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Nature Based Solutions in Egypt: Current Status and Future Priorities

Enhancing the implementation of Egypt vision 2030 through Nature-Based Solutions

SUBMITTED BY CEDARE TO IUCN ROWA

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Preface

Egypt's high biodiversity is partly due to its location at the juncture of four bio-geographical regions, namely the Irano-Turanian, Mediterranean, Saharo-Sindian and Afrotropical regions, and to its diversity of landscapes and topographic features, ranging from the rugged mountains of South Sinai and the Eastern Desert (up to 2,641 m) to the Qattara Depression (134 m below mean sea level), to flat featureless gravel plains and complex hilly country. Egypt is considered home to an extensive diversity of terrestrial habitats, fauna, flora and microorganisms, and although the country has comparatively low species numbers and few endemics, its biodiversity is exceptionally diverse in composition and has high global significance. A significant part of Egypt's diverse species lies within nationally designated protected areas.

In Egypt, there are 30 protected areas covering 15% of the terrestrial area, while over 9% of the coastal and nearshore environment is protected and all activities carried out in these protected areas are to be subjected to the Egyptian Environmental Affairs Agency's (EEAA) control. A number of laws in Egypt provide the enabling environment that supports biodiversity management in the country. The law assigns a major role to EEAA in the management and monitoring of protected areas, including the management of the licensing and permit system for any activity undertaken in protected areas requiring EIAs. All activities carried out in protected areas are to be subjected to the EEAA's control, which can take steps to enforce the rules and stop any illegal activity.

The International Union for the Conservation of Nature –Regional Office for West Asia (IUCN-ROWA) executed the Project "Effective Management of Wadi El-Rayan and Lake Qarun Protected Areas in Egypt". The project was implemented in partnership with the Egyptian Environmental Affairs Agency (EEAA) and with the support of the GEF and UN Environment. The project aimed to strengthen the overall management of the Wadi El-Rayan and Lake Qarun protected areas to safeguard biodiversity by addressing a range of threats. It sought to enable community involvement, capacity building and gender equality as the principle means toward improving effectiveness. The project mainly focused on two PAs, Wadi El Rayan and Lake Qarun, which are located within the Fayoum Governorate.

As part of the project activities, the project aims to investigate and identify existing nature based-solutions already implemented in Egypt and identify potential NBS in pilot locations across Egypt with focus on Wadi El Rayyan and Lake Quran protected areas as these areas lack a cohesive ecosystem-based strategy to reconcile natural values, ecosystem services and increasing threats.

This activity comes in alignment with the Egyptian initiative "Addressing biodiversity loss, climate change, land degradation and ecosystems using a nature-based approach" which was launched as a result of the 2018 UN Biodiversity Conference held in Sharm Shaikh.

This report was produced by the project through a consultancy agreement with Centre for Environment and Development for the Arab Region and Europe (CEDARE).

Executive summary

The concept of Nature-based Solutions (NbS) arose in response to the neglect of nature in national and global agendas. Although ecosystem management has been central to the Convention on Biodiversity since it was established. There is growing understanding that nature is essential for life and that by degrading nature and natural resources we contribute to many societal challenges, including climate change, food security and disaster risks.

IUCN popularized the concept of Nature Based Solutions for Societal Challenges over the past decade. The concept was used to develop pathways for sustainable management of ecosystem services to address societal needs arising from climate change, disaster risks, water and food security, human health and wellbeing, and socio-economic development. The NbS concept builds on established approaches to inclusive and participatory natural resource governance and is designed to take these approaches to scale to simultaneously address the needs of biodiversity and human wellbeing.

Nature based Solutions have been shown to provide a powerful defence against the impacts and long-term hazards of climate change, which is the biggest threat to biodiversity. Research has shown that NbS can provide around 30% of the cost-effective mitigation needed by 2030 to stabilize global warming to below 2°C. NbS have been deployed to 'green' cities, contributing to significant energy savings and health benefits. Many countries have included NbS in their national climate strategies and to ensure consistency and adherence to good practices.

Since 2020, the adoption of NbS has been boosted by adoption of the NbS Standard, which is outlined later in this chapter. By following this standard, NbS offer great potential for achieving sustainable development and will make a major contribute to many SDG targets, including those on land, water and climate.

