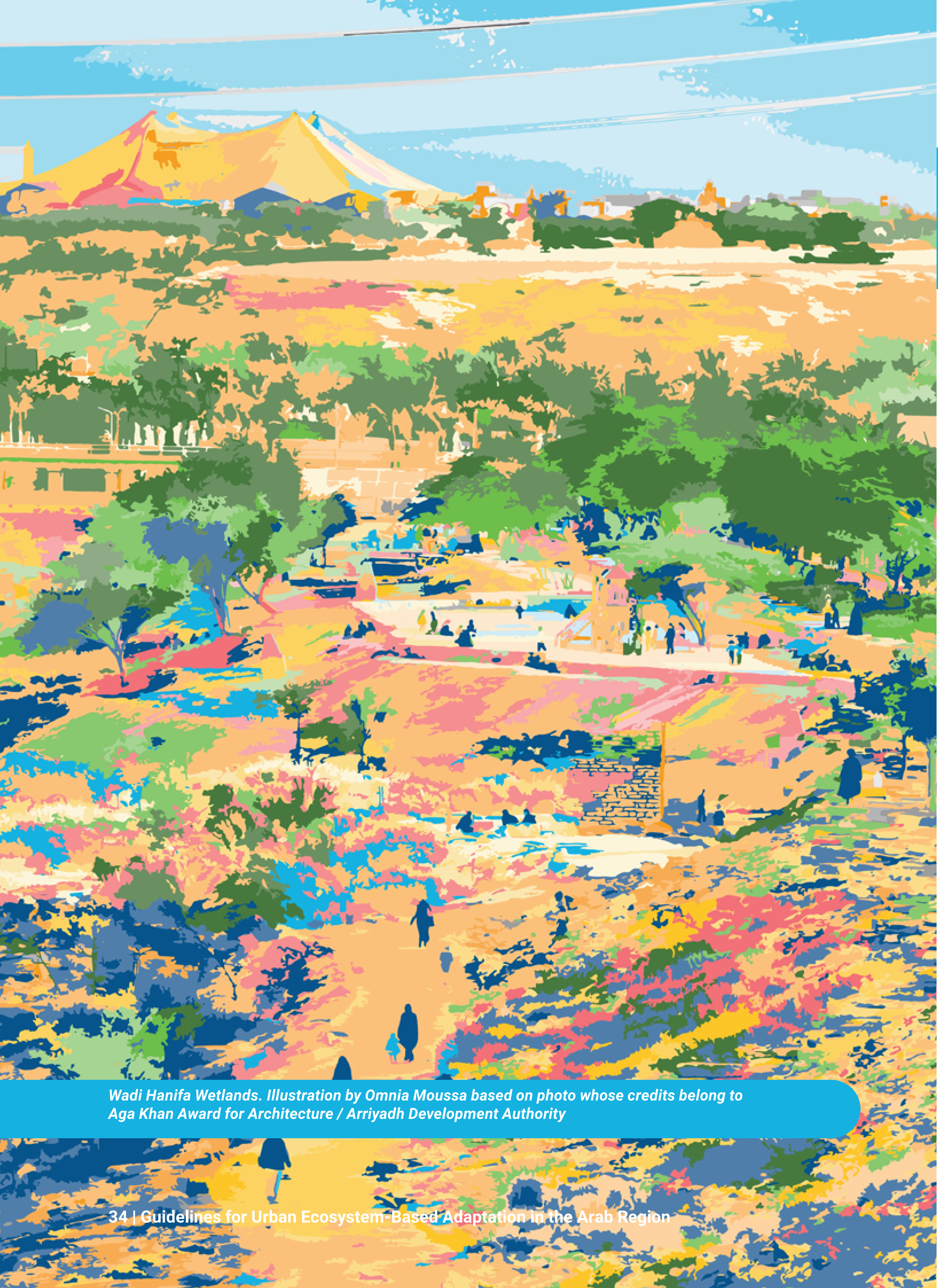
Various programmes were introduced to mitigate the negative impacts of drought in Lebanon, including the establishment of the drought early warning system, which is currently being managed by LARI. This system aims to provide daily climate predictions and identify the most vulnerable areas, enabling the implementation of EbA programmes such as water harvesting and hydroponic agriculture. These initiatives play a crucial role in ensuring the sustainability of farmers and positively contributing to their long-term viability.

Soil-free techniques were also introduced, such as urban hydroponics, in small and fragmented land and between refugee communities lacking agricultural land and food security. Hydroponic agriculture is a soil-less method of growing plants in a water-based, nutrient-rich solution.[2]

Figure 9: Example of hydroponic agriculture in Lebanon Credits Georges Abi Sleiman 2024

2 Sources: Verner D., Ashwill M., Christensen J., McDonnell R., Redwood J., Jomaa I., Saade M., Massad R., Chehade A., Bitar A., Treguer D., Droughts and agriculture in Lebanon: Causes, consequences, and risk management. World Bank group, Lebanon; http:/ /docurnents.worldbank.org/ curated/en/892381538415122088/ pdf/I 30405-WP-PI60212-Lebanon-WEB.pdf, accessed online 01 March 2023

UNESCO. (2021). UNESCO DRR Atlas. Retrieved from UNESCO DRR Atlas: https://unesco-arab-drratlas.com/en/case-studies



Wadi Hanifa Wetlands. Illustration by Omnia Moussa based on photo whose credits belong to Aga Khan Award for Architecture / Arriyadh Development Authority

Chapter 3

Ecosystem-based Adaptation in Urban Areas

3.1 Introduction

Ecosystem-based adaptation is increasingly recognized as a practical approach to addressing the challenges of climate change in the Arab region. With its unique blend of arid, semi-arid, and coastal ecosystems, the Arab region faces many climate-related risks, including water scarcity, desertification, loss of biodiversity, and extreme weather events. Ecosystems such as forests, wetlands, coastal areas, and agricultural landscapes play critical roles in providing essential services supporting the livelihoods and well-being of millions across the region. By integrating ecosystem management and conservation into adaptation strategies, EbA aims to enhance the resilience of both ecosystems and human communities to climate change impacts. Through preservation, restoration, and sustainable management of natural habitats, EbA initiatives in the Arab region offer promising pathways to mitigate the adverse effects of climate change while promoting sustainable development and safeguarding ecosystem services for future generations.

3.2 Implementing EbA in Urban Areas

Adapting to climate change is imperative across all areas. Urban settlements face distinctive challenges, especially those related to the UHI effect, where cities have higher temperatures due to reduced vegetation and increased built infrastructure. Paved surfaces increase runoff, leading to flash floods and overwhelmed drainage systems. In addition, urban populations put pressure on water resources, and climate change can exacerbate this strain. The effects of traffic and industrial activities, which contribute to poor air quality and adversely impact public health, are further amplified. Urbanization also often leads to habitat loss and decline in species diversity.

EbA provides several solutions in urban areas, including the implementation of urban green infrastructure such as parks, green roofs, bioswales, and street trees that can cool the city, manage stormwater, filter air pollution, and provide habitat for birds and insects. Urban agriculture is another solution, especially using rooftop and community gardens, which can increase food production, improve food security, and reduce reliance on long-distance transport. Sustainable water management through rainwater harvesting, green roofs, and permeable paving can reduce demand for freshwater, and mitigate flooding. For coastal areas, mangrove restoration and living shorelines can provide natural buffers against storm surges and rising sea levels. Protecting and expanding existing urban forests and creating new ones can cool the city, improve air quality, and provide recreational opportunities. Urban wetlands can also filter and capture floodwater, abate UHI effect, replenish groundwater while simultaneously improving air quality, and provide green spaces. These solutions can increase the resilience of cities, improve health and well-being, enhance social cohesion, and strengthen economic benefits and biodiversity conservation.

Table 2: Examples of Ecosystem-based Adaptation approaches that can be applied in urban areas in the Arab region

Existing urban challenges	EbA approach
• Floods • soil erosion • Poor air quality • Lack of shade	**Reforestation** in urban areas, including: • Streets • Green belts • Nurseries • Groves
• UHIs and heat stress • Drought • Poor air quality • lack of shade	Creating **green spaces**: • Parks • Conservation areas • Stream restoration • Public gardens • Groves
• Floods • Transportation disruption due to extreme weather events	**Flood risk management**: • Well-designed, dedicated lanes for pedestrians and vehicles • Community gardens • Playgrounds
• Floods • Drought	**Rainwater harvesting**: • Greywater supply • Surface run-off redirection • Urban gardens
• Drought • Floods • Land subsidence	**Permeable sidewalks:** • Recharge aquifer and water storage • Diversion of run-off • Safety of pathways
• Inefficient water and sanitation systems	**Water purification**: • Urban gardens • Artificial wetlands
• Biodiversity loss • Poor water quality	**Nature connecting corridors**: • Conservation areas • Habitats for birds and plants • Community gardens
• Urban canyons and high urban densities • Air pollution • Urban food insecurity	**People-centered urban design and planning:** • Sustainable land management • Green space planning • Sustainable urban food production

Source: United Nations Environment Programme, 2021

To effectively address the challenges of climate change, EbA needs to be integrated into adaptation strategies. In addition to the growing need to manage and restore ecosystems, cities need to prioritize building their resilience to adapt to the escalating impacts of climate change to protect their populations and safeguard their infrastructure. Infrastructure resilience plays a crucial role in withstanding anticipated future climate change impacts. A wide range of measures can be implemented to achieve this, including raising the height of bridges and road surfaces to withstand rising sea levels and urban flooding in coastal areas, increasing the capacity of drainage systems and sewage infrastructure to accommodate higher rainfall rates and urban flooding, using climate-resistant materials for roads, and implementing wind protection initiatives. It is also important to consider relocating communities away from hazardous areas prone to floods and flash floods, elevating electrical equipment and control devices, and utilizing, enhancing, or restoring natural or semi-natural systems such as wetlands, plants along river channels, or vegetative cover on sand dunes to safeguard vital infrastructure. Additionally, employing environmentally safe road engineering techniques that utilize plants on slopes to protect roads, especially in mountain areas, and utilizing physical protection measures like seawalls or dams to safeguard against flooding are essential strategies.