Two-thirds of the governments supporting the Paris Agreement included NbS actions in their national climate plans. The estimated global benefits in ecosystem services from Nature based Solutions that focus on climate could be as high as US$ 170 billion. NbS can provide up to 37% of our climate change mitigation needs and they can reduce the impact of climate change on people and nature by decreasing the impact of disasters and strengthening resilience.

The IUCN Global Standard for NbS[1] is a tool to help governments, communities, business and NGOs implement strong, effective NbS projects that are ambitious in scale and sustainable, prevent misuse and safeguard people and planet. The Global Standard was published in 2020 and was developed through public consultation in over 100 countries with state and non-state actors. It consists of eight criteria and associated indicators that address the pillars of sustainable development (environment, economy and society) and that can be used to operationalize best-practice principles of NbS.

Egypt is home to a wide variety of ecosystems and terrestrial and aquatic life due to its unique geographic location midway between Africa and Asia. Many plant and animal species in Egypt represent tropical and Mediterranean environments, some of which go back millions of years. Egypt is a home to over 22,000 plant and animal species (888 threatened

[1] https://portals.iucn.org/library/node/49070

with extinction): 2,145 species and 220 infra-specific taxa of native and naturalized vascular plants, 175 species and subspecies of mosses, 13 hepatics, 111 mammals (72 threatened with extinction), 485 birds (60 threatened with extinction), 112 reptiles (47 threatened with extinction), 9 amphibians (2 threatened with extinction), more than 1,200 fish species (52 threatened with extinction), 800 Mollusca, 1,000 Crustacean, more than 325 species of coral reefs, 10,000 – 15,000 species of insects (including 63 butterflies), 2,420 species of fungi, in addition to thousands of algae, bacteria and viruses. A significant part of these species is found in nationally designated protected areas.

Egypt's biodiversity contributes to the economy and supports human wellbeing. A significant portion of Egypt's Gross Domestic Product (GDP) is directly linked to the use of biological resources. The agriculture, irrigation and fisheries sector contribute 14.7% to GDP. Agriculture provides food production estimated at 12% of GDP and jobs at 20.6% of man power in 2017. The contribution to GDP from the fisheries sector is about 0.4%. More than 250,000 fishermen are employed in the fisheries sector in Egypt. Fish production has increased from 790,000 tons in 2001 to 1.6 million tons in 2017. Overall fishery production is about 1.6 million tons per year in 2017, with a value of about Egyptian L.E. 25 billion. Tourism is one of the most important sectors in Egypt contributing 11.3% of GDP and with 12.6% of the total labour force employed in this sector. With the stabilization of the political situation in Egypt, it is expected that foreign tourism will even exceed the figures prior to 2010 levels of 14.7 million tourists.

Biodiversity in Egypt is deteriorating at the level of ecosystems, species and populations; and, genetic diversity is also declining. The losses are due to a range of threats including habitat loss and fragmentation, over exploitation and unsustainable use of natural resources, pollution, and invasive species. Limited human and financial resources have also contributed to the loss of biodiversity. These pressures are continuing to increase and are themselves driven by a range of socio-economic drivers, mainly the growing population and limited human and financial resources. Climate change will act synergistically with other threats with serious consequences for biodiversity.

The Global Environment Facility (GEF) in collaboration with United Nation Environment Programme (UNEP), the Ministry of Environment in Egypt (MoE), and the International Union for Conservation of Nature-Regional office of west Asia (IUCN-ROWA) are working towards a GEF funded project on strengthening the overall management of the Wadi El-Rayan and Lake Qarun protected areas in Egypt titled "***Effective Management of Wadi El-Rayan and Lake Qarun Protected Areas in Egypt***" (**EMPA Project**). As part of this project, IUCN-ROWA through a consortium of international and national consultants, developed a thematic national report on status of the Nature based solution best practices in Egypt with some attention for both Wadi El Rayan and Qarun protected areas using IUCN's most recent guidelines, best practices on NBS in close collaboration with the two protected areas management authorities and relevant stakeholders which will be discussed in details in this report.