Box 4: A comprehensive development plan for the rehabilitation of Wadi Hanifah, Saudi Arabia

Location:	Riyadh, Saudi Arabia
Existing Ecosystems:	Watersheds, drylands, and urban ecosystems
Climate Change Challenges:	seasonal flooding, and soil erosion.
Implemented EbA Approach:	Valley rehabilitation including natural flood management, afforestation, open parks creation, and wastewater bioremediation

Figure 10: The flood performance of the channel is improved by reprofiling and regrading Credit: Aga Khan Award for Architecture / Arriyadh Development Authority

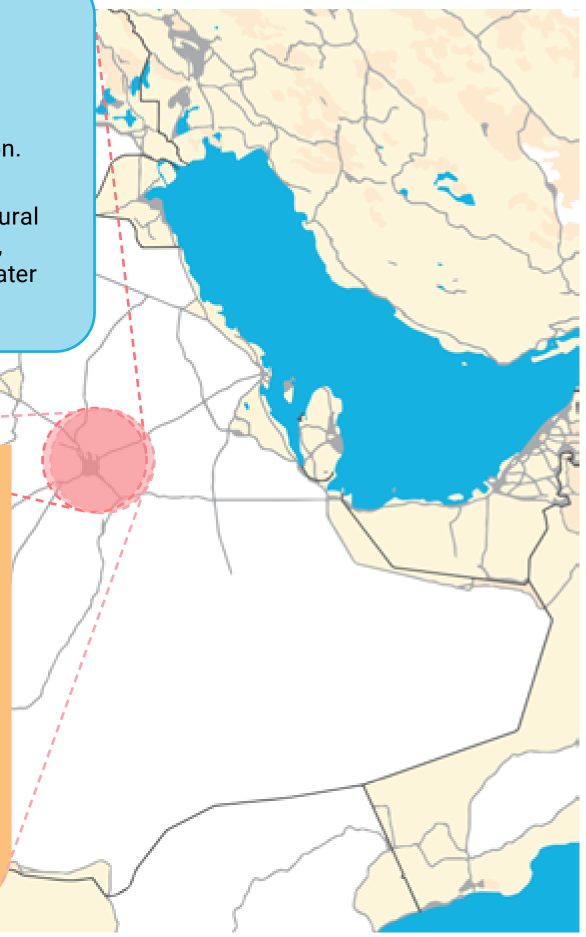


Figure 11: Map of Wadi Hanifa in Saudi Arabia

Running through the rapidly urbanizing city of Riyadh is the 120km-long watershed called Wadi Hanifah, or Hanifah valley. It has an area of 4500m2 with several tributaries and smaller valleys. Between the 1960s and the 1990s, the valley's natural resources, including natural stones and ground water, were overexploited and polluted while the valley was being used as a waste site. In response to the extreme deterioration, the Royal Commission for Riyadh City (RCRC) launched and implemented the Comprehensive Development Plan for Wadi Hanifah (CDPWH) between 2001 and 2010 to rehabilitate and restore the valley. The CDPWH rehabilitated Wadi Hanifah to serve as a natural drainage system for Riyadh city while also functioning as a leisure park for city residents and a sustainable water supply through wastewater bioremediation.

The CDPWH worked through two components: the Wadi Hanifah Restoration Project (immediate actions) and the Wadi Hanifah Development Programme (long-term actions). The immediate actions focused on stopping harmful activities and assessing flood performance and water quality, while the long-term actions focused on environmental rehabilitation and the cleaning of polluted sites, renaturing, protecting ecologically valuable sites and developing recreational spaces. Through the second component, nine major public parks have been implemented along the valley's riverbed. The parks, which attract over 200,000 visitors per week, were designed to suit Saudi culture, integrating outdoor family "privacy rooms", recreational trails, adequate parking and sanitary facilities. With local materials and plant species in mind, limestone blocks were used for structures and aggregates for recreational trails in the parks, while 35 different types of native plants were brought from areas that were least polluted and reintroduced throughout the valley grounds. Using urban wastewater bioremediation, 92.5 million gallons of potable water were saved per day for park amenities and irrigation. The project successfully linked ecological and social benefits, which increased public awareness and support for the project.[3]

Figure 12: Water filtration facility in Wadi Hanifa Credit: Aga Khan Award for Architecture / Arriyadh Development Authority

Figure 13: Walking trails and family compartments in the form of semi-enclosed areas along the wadi Credit: Aga Khan Award for Architecture / Arriyadh Development Authority

3 Sources: Buro Happold. (n.d.). Wadi Hanifah Flood Management Plan. Retrieved from Buro Happold - Integrated Consulting Engineers and Advisers: https://www.burohappold.com/projects/wadi-hanifah-flood-management-plan/

Royal Commision for Riyadh City. (n.d.). Environmental Rehabilitation Program for Wadi Hanifa and its Tributaries. Retrieved from Royal Commision for Riyadh City: https://www.rcrc.gov.sa/en/projects/wadi-hanifah

Trottier, J., & Eidick, K. (2015). Wadi Hanifah Comprehensive Development Plan | Landscape Performance Series. doi:https://doi.org/10.31353/cs1040

3.3 Integrating EbA into urban development planning

Development refers to actions directed towards enhancing and maintaining human welfare, encompassing social, economic, and environmental dimensions and objectives such as economic growth, poverty alleviation, infrastructure development, efficient energy utilization, and adaptation to climate change. Development goals and plans could be achieved by safeguarding ecosystem services that contribute to the well-being and livelihoods of human communities. As discussed in previous sections, urban areas could benefit greatly from the integration of EbA into climate action and planning processes. Given the complexity of the challenges faced by cities and the multitude of stakeholders involved in ecosystem upkeeping and maintenance, the key question remains how EbA can be effectively incorporated into planning for climate adaptation and disaster risk reduction as well as decision-making processes in urban areas. The following entry points serve as drivers and enablers for mainstreaming EbA in urban areas:

- Stakeholders' awareness of the challenges and risks posed by climate change to the urban environment as well as solutions, proposals, tools and knowledge available to address these challenges;
- political will to adopt an EbA approach in urban areas;
- clarity on responsibilities and roles of stakeholders.

Furthermore, the United Nations Environment Programme (UNEP) identifies the following eight steps as actions and entry points for integrating EbA into National Adaptation Plans (Secretariat of CBD, 2019, p. 50; UNDP-UNEP, 2015). These steps can also be reconfigured for adaptation and resilience planning at the local level. Figure 7 below outlines the steps involved in a comprehensive integration of EbA into development planning for urban settlements.

Figure 14: Steps to integrate EbA into development planning at the different levels. Adaptation based on United Nations Environment Programme, 2021

3.3.1 Climate risk and vulnerability assessment

The first step in integrating EbA into development planning is to carry out a climate risk and vulnerability assessment for the urban environment in question. This step involves the identification of climate change hazards, and assessing their economic, social, sectoral, and cross-sectoral impacts on the study area. The assessment process may involve a wide range of inputs from various sources and assessments, including insights obtained through the formulation of modelled and analysed indicators, trend data analysis, and risk modelling or simulation, as well as inputs of experts from the urban and environmental planning fields. To develop a realistic assessment, the four steps listed below should be followed (for more details about conducting climate risk and vulnerability assessment in urban areas, see Annex 1):

- **Step 1:** Climate hazard assessment: developing projections (models) of climate-related risks to the urban environment
- **Step 2:** Vulnerability assessment: conducting climate risk assessment, including sensitivity, exposure, and adaptive capacity
- **Step 3:** Analysis of results: Understanding the economic, social, sectoral, and cross-sectoral impacts of climate change
- **Step 4:** Communication of results and recommendations to decision-makers

3.3.2 Stakeholder engagement

A stakeholder is defined as an institution or individual who could be positively or negatively affected by a specific project or programme, and could have a direct or indirect impact on it during its different stages of development. An important and necessary step in implementing EbA options is understanding the stakeholders, their responsibilities, and the expected roles each of them will play in implementing the various options that will be proposed. Therefore, it is advisable to follow these steps to understand the stakeholders:

- **Stakeholder Mapping:** It is very important to map and identify all relevant stakeholders and at which stage of the process they could contribute (design, implementation, monitoring and evaluation)
- **Capacity-Building:** This is a crucial stage that should include an assessment of capacity needs to determine stakeholders' training and development requirements, followed by the development of a workplan to conduct the identified capacity-building programs. Some important programmes that could be delivered to stakeholders according to their capacity needs that would enable them to successfully carry out urban EbA initiatives include: (a) climate risk assessment; (b) assessment of the climate change vulnerability of environmental and urban systems; (c) assessment of ecosystem services, and (d) institutional enabling environment for EbA
- **Stakeholder Engagement:** For successfully planning and ensuring the effectiveness of EbA initiatives in the urban environment, stakeholders must be engaged at all stages of the project, starting from design, through implementation, and to monitoring and evaluation, at the different levels

3.3.3 Identification of EbA options and priorities

Once the vulnerability assessment is complete and both the climate change risks and the stakeholders have been identified, the next step is to start identifying EbA options that would reduce the severity of the identified climate change risks for the study area. These options depend on the nature of the site, the extent of ecosystem degradation, and the extent to which humans are affected by climate change. Decision-makers can rely on several criteria to determine suitable EbA options, and use the set of questions listed below. The following questions could help determine the appropriate options, such as whether a hybrid option between grey and green urban environments may be the optimal arrangement.