A series of case studies have been developed to examine examples of Nature based Solutions in Egypt. The majority of these examples were implemented before the NbS Standard was published in 2020 and therefore were not designed using the NbS criteria. The examples have been evaluated against the NbS criteria to illustrate how each case conforms, and to identify areas for strengthening. The overall evaluation of the Nature based Solutions practices in Egypt (evaluated in this report), can be summarized in the following table:

Table 1 The overall evaluation of the NbS practices in Egypt

Practice	C1. Addressing societal challenges			C2. Design at scale			C3. Biodiversity net-gain				C4. Economic feasibility				C5. Inclusive governance					C6. Balance trade offs			C7. Adaptive management			C8. Mainstreaming and sustainability		
1. Community Based Rangeland Restoration in Egypt	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
2. Sustainable land management to restore desertified land	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
3. Mangrove Restoration as a Nature based Solution in Egypt's Coastal Zones	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
4. Waste water irrigation for rehabilitation of arid areas in Egypt																												
5. Medicinal Plants Rehabilitation Program																												
6. Biodynamic farming																												
7. Integrated Coastal Zone Management																												
8. Agroforestry as a Nature based Solution Egypt																												

Analysis of results came out from NBS evaluation described in the above table showed the following facts:

1.

Finally, evaluation of the the Nature based Solutions practices in Egypt came out with several recommendations, where the details of these recommendations are summarized as follows:

I. Introduction

II. Background

1. Biodiversity in Egypt

Egypt has unique strategic location in the middle point of the old continents between Europe, Africa and Asia, covering an area of approximately one million square kilometers. It extends from the Mediterranean Sea in the north (the northern coast extends to about 970 km from Rafah in the east to Salum to the west) to Sudan in the south, and from the Red Sea in the east (the eastern coast extends to about 1,100 km) to Libya in the west. Egypt can be divided geographically into four physiographic regions: the Nile Valley and Nile Delta, Western Desert, Eastern Desert, and Sinai (EEAA, 2014 - EEAA, 2015).

Additionally, Egypt accommodates four bio-geographical regions: (1) the Mediterranean-Sahara regional transition zone (MS-XVIII), which occupies a small area along the Mediterranean coast; (2) the Sahara- Sindian regional zone (SS-XVII), which encompasses the vast desert occupying the greater part of Egypt; (3) the Irano-Turanian regional center of endemism (IT), which occupies a small area in the Sinai highlands and some enclave areas in the Eastern Desert (e.g. Galala Mountains); and (4) the Sahel regional transition zone (Sa-XVI), which comprises the Afrotropical Gebel Elba mountainous region in the southeast of Egypt (EEAA, 2014 - EEAA, 2015).

Egypt's biodiversity contributes to the economy and supports human wellbeing. A significant portion of Egypt's Gross Domestic Product (GDP) is directly linked to the use of biological resources. The agriculture, irrigation and fisheries sector contribute 14.7% to GDP. Agriculture provides food production estimated at 12% of GDP and jobs at 20.6% of man power in 2017. The contribution to GDP from the fisheries sector is about 0.4%. More than 250,000 fishermen are employed in the fisheries sector in Egypt. Fish production has increased from 790,000 tons in 2001 to 1.6 million tons in 2017. Overall fishery production is about 1.6 million tons per year in 2017, with a value of about Egyptian L.E. 25 billion. Tourism is one of the most important sectors in Egypt contributing 11.3% of GDP and with 12.6% of the total labor force employed in this sector. With the stabilization of the political situation in Egypt, it is expected that foreign tourism will even exceed the figures prior to 2010 levels of 14.7 million tourists (EEAA, 2018).

Egypt has diverse and a wide range of habitats (e.g. mangroves, coral reefs, mountains, sand dunes, oasis, and wadis) that host many plant and animal species and communities representing both tropical and Mediterranean environments. Some dating back millions of years ago, such as the skeletons of whales in the Western Desert (e.g. Wadi El-Hitan Natural World Heritage Site in Wadi El-Rayan Protected Area), while other sites represent the Stone Age, about 10,000 years ago (e.g. El-Gelf El-Kebir Protected Area). Some animal and plant species represent relicts of a once flourishing growth in ancient periods when the environment was less severe. As conditions became decidedly arid, a limited number of these species remained in the natural refugee sites. For example, small populations of

gymnosperms trees of *Juniperus phoenicea* still exist in a few hilly sites in N. Sinai (e.g. Gebel El-Maghara, Yelleg, Labni and El-Halal) (EEAA, 2014 - EEAA, 2015).