- Can the EbA option be implemented within a desired timeframe, or does it require long periods?
- Does the local community have the necessary capacity to implement the EbA option, or is it necessary to bring in external experts?
- Are the operational and maintenance requirements more challenging (or more costly) than alternative infrastructure approaches?
- Are EbA measures effective in adapting to the long-term impacts of climate change, or are they likely to be effective only in the short term?
- Is it possible to develop a pilot to measure the effectiveness of EbA measures without incurring significant costs?
- Has a similar EbA approach been adopted elsewhere (nationally, regionally, or globally) and proven to be superior to the infrastructure approach in this context?
- Are the co-benefits significant enough to outweigh the direct benefits of the alternative infrastructure option?

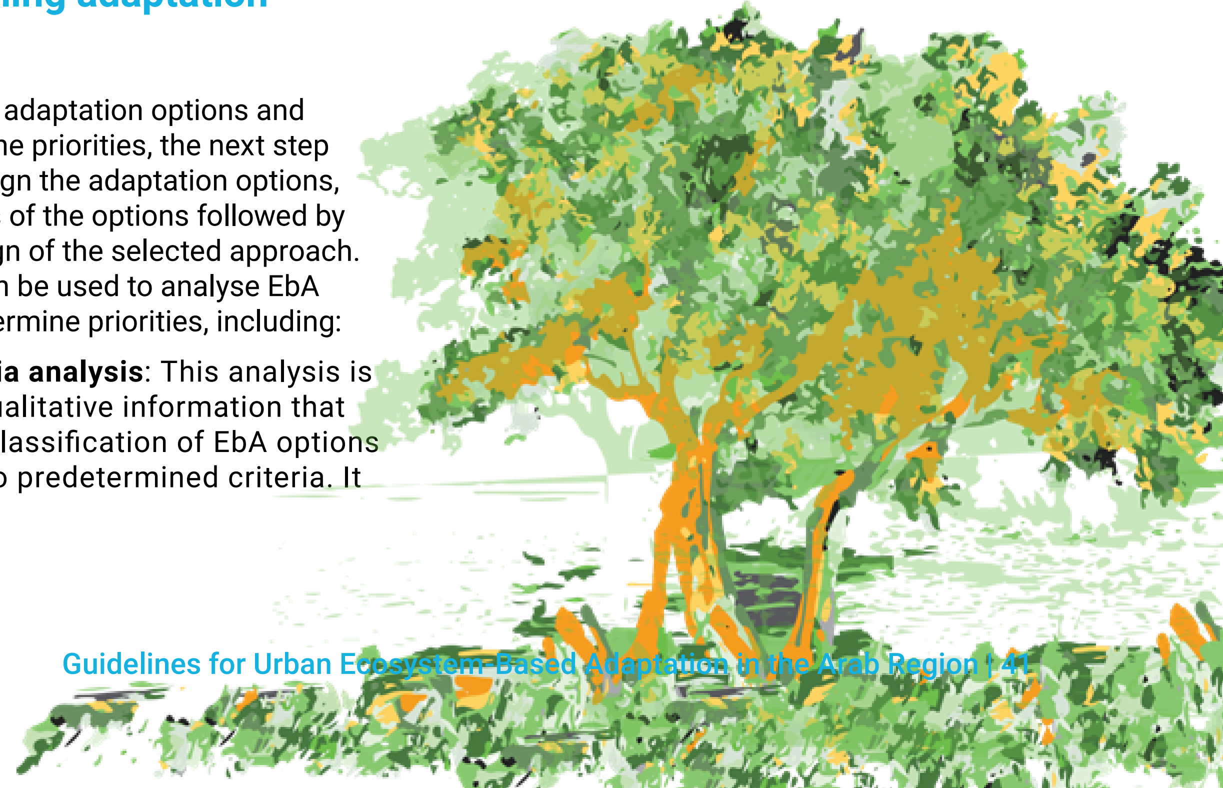
Once the necessary criteria for understanding urban EbA options are determined, it is important to start identifying these options. Another important question to ask, which would help in the identification of appropriate EbA options, concerns the main priority of the approach. EbA initiatives can be classified according to the main priority of the project into the following three categories:

- Capacity-building or resilience-building initiatives;
- Initiatives that reduce exposure to the risks of climate change;
- Initiatives that aim to create employment opportunities while simultaneously reducing climate risks and minimizing exposure to their impacts.

3.3.4 Designing adaptation options

After identifying adaptation options and understanding the priorities, the next step would be to design the adaptation options, through analysis of the options followed by the project design of the selected approach. Several tools can be used to analyse EbA options and determine priorities, including:

- **Multi-criteria analysis**: This analysis is based on qualitative information that allows the classification of EbA options according to predetermined criteria. It requires the participation of all relevant stakeholders during the planning process to define the criteria. The criteria that should be used to evaluate EbA options include:
  - Potential for reducing risks associated with current and future climate hazards and changes
  - Potential for improving people's capacity to adapt to climate change
  - Potential for generating benefits for vulnerable social groups and promoting gender equality
  - Sustainable use of biodiversity and ecosystem services to build resilience
  - Enhancement of ecosystem resilience to current and future climate hazards and changes
- **Cost-benefit analysis**: This analysis relies on quantitative information to estimate and compare the costs and benefits of EbA options. It provides information on which specific measures generate the greatest direct and indirect benefits related to climate risk reduction. Criteria that can be considered during a cost-benefit analysis include:
  - Cost affordability.
  - Technical feasibility
  - Political feasibility



- Maintenance costs and availability of skilled labour for maintenance
- Monitoring feasibility
- Resilience
- Number of beneficiaries
- Cultural suitability

The International Union for Conservation of Nature (IUCN) has developed guided forms that could also be used to prioritize and design EbA options through EbA qualification criteria analysis and quality standard assessment of the measure. More details on the forms can be found in Annex 1.

3.3.5 Raising awareness and knowledge

Based on the discussion and analyses carried out during the stakeholder engagement phase, a component for raising awareness and knowledge-sharing should be developed. The activities involved in this component would target relevant stakeholders and disseminate knowledge on key topics like ecosystem services and the value of nature, climate change and its risks, adaptation measures like EbA, and the role and responsibilities of each stakeholder. This step is crucial for the success and sustainability of the EbA approach as it will pave the way for community acceptance and upkeep of the implemented measure, building on the sense of awareness and ownership of the recipients.

3.3.6 Resource mobilization for EbA initiatives

One of the key steps in implementing EbA programmes is identifying funding opportunities and mobilizing financial resources at the local and international levels, as well as seeking out private sector investments for these programmes. The following subsections provide some guidelines related to funding at the local and international levels, as well as from the private sector.

3.3.6.1 Local funding

Funding measures for disaster risk reduction and EbA require long-term planning to achieve the desired adaptation benefits as well as the social, economic, and environmental co-benefits (GIZ, CMP, 2020). Local public funding can serve as a stable and predictable funding source depending on national economic conditions, priorities, and the need for implementing such initiatives. One of the easiest ways to prioritize climate change budgets is by increasing allocations for climate-related initiatives within ministries. The following list provides recommendations to help address key issues related to funding for EbA programmes and integrating them into climate-resilient development planning tools:

- Assess the benefits of disaster risk reduction, climate adaptation, and the co-benefits of habitat restoration and conservation to facilitate channelling of funds towards implementing EbA initiatives
- Strategically plan at the municipal level for disaster risk reduction, health, food security, infrastructure, and allocate budgets to implement EbA programmes to address these challenges
- Incorporate priorities of EbA programmes into national plans, such as regional development plans, provincial development plans, or local climate action plans
- Enhance the role and effective participation of environmental ministries in collaboration with the key ministries responsible for budget development, such as the ministries of finance and economy, to:
    - Establish specific budget lines for EbA programmes within annual general budgets.
    - Direct public investment towards supporting biodiversity protection and ecosystem programs.
    - Promote public investment to transition from traditional grey infrastructure to measures related to EbA programs, including green urban infrastructure.
- Develop innovative financial tools such as reward/compensation mechanisms or payment for ecosystem services models for community initiatives implementing EbA.
- Develop local financing mechanisms to expedite climate change adaptation measures, such as national environmental funds. These funds can be jointly financed by governments and donors through financial instruments such as taxes, fees, and bonds.

3.3.6.2 International funding

International climate finance consists of bilateral and multilateral funding mechanisms. The major sources of multilateral climate finance can be divided into two categories: those associated with the UNFCCC and those not associated with it. Table 3 provides an overview of these sources.

Table 3: Sources of multilateral climate finance

Sources of climate finance associated with the UNFCCC	Global Environmental Facility (GEF), which includes: • Special Climate Change Fund • Least Developed Countries Fund
	Green Climate Fund (GCF)
	Adaptation Fund (AF)
	Clean Development Mechanism
	Joint Implementation Mechanism
	Climate Investment Fund
Sources of climate finance not associated with the UNFCCC	World Bank Group, including: • Clean Technology Fund • Forest Investment Program • Pilot Program for Resilience • Scaling up RE Program
	Global Fund for Disaster Reduction
	Global Climate Change Alliance
	The International Climate Initiative
	Nordic Climate Facility

3.3.7 Implementation of prioritized EbA option(s)

Effective implementation of prioritized EbA option(s) involves following a clearly designed project plan that builds and ensures the mobilization and employment of resources and capacities of individuals and organisations for a successful EbA initiative. To achieve this, a strategic action plan needs to address several elements, including clear objectives and outputs, well-defined responsibilities, roles, and relationships, and provision of human and financial resources.

3.3.8 Monitoring and evaluation

Monitoring and evaluation (M&E) are vital for understanding the progress of a project in achieving its initial objectives and identifying uncertainties, gaps, and barriers that hinder progress in both the short and long term. M&E should be implemented during the lifespan of EbA projects and beyond. It enables policymakers, planners, and practitioners to improve adaptation measures by adjusting processes and objectives to ensure the realization of benefits over time. The importance of M&E stems from its ability to:

- Provide valuable evidence to support learning about what works in EbA;
- Enhance future investment by demonstrating cost-effectiveness; and
- Stimulate stakeholder participation in participatory monitoring.

There are some considerations to keep in mind when designing an effective M&E process for an EbA initiative, including:

- Establishing clear objectives as a first step in developing an effective M&E system. These objectives may address issues such as improving ecosystem functions or services, with the additional goal of reducing population vulnerability to climate change and enhancing adaptive capacity.
- Considering the quality and characteristics of the planning context as inputs for a strong baseline.
- Understanding the extent to which ecosystem services have been considered in the adaptation planning process.
- Identifying the factors that may lead to adaptive capacity weaknesses and how they have been addressed in current efforts.
- Designing M&E systems that include short-, medium-, and long-term indicators and operate at the appropriate scale to assess project effectiveness and changes in vulnerability.
- Ensuring that the selected/developed indicators directly address specific drivers of climate-related vulnerability (sensitivity, adaptive capacity, or exposure) identified during the planning stages as being linked to ecosystems and/or ecosystem services.
- Involving local communities in the monitoring process to enhance efficiency, local capacity, and learning. Additionally, M&E systems should be designed to cover a sufficient period of time and operate at the appropriate scale to assess the project or programme's effectiveness.
- Ensuring the possibility of replicating and scaling up initiatives and projects.

3.3.8.1 Types of indicators

EbA indicators can be classified as 1) process-based indicators (input and output indicators) and 2) performance-based indicators (outcome and impact measurement). Moreover, there are fundamental criteria to consider in the process of identifying and selecting indicators relevant to EbA. These criteria are listed below.

- Identification of indicators that reflect the resilience of all components of the human-environment system and the interconnections between them.
- Selection of commonly shared indicators that can be measured and monitored similarly within a specific area and across regions.
- Inclusion of indicators that reflect the health of the ecosystem (i.e. indicators that illustrate the state and aspects of biodiversity).
- Inclusion of indicators that can measure the ecosystem services provided to vulnerable populations (i.e. indicators that quantify the benefits derived by humans from ecosystems and their services).

- Integration of tools to assess the vulnerability and adaptability, in terms of quantity or type, of local human communities after implementing awareness initiatives.
- The selected indicators should allow for reporting at various levels (national, regional, international) and across different national levels.
- A prerequisite for ecosystem-based indicators is that they relate to spatial reference data and/or policies for a specific area or ecosystem.

Indicators and goals should be framed considering any changes that could take place over time.

Box 5: Afforestation and mangrove planting to address the risk of sea level rise

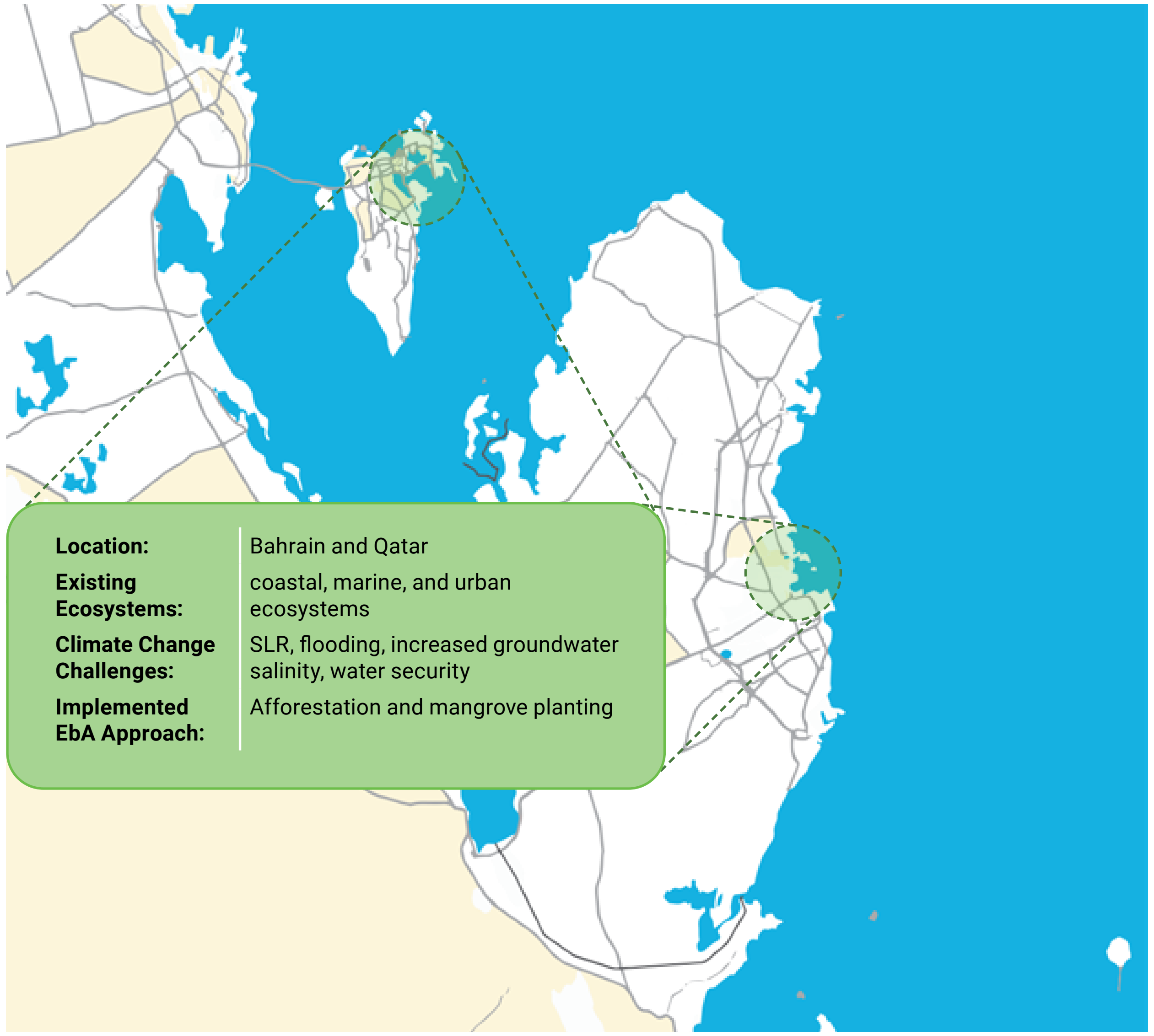


Figure 15: Map of Bahrain and Qatar

Both Qatar and Bahrain are highly susceptible to the impacts of climate change, including increased temperatures and SLR. Bahrain's low-lying coastal areas, where most of its population resides, are particularly vulnerable, with projections suggesting that a 1.5-metre SLR would submerge 27 per cent of its total area. Projections also show that a 0.5-metre increase will inundate 50 per cent of wetlands, while an increase of 1.5 metres will cost Bahrain 75 per cent of its wetlands. SLR of 5 metres will have a severe impact on most of the Kingdom of Bahrain and lead to the full submersion of Bahrain International Airport, in addition to affecting 74 per cent of urban areas. Similarly, Qatar is among the ten countries most affected by SLR, with over 18 per cent of its land area low enough to be permanently inundated in the case of a SLR of 5 metres. Additionally, SLR will increase groundwater salinity levels, threatening water security.

According to the definition of EbA, interventions should be embedded in a wider adaptation plan. In Bahrain, national efforts to mitigate and adapt to the impacts of climate change, including SLR, have been in place since 1994. Several measures have been considered in development sectors including the application of strategic environmental assessment (SEA) by relevant competent authorities in all development projects to ensure compliance with environmental standards (UNESCO, 2021).

Furthermore, the government of Bahrain has launched Bahrain's National Afforestation Plan, which aims to double the current number of trees and quadruple mangrove trees by the year 2035. This involves several initiatives and policies that would help increase the tree cover in Bahrain from 1.8 million to 3.6 million by 2035 through the cultivation of salinity and drought-tolerant trees compatible with the local climate. It also includes the

Figure 16: Recreational activities around mangroves in Bahrain Credits Hady Elcott 2023

Figure 17: Afforestation efforts in Bahrain Credits Hady Elcott 2023

implementation of a mangrove planting project, the Mangrove Cultivation Project, in several locations as a protection measure against SLR in coastal areas (Ministry of Municipalities Affairs and Agriculture, Kingdom of Bahrain, n.d.; UNESCO, 2021).