Egypt has 36 habitats covering all the marine and terrestrial areas in Egypt, the following table summarizes the defined habitats in Egypt:

Table 2Habitats classification and areas in Egypt

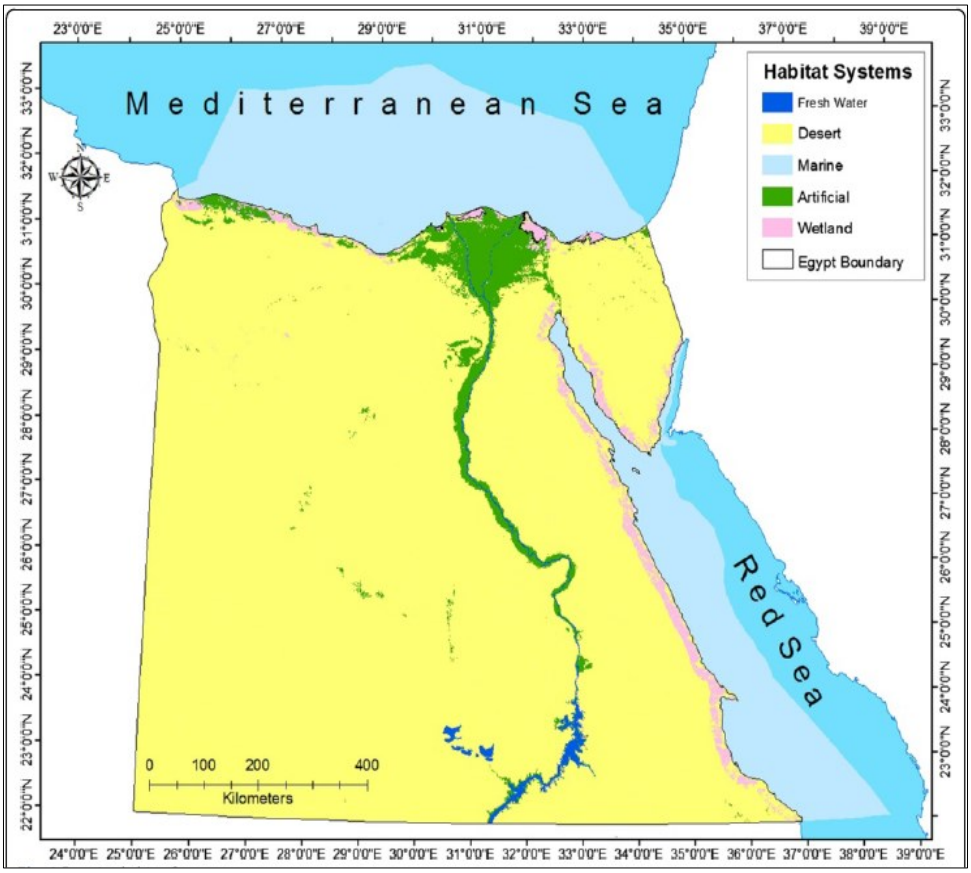
No.	Main habitats	Habitats classes	Habitat area (km^2)
1	Marine	Epipelagic	52445.57
2		Mesopelagic	97643.00
3		Bathypelagic	115066.06
4		Islands	637.16
5		Corals	3412.84
6	Artificial	Arable Land	39773.27
7		Urban Areas	2197.23
8		Water Storage Areas	9357.76
9		Aquaculture Ponds	292.96
10		Salt Exploitation Sites	178.68
11		Canals, Drainage Channels and Ditches	139.07
12	Wetlands	Rivers Banks	4397.81
13		Seasonal/Intermittent Freshwater Marshes/Pools	Not identified
14		Springs and Oases	Not identified
15		Permanent Saline, Brackish or Alkaline Lakes	2866.41
16		Swamps and Marshes	1135.16
17		Rocky Shoreline	31374.91
18		Sandy Shorelines and/or Beaches, Sand Bars, Spits, etc	22060.99
19		Mud Shoreline and Intertidal Mud Flats	25.41
20		Salt Marshes	8314.36
21		Tidepools	Not identified
22		Mangrove Submerged Roots	2.44
23	Desert	Mountains	11756.33
24		Hills and Plateaus	73139.16
25		Scarps and High Areas	233288.52
26		Plain Areas	15008.71
27		Desert Sand Dunes, Sand Sheets and Sand Mounds	254579.23