In the context of this plan, UN-Habitat, in partnership with FAO, is implementing the "Building Greener and Sustainable Cities" project in Bahrain. The project aims to promote the transition to climate-resilient urban ecosystems as well as raise the awareness and build the capacities of relevant stakeholders (United Nations, 2023).

Other suggested EbA solutions:

Since both Qatar and Bahrain share comparable climatic conditions and are vulnerable to similar impacts of climate change, the suggested EbA approaches in the context of Qatar are like the ones implemented in Bahrain, including:

Application of SEA by relevant authorities in all development projects to protect ecosystems.

Implementation of a mangrove cultivation project in several locations as a protection measure for coastal areas

Urban Ecosystem. Illustration by Omnia Moussa

Chapter 4

Recommendations for Operationalizing the Guidelines

4.1 Introduction

When planning for urban Ecosystem-based Adaptation, it is essential to recognize that no single overarching formula exists. Rather, EbA must be considered context-specific. EbA's operationalization in urban areas requires the establishment of efficient and coherent cooperation and coordination efforts across different sectors and levels of governance and society. It necessitates the development of innovative solutions to problems that exist in a constrained and often challenging context. Crucially, it requires a comprehensive understanding of the objectives, costs and benefits, socioecological drivers, interdependencies, and potential outcomes of this approach.

The Arab region is particularly susceptible to climate change, with urban areas showing increased vulnerability due to existing inadequacies in resource management and urban planning. Enhancing the resilience of both the population and the ecosystem services they depend on can be achieved by integrating EbA approaches into policy processes and urban planning. This document provides steps for climate risk assessment, stakeholder engagement, and for identifying and prioritizing EbA options. Nevertheless, it would be beneficial to also elaborate on specific considerations to guarantee EbA's effective integration into subnational and local policymaking.

In a notable example of successful integration, several countries in the region are increasingly incorporating mangrove restoration into their urban planning strategies as a means of advancing environmental sustainability. These countries employ a variety of mechanisms to achieve this integration, including urban zoning and land-use policies that reserve areas for mangroves, rigorous coastal and environmental regulations, and public-private partnerships that engage developers in restoration efforts. National environmental strategies, exemplified by those of Saudi Arabia and the UAE, provide the necessary policy support and funding to guide these efforts. Indeed, Bahrain places a significant emphasis on mangrove conservation and restoration within its National Biodiversity Strategy and Action Plan (NBSAP). Similarly, Oman incorporates mangrove conservation and restoration initiatives into its National Strategy for Sustainable Development. Furthermore, Kuwait's Environment Authority provides dedicated funding for projects incorporating mangrove restoration into coastal management plans. Additionally, community engagement plays a crucial role, with public awareness campaigns and local involvement ensuring the long-term success of these projects.

While presented individually for clarity, the following recommendations should be considered as an integrated whole. Depending on the context, they can and should be applied together to achieve optimal results.

4.2 Enhancing capacity building for EbA

It is essential to develop the capacity for EbA across all sectors, including the public and private sectors, and civil society, with tailored approaches for urban planning. The objective of capacity building for EbA is to enhance awareness and address any potential knowledge gaps in the policymaking process for EbA. This can be achieved by establishing an evidence base to substantiate the benefits of implementing an ecosystem-based approach to urban adaptation through scientific research, vulnerability assessments, and leveraging traditional and local knowledge into modern innovative approaches for urban adaptation. This can then be disseminated to policymakers, local governments, and urban planners to inform their decision-making and planning processes. Such an approach requires efficient mechanisms for the proper management and integration of knowledge. Capacity building can be further enhanced by facilitating more effective interdisciplinary stakeholder engagement, such as involving academia or concerned private and civil society stakeholders. This will ensure the development of transparent, accountable, culturally appropriate, and equitable outcomes, which could contribute to the building of trust in governmental and institutional structures. Furthermore, it is of vital importance that new institutional and governance mechanisms are implemented to ensure flexibility in the policy process and implementation of EbA approaches, and to account for the ever-changing context of climate change adaptation.

4.3 Strategic long-term planning and resource management

Long-term planning for EbA is essential to ensure that adaptation measures deliver sustainable benefits over time. It allows for effective adaptation to any new future scenarios resulting from climate change or urban growth, and ensures that strategies remain relevant or flexible as conditions evolve. This approach helps to maintain and manage green infrastructure, ensuring continued improvements in the community and the environment.

While urban areas are rich in grey infrastructure, they also have urban-specific ecosystem services that need to be considered in the decision-making process. This should be done in conjunction with knowledge management and monitoring and evaluation mechanisms, by assessing and prioritizing urban ecosystem service needs such as air quality improvement, temperature regulation, water management, etc.

EbA approaches also need to be adapted to local urban challenges. One way to do this could be by integrating traditional and local knowledges into modern and innovative approaches to urban adaptation, such as adopting indigenous agricultural practices on green roofs, or implementing traditional water management practices in generally arid areas. This may be appropriate, as such traditional methods may yield the best results and can be easily adapted for modern implementation.

Furthermore, increasing public awareness and engagement can also strengthen the implementation and monitoring of EbA projects. Local stakeholders such as individuals and civil society organisations should be encouraged to learn about and participate in greening activities through public awareness campaigns and project consultations, the latter of which should be managed through the implementation of public participation mechanisms by the appropriate institutional frameworks.

4.4 Optimizing financing tools and strategies

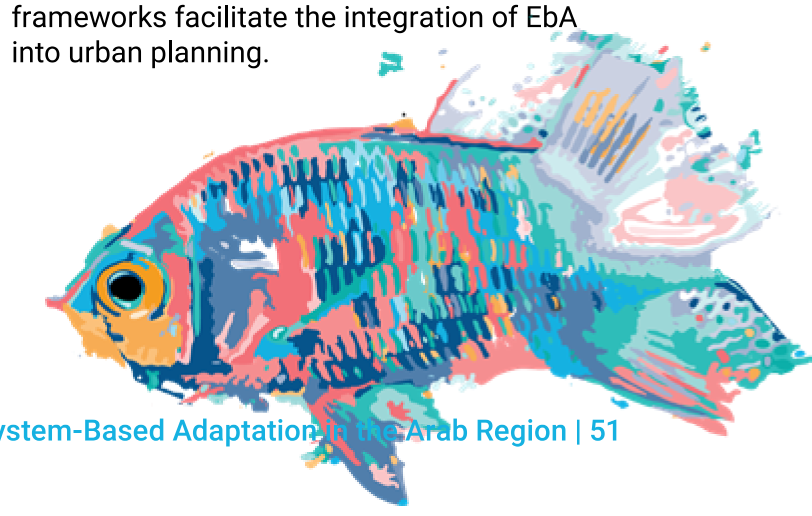
Financing opportunities may be accessed through multilateral funds, such as the Green Climate Fund and the Global Environment Facility, or even through multilateral development banks. Domestic public sources, such as national funds or budget, which have the potential to provide financial or tax incentives, may also be utilized. Private sources, such as non-profit organisations, can also be leveraged to complement these efforts.

Innovative financial mechanisms offer considerable advantages for urban EbA – such mechanisms can provide tailored solutions that address the specific ecological and social requirements of urban areas, through instruments such as public-private partnerships (PPPs) and green bonds. These mechanisms facilitate the mobilization of additional resources by attracting private investors and international funds, thereby overcoming the potential limitations of traditional funding. Furthermore, financial risks can be mitigated through instruments such as risk insurance and payment for ecosystem services (PES), which encourage more investment in adaptation efforts. Approaches like the debt-for-nature and debt-for-climate swaps ensure the sustainability and long-term impacts of EbA projects by turning public debt into green investments.

4.5 Strengthening governance and institutional frameworks

The above-mentioned approaches and mechanisms rely on substantial political and institutional support and the establishment of effective institutional and legislative frameworks to ensure their successful implementation. In light of the inherent challenges and vulnerabilities of urban areas, the development of strong institutions and policies is of vital importance for the effective implementation of EbA, and can further facilitate the creation and maintenance of EbA mechanisms. Strong governance and institutional frameworks ensure the alignment of EbA processes with national and regional policies. This is where policy coherence is of the utmost importance, as it allows for the harmonization of ecosystem-based planning across the different frameworks, from planning to legislation and policy. Harmonization requires strong interministerial and cross-sectoral coordination to avoid transboundary trade-offs, ensure coherence with broader sustainable development strategies, and allow for coordination with local stakeholders. Institutional and governance frameworks also set the foundation for the development of monitoring and evaluation systems.

In the urban context, these systems should establish context-specific indicators, such as green space coverage, air quality index, flood risk reduction, the UHI effect, water management, etc. Such systems, if applied periodically, allow for the constant development and adjustment of a solid knowledge base, which can be used to inform new policies, plans, and budgets as well as to reorient old ones, encouraging results-based planning and adaptive management. The integration of EbA into urban development strategies ensures that urban planning and zoning regulations encompass the use of green and blue infrastructure like bioswales, rain gardens, and green roofs. Furthermore, stronger institutional and governance frameworks facilitate the integration of EbA into urban planning.



Peri-urban ecosystem. Illustration by Ana Pastore and Omnia Moussa

Glossary

Term	Definition
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. This glossary entry builds on definitions used in previous IPCC reports and the Millennium Ecosystem Assessment (MEA, 2005; Intergovernmental Panel on Climate Change (IPCC), 2022).
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be a result of natural internal processes or external agents such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes (IPCC, 2022).
Climate change adaptation	Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change (UNFCCC, n.d.).
Climate extreme	The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes' (IPCC, 2022).
Climate-smart agriculture	Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing and/or removing greenhouse gas emissions, where possible (FAO, 2018, as cited in IPCC, 2022).

Term	Definition
Desertification	Land degradation in arid, semi-arid and dry subhumid areas resulting from various factors, including climatic variations and human activities (Hulme and Kelly, 1993, as cited by UNCCD).
Disaster risk	The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR, 2009a).
Disaster risk reduction	Action taken to reduce the risk of disasters and the adverse impacts of natural hazards, through systematic efforts to analyse and manage the causes of disasters, including through avoidance of hazards, reduced social and economic vulnerability to hazards, and improved preparedness for adverse events (World Meteorological Organization, 2015).
	Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development (UNDRR, 2007a).
Ecosystem-based Adaptation (EbA)	Ecosystem-based Adaptation (EbA), also referred to as Nature-based Solutions for Adaptation, involves a wide range of ecosystem management activities, such as the sustainable management of forests, grasslands, and wetlands, that increase the resilience and reduce the vulnerability of people and the environment to climate change (IUCN, n.d.-a).
	Ecosystem-based adaptation is a strategy for adapting to climate change that harnesses nature-based solutions and ecosystem services. For instance, protecting coastal habitats like mangroves provides natural flood defences; reforestation can hold back desertification and recharge groundwater supplies in times of drought; and water bodies like rivers and lakes provide natural drainage to reduce flooding (UNEP, n.d.).
	It's defined by CBD as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change," with the aim of maintaining and increasing the resilience and reducing the vulnerability of ecosystems and people against the impacts of climate change (Secretariat of the Convention on Biological Diversity, 2009).
Ecosystem services	Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth (Lugo, 2008).

Term	Definition
Hazard	The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources (IPCC, 2022). A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation (UNDRR, 2007b).
Exposure	The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2022). The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas (UNDRR, 2009b).
Impacts	The consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services (including ecosystem services); and infrastructure. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial (IPCC, 2022).
Natural capital	The stock of renewable and non-renewable natural assets (e.g. ecosystems) that yield a flow of benefits to people (i.e. ecosystem services). The term "natural capital" is used to emphasize that it is a capital asset, like produced capital (roads and buildings) and human capital (knowledge and skills) (UNEP, 2021).
Nature-based Solution (NbS)	Nature-based Solutions are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature. Nature-based Solutions address societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being. Nature-based Solutions are underpinned by benefits that flow from healthy ecosystems. They target major challenges like climate change, disaster risk reduction, food and water security, biodiversity loss and human health, and are critical to sustainable economic development. (IUCN, n.d.-b)
	In 2022, United Nations Environment Assembly agreed that Nature-based Solutions are "actions to protect, conserve, restore, sustainably use and manage ecosystems" (UNEP, 2022).

Term	Definition
Risk	Risk is the probability of an outcome having a negative effect on people, systems or assets. Risk is typically depicted as being a function of the combined effects of hazards, the assets or people exposed to hazard and the vulnerability of those exposed elements (UNDRR, 2019).
Socio-ecological system	A social-ecological system is defined as a coupled system of humans and nature that constitutes a complex adaptive system with ecological and social components that interact dynamically through various feedback (Berkes et al, 2008).
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2022).
	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNDRR, 2007c).
Biodiversity (biological diversity)	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (United Nations | Convention on Biological Diversity, 2006).
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (United Nations | Convention on Biological Diversity, 2006).
Rehabilitation	Ecosystem restoration means assisting in the recovery of ecosystems that have been degraded or destroyed, as well as conserving the ecosystems that are still intact (UN Decade on Restoration, n.d.).
	The restoration of basic services and facilities for the functioning of a community or a society affected by a disaster (UNDRR, 2017).

References

AbuZeid, K., Alroudy, M., CEDARE, & Arab Water Council. (2014). Second State of Water Report for the Arab Region - 2012. Water Resources Programe - CEDARE and Arab Water Council.

AbuZeid, K., Wagdy, A., Ibrahim, M., CEDARE, & Arab Water Council. (2019). Third State of Water Report for the Arab Region - 2015. Water Resource Management Program - CEDARE & Arab Water Council.

Algerie Presse Service. (2021, August 24). Agriculture: plus de 89.000 hectares ravagés par les feux de forêt. Algerie Presse Service. Retrieved from https://www.aps.dz/economie/126507-agriculture-plus-de-89-000-hectares-ravages-par-les-feux-de-foret

Al-Zubari, W. K. (2017). Status of Water in the Arab Region. In K. Amer, Z. Adeel, B. Böer, & W. Saleh, The Water, Energy, and Food Security Nexus in the Arab Region (pp. 1-24). Springer Cham. doi:https://doi.org/10.1007/978-3-319-48408-2

Arab Forum for Environment and Development. (2009). Arab Environment: Climate Change - Impact of Climate Change on Arab Countries. Beirut, Lebanon: Technical Publications and Environment & Development magazine. Retrieved from https://wedocs.unep.org/20.500.11822/9631

Arab Organization for Agricultural Development. (2017). Arab Food Security Situation Report. League of Arab States.

Assessment, M. E. (2005). Ecosystems and Human Well-being: Synthesis. Washington, D.C.

Banerjee, A., Bhavnani, R., Burtonbody, C. H., Hamad, O., Linares-Rivas Barandiaran, A., Safaie, S., . . . Zanon, A. (2014). Natural disasters in the Middle East and North Africa: a regional overview (English). Washington D.C.: World Bank Group: Global Facility for Disaster Reduction and Recovery (GFDRR). Retrieved from http://documents.worldbank.org/curated/en/211811468106752534/Natural-disasters-in-the-Middle-East-and-North-Africa-a-regional-overview.

Berkes, F., Colding, J., & Folke, C. (2008). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press.

Borghesi, S., & Ticci, E. (2019). Climate Change in the MENA Region: Environmental Risks, Socioeconomic Effects and Policy Challenges for the Future. Retrieved from IEMed. Mediterranean Yearbook 2019: https://www.iemed.org/wp-content/uploads/2021/01/Climate-Change-in-the-MENA-Region.pdf

Browder, G., Ozment, S., Rehberger Bescos, I., Gartner, T., & Lange, G.-M. (2019). ntegrating Green and Gray : Creating Next Generation Infrastructure. Washington, DC: World Bank and World Resources Institute. Retrieved from http://hdl.handle.net/10986/31430

CBD. (2018). Guidelines for Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction. Guidelines.

Chibani, A. (2022, July 29). Sand and Dust Storms in the MENA Region: A Problem Awaiting Mitigation. Retrieved from Arab Center Washington DC: https://arabcenterdc.org/resource/sand-and-dust-storms-in-the-mena-region-a-problem-awaiting-mitigation/

Convention on Biological Diversity. (2018, January). Guidelines for Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction . Retrieved from Convention on Biological Diversity: https://dev-chm.cbd.int/sbstta/sbstta-22-sbi-2/EbA-Eco-DRR-Guidelines-en.pdf

FAO. (2014). Climate Smart Agriculture Sourcebook. Retrieved from https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b3-forestry/chapter-b3-1/en/

GIZ. (2022). Why working with nature pays off: The case for investing in Ecosystem-based Adaptation. Bonn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.adaptationcommunity.net/wp-content/uploads/2022/03/EbA-and-cities.pdf

GIZ, CMP. (2020). Guidance for Applying the Conservation Standards to Ecosystem-based Adaptation. Bonn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Hulme, M., & Kelly, M. (1993). Exploring the links between Desertification and Climate Change. Environment: Science and Policy for Sustainable Development, 35(6), 4–45. https://doi.org/10.1080/00139157.1993.9929106

IFRC. (2024). Egypt: Aswan Floods. International Federation of Red Cross And Red Crescent Societies. Retrieved from Reliefweb: https://reliefweb.int/disaster/fl-2021-000190-egy

IPCC. (2001). Climate Change 2001: Impacts, Adaptation, and Vulnerability | Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

IPCC. (2007). Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. (O. C. eds. M. Parry, Ed.) Cambridge, UK: Cambridge University Press.

IPCC. (2014). Chapter 24: Asia. In IPCC, AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability (pp. 1327-1370). Geneva: IPCC. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24_FINAL.pdf

IPCC. (2014). Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

IPCC. (2022). Summary for Policymakers In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press. doi:doi:10.1017/9781009157926.001

IPCC (2022). Annex I: Glossary. In Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (pp. 541–562). Cambridge University Press. https://doi.org/10.1017/9781009157940.008

IUCN. (n.d.-a). Ecosystem-based Adaptation | IUCN. Retrieved December 3, 2023, from https://iucn.org/our-work/topic/ecosystem-based-adaptation

IUCN. (n.d.-b). Nature-based Solutions | IUCN. Retrieved December 3, 2023, from https://www.iucn.org/our-work/nature-based-solutions

IUCN. (2010). TEEB : the economics of ecosystems and biodiversity report for business : executive summary. Retrieved from https://portals.iucn.org/library/node/9597

Kebir, K. E. (2022, July 18). Morocco sends more firefighters, soldiers to tackle blazes in northern forest regions. Al Arabiya News. Retrieved from https://english.alarabiya.net/News/north-africa/2022/07/18/Morocco-sends-more-firefighters-soldiers-to-tackle-blazes-in-northern-forest-regions

Lo, V. (2016). Synthesis Report on Experiences with Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction. Technical Series No.85. Montreal: Secretariat of the Convention on Biodiversity.

Loveluck, L., & Salim, M. (2022, August 2022). Iraq broils in dangerous 120-degree heat as power grid shuts down. The Washington Post. Retrieved from https://www.washingtonpost.com/world/2022/08/07/baghdad-heat-record/

Lugo, E. (2008). Ecosystem Services, The Millennium Ecosystem Assessment, and the Conceptual Difference Between Benefits Provided by Ecosystems and Benefits Provided by People. Journal of Land Use & Environmental Law, 23(2), 243-261. Retrieved from http://www.jstor.org/stable/42842990

MacCarthy, J., Richter, J., Tyukavina, S., Weisse, M., & Harris, N. (2023, August 29). The Latest Data Confirms: Forest Fires Are Getting Worse. Retrieved from World Resource Institute | Making Big Ideas Happen: https://www.wri.org/insights/global-trends-forest-fires

Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-being: Synthesis. Retrieved from UNESCO DRR Atlas: https://unesco-arab-drratlas.com/en/case-studies

Morecroft, M. D., Duffield, S., Harley, M., Pearce-Higgins, J. W., Stevens, N., Watts, O., & Whitaker, J. (2019). Measuring the success of climate change adaptation and mitigation in terrestrial ecosystems. Science. doi:10.1126/science.aaw9256

Namrouqa, H. (2018, November 11). Floods 'only beginning' of severe climate change impacts on Jordan. The Jordan Times. Retrieved from https://www.jordantimes.com/news/local/floods-only-beginning-severe-climate-change-impacts-jordan

Narayanan, A. (2022, July 29). UAE: Seven people dead after floods hit Sharjah, Fujairah, Ras al-Khaimah. Retrieved from Al Arabiya | Breaking News from Around the World: https://english.alarabiya.net/News/gulf/2022/07/29/UAE-announces-six-deaths-after-rains-flooding

O'Neill, A. (2023, February 1). Arab world: Urbanization from 2011 to 2021 | Statista. Retrieved from Statista: https://www.statista.com/statistics/806117/urbanization-in-the-arab-world/

Osipov, S., Chowdhury, S., Crowley, J., & al., e. (2022). Severe atmospheric pollution in the Middle East is attributable to anthropogenic sources. Commun Earth Environ, 3(203). doi:https://doi.org/10.1038/s43247-022-00514-6

Oxfam. (2023, August 24). Report | Water dilemmas - Oxfam Aotearoa. Retrieved from https://www.oxfam.org.nz/news-media/media-releases/water-dilemmas-report/

Papadimas, L., & Chestney, N. (2023, September 12). Mediterranean's devastating Storm Daniel may be harbinger of storms to come. Reuters. Retrieved from https://www.reuters.com/world/mediterraneans-devastating-storm-daniel-may-be-harbinger-storms-come-2023-09-12/

RAMSAR. (n.d.). Ramsar Sites Information Service. Retrieved February 29, 2024, from Ramsar Sites Information Service.

Republic of Lebanon Ministry of Environment and University of Balamand. (2010). State of Lebanon's wildfires in 2010. Beirut: Republic of Lebanon Ministry of Environment. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://studies.gov.lb/getattachment/Sectors/Environment/2015/ENV-15-15/env-15-15.pdf

Reuters. (2021, July 28). Lebanon battles wildfires in country's north, firefighter dies.

Reuters. Retrieved from https://www.reuters.com/world/middle-east/lebanon-battles-wildfires-countrys-north-firefighter-dies-2021-07-28/

Reuters. (2022, August 12). Tunis hit record 49C in heat wave on Tuesday. Reuters. Retrieved from https://www.reuters.com/world/middle-east/tunis-hit-record-49c-heat-wave-tuesday-2021-08-11/

Reuters. (2023, September 14). Libya floods: what caused them and why are they so bad? Reuters. Retrieved from https://www.reuters.com/world/africa/what-caused-floods-libya-why-are-they-so-bad-2023-09-14/

Secretariat of the Convention on Biological Diversity. (2009). Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal.

U.S. Environmental Protection Agency. (2008). Reducing Urban Heat Islands: Compendium of Strategies. Washingtom, DC: U.S Environmental Protection Agency.

United Nations | Convention on Biological Diversity. (2006, November 2). Convention Text. Secretariat of the Convention on Biological Diversity. https://www.cbd.int/convention/articles/?a=cbd-02

United Nations Decade on Restoration. (n.d.) | What is Ecosystem Restoration? Retrieved December 3, 2023, from https://www.decadeonrestoration.org/what-ecosystem-restoration

UNDP. (2018). The Arab cities Resilience Report. New York, 10017, USA: United Nations Development Programme.

UNDP. (2022). Arab Human Development Report. New York: United Nations Development Programme Regional Bureau for Arab States. Retrieved from https://www.undp.org/arab-states/publications/arab-human-development-report-2022-expanding-opportunities-inclusive-and-resilient-recovery-post-covid-era

UNDP. (2022). Global Multidimensional Poverty Index (MPI). Retrieved from https://www.undp.org/arab-states/ publications/2022-global-multidimensional-poverty-index-mpi

UNDRR. (n.d.). The disaster risk reduction (DRR) glossary. Retrieved March 24, 2024, from United Nations Office for Disaster Risk Reduction UNDRR: https://www.undrr.org/terminology/hazard

UNDRR. (2007a, August 30). Disaster risk reduction | UNDRR. http://www.undrr.org/terminology/disaster-risk-reduction

UNDRR. (2007b, August 30). Hazard | UNDRR. http://www.undrr.org/terminology/hazard

UNDRR. (2007c, August 30). Vulnerability | UNDRR. http://www.undrr.org/terminology/vulnerability

UNDRR. (2009a, January 23). Disaster risk | UNDRR. http://www.undrr.org/terminology/disaster-risk

UNDRR. (2009b, January 23). Exposure | UNDRR. http://www.undrr.org/terminology/exposure

UNDRR. (2017, February 2). Rehabilitation | UNDRR. http://www.undrr.org/terminology/rehabilitation

UNDRR. (2019, November 26). Understanding Risk. http://www.undrr.org/building-risk-knowledge/understanding-risk

UNEP. (n.d.). Ecosystem-based Adaptation | UNEP - UN Environment Programme. Retrieved December 3, 2023, from https://www.unep.org/topics/climate-action/adaptation/ecosystem-based-adaptation

UNEP. (2013). ARAB MILLENNIUM ECOSYSTEM ASSESSMENT: SYNTHESIS REPORT. UNEP. Retrieved from https://cedarekmp.net/arabma/docs/MA_CH2.pdf

UNEP. (2016, June 14). More action needed on sand and dust storms. Retrieved from UNEP - UN Environment Programme: https://www.unep.org/news-and-stories/story/more-action-needed-sand-and-dust-storms

UNEP-WCMC and UNEP. (2019). Making EbA an effective part of balanced adaptation strategies: Introducing the UNEP EbA briefing notes | Briefing Note 1.

UNESCO. (2021). Atlas on Natural Hazards in the Arab Region. Retrieved from UNESCO DRR Atlas: https://unesdoc.unesco.org/ark:/48223/pf0000378046.locale=en

UNESCO. (2024, February 1). Virtual Exhibition – Mangroves: Guardians of Coastal Ecosystems in the Arab Region. Retrieved February 29, 2024, from UNESCO: https://www.unesco.org/en/articles/virtual-exhibition-mangroves-guardians-coastal-ecosystems-arab-region#:~:text=The%20Arab%20Region%20boasts%20192,face%20threats%20from%20human%20activities.

UN-ESCWA. (2020). Arab Sustainable Development Report 2020. Beirut: UN-ESCWA.

UN-ESCWA. (2022, September). ESCWA Water Development Report 9: Groundwater in the Arab region. Retrieved from United Nations Economic and Social Commission for Western Asia: https://www.unescwa.org/publications/water-development-report-9

UN-ESCWA. (2022). Situation Report on International Migration 2021. Beirut: UN-ESCWA. Retrieved from https://www.unescwa.org/publications/situation-report-international-migration-2021

UNFCCC. (n.d.). Introduction | UNFCCC. Retrieved December 3, 2023, from https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

UN-Habitat. (2020). UN-Habitat COVID-19 Response Plan. Nairobi. Retrieved from https://unhabitat.org/sites/default/files/2020/04/final_un-habitat_covid-19_response_plan.pdf

UN-Habitat. (2021). Climate Action for Cities - Key Messages. Retrieved from UN-Habitat - A Better Urban Future: https://unhabitat.org/sites/default/files/2021/04/ca4c_key_messages_1.pdf

UN-Habitat. (2021, October 30). World Cities Day celebrations at Expo 2020 Dubai. Retrieved from UN-Habitat - A Better Urban Future: https://unhabitat.org/news/09-nov-2021/world-cities-day-celebrations-at-expo-2020-dubai

UN-Habitat. (2022). UN-Habitat Regional Office for Arab States Overview 2021. Cairo: UN-Habitat.

UNHCR. (2023, September 22). Five things to know about the crisis in Sudan. Retrieved from UNHCR, the UN Refugee Agency: https://www.unhcr.org/news/stories/five-things-know-about-crisis-sudan

United Nations. (2018). Background Analytical Study: Forest Ecosystem Services. Retrieved from https://www.un.org/esa/forests/wp-content/uploads/2018/05/UNFF13_BkgdStudy_ForestsEcoServices.pdf

United Nations. (2022, August 17). The World Health Organization steps up assistance to flood-ravaged Yemen. Retrieved from UN News | Global perspective Human stories: https://news.un.org/en/story/2022/08/1124862

United Nations Environment Programme. (2021, March 2). Guidelines for Integrating Ecosystem-based Adaptation into National Adaptation Plans. Retrieved 2024, from UNEP - UN Environment Programme: https://www.

unep.org/resources/toolkits-manuals-and-guides/guidelines-integrating-ecosystem-based-adaptation-eba

United Nations Environment Programme. (2022). 2022 Global Status Report for Buildings and Construction: Towards a Zero emission. Nairobi: Efficient and Resilient Buildings and Construction Sector.

United Nations Environment Programme. (2022, March 2). UN Environment Assembly concludes with 14 resolutions to curb pollution, protect and restore nature worldwide. Retrieved 2024, from UNEP - UN Environment Programme: https://www.unep.org/news-and-stories/press-release/un-environment-assembly-concludes-14-resolutions-curb-pollution

United Nations, Department of Economic and Social Affairs, Population Division. (2019). World Urbanization Prospects 2018: Highlights. New York: United Nations.

Verner, D. (2012, November). Adapting to Climate Change in the Middle East and North Africa Region. World Bank. doi:https://doi.org/10.1596/978-0-8213-9459-5

Williams, M. (2019). The Red Sea Hills. In The Nile Basin: Quaternary Geology, Geomorphology and Prehistoric Environments (pp. 257–266). Cambridge: Cambridge University Press. doi:https://doi.org/10.1017/9781316831885.019

World Bank. (2019). Sand and Dust Storms in the Middle East and North Africa (MENA) Region - Sources, Costs, and Solutions. Washington, DC.

World Bank Group. (n.d.). Population, total - Arab world | Data. Retrieved from World Bank Group: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=1A&most_recent_value_desc=true

World Meteorological Organization. (2015, November 12). Disaster Risk Reduction, Climate Risk Management and Sustainable Development. https://public-old.wmo.int/en/bulletin/disaster-risk-reduction-climate-risk-management-and-sustainable-development

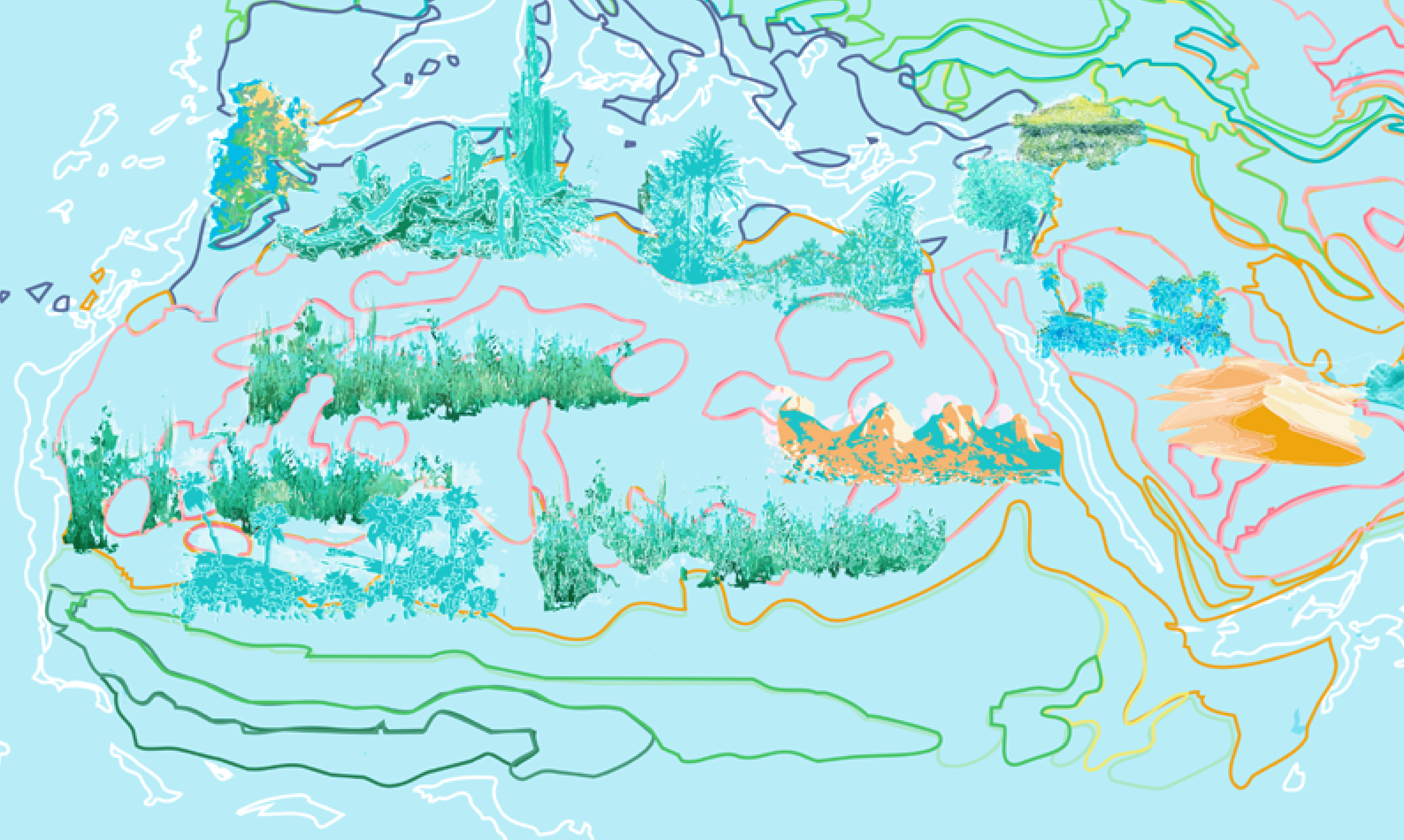
Zittis, G., Almazroui, M., Alpert, P., Ciais, P., Cramer, W., Dahdal, Y., . . . Lelieveld, J. (2022, June 28). Climate Change and Weather Extremes in the Eastern Mediterranean and Middle East. Reviews of Geophysics, 60(3). doi:https://doi.org/10.1029/2021RG000762

Zittis, G., Hadjinicolaou, P., Almazroui, M., Bucchignani, E., Driouech, F., El Rhaz, K., . . . Lelieveld, J. (2021). Business-as-usual will lead to super and ultra-extreme heatwaves in the Middle East and North Africa. npj Clim Atmos Sci, 4(20). doi:https://doi.org/10.1038/s41612-021-00178-7

Annexes

Annex 1: Available tools and resources related to EbA

Access Link	Tool
Ecosystem-based Adaptation Planning: ALivE - Adaptation, Livelihoods and Ecosystems	Available online at https://www.iisd.org/projects/alive-adaptation-livelihoods-and-ecosystems-planning-tool
Handbook: A Handbook for Ecosystem-based Adaptation in Mountain, Dryland, and Coastal Ecosystems	Available online at https://wedocs.unep.org/xmlui/handle/20.500.11822/33185
Massive Open Online Course: Nature-based Solutions for Disaster and Climate Resilience	Available online at https://www.unep.org/events/online-event/massive-open-online-course-mooc-nature-based-solutions-disaster-and-climate
Reference Guide: Research on Ecosystem-based Adaptation (EbA)	Available online at https://wedocs.unep.org/handle/20.500.11822/33379
Resource Guide: Integrating Ecosystem-based Adaptation in Education Curriculum	Available online at https://wedocs.unep.org/handle/20.500.11822/33184
Panorama EbA Solutions Portal	Available online at https://panorama.solutions/en/portal/panorama-eba
Guidebook for Monitoring & Evaluating EbA Interventions	Available online at https://climate-adapt.eea.europa.eu/metadata/guidances/guidebook-for-monitoring-and-evaluating-ecosystem-based-adaptation-interventions
Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards	Available online at https://pubs.iied.org/g04167
Guidelines for Integrating Ecosystem-based Adaptation into National Adaptation Plans: Supplement to the UNFCCC NAP Technical Guidelines	Available online at https://www.unep.org/resources/toolkits-manuals-and-guides/guidelines-integrating-ecosystem-based-adaptation-eba
The Global Climate Finance Architecture	Available online at https://climatefundsupdate.org/cff2-2023-eng-global-architecture/
Friends of Ecosystem-based Adaptation (FEBA) - EbA tools navigator	Available online at https://friendsofeba.com/toolsnavigator/
Implementation Guides | Climate change risk assessment	Available online at https://www.c40knowledgehub.org/s/guide-navigation?language=en_
Urban adaptation support tool, Urban AST	Available online at https://climate-adapt.eea.europa.eu/en/knowledge/tools/adaptation-support-tool



A better quality of life for all in an urbanizing world

UN-HABITAT

UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME
P.O. Box 30030, Nairobi 00100, Kenya
unhabitat-info@un.org
www.unhabitat.org

@UNHABITAT