No.	Main habitats	Habitats classes	Habitat area (km^2)
28		Hamada Desert	220539.31
29		Coastal Sand Dunes	5600.89
30		Valleys and Canyons	35088.03
31		Depression	12761.35
32		Sabkhat	7099.18
33		Caves and Karsts	Not identified
34	Fresh water	Rivers	3180.31
35		Lakes	3691.60
36		Islands	284.40

Source: Khaled Allam Harhash *et al.,* 2015: Conservation oriented habitat classification scheming and mapping of Egypt". Environmental Systems Research, a Springer Open Journal.

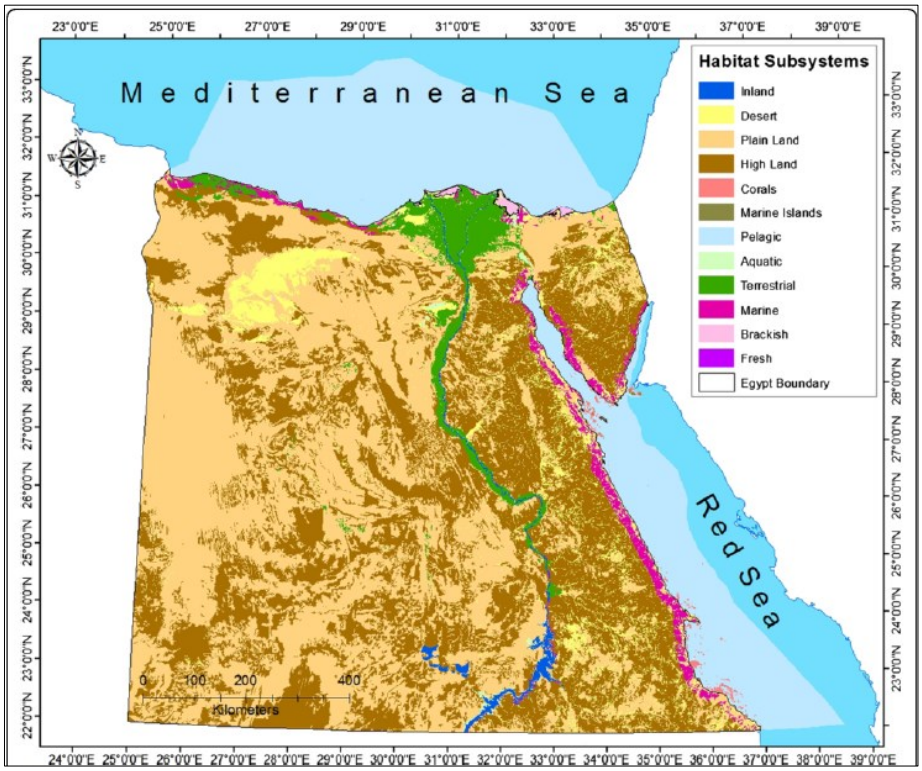
Egypt has an immense array of habitats and micro-climates zones holding extensive biodiversity and local communities. A total of 5 main habitat systems, 12 habitat sub-system and 36 habitat classes were identified and described. Detailed analysis of the input GIS layer indicated that 4 habitat classes were described but not mapped because of their occurrences were too small to be mapped (Seasonal/Intermittent Freshwater Marshes/ Pools – Oasis and springs – caves and karst – tide pole) at the 90 m spatial resolution used in this study. This hierarchy represents a new standardized habitat scheming for Egypt. The 36 habitats mapped through this process represent 22 % of the total number of ecosystems (163) described for Africa in 2013 (Sayer *et al*. 2013). To convey a sense of the types, numbers, and distributions of habitats at the national context, Map 1 presents a map of the 5 main habitat systems, while Map 2 presents a map of the 12 habitat sub-systems and Map 3 presents a map of the 36 habitat classes (Khaled Allam Harhash *et al*., 2015).

Map 1 Main habitat systems in Egypt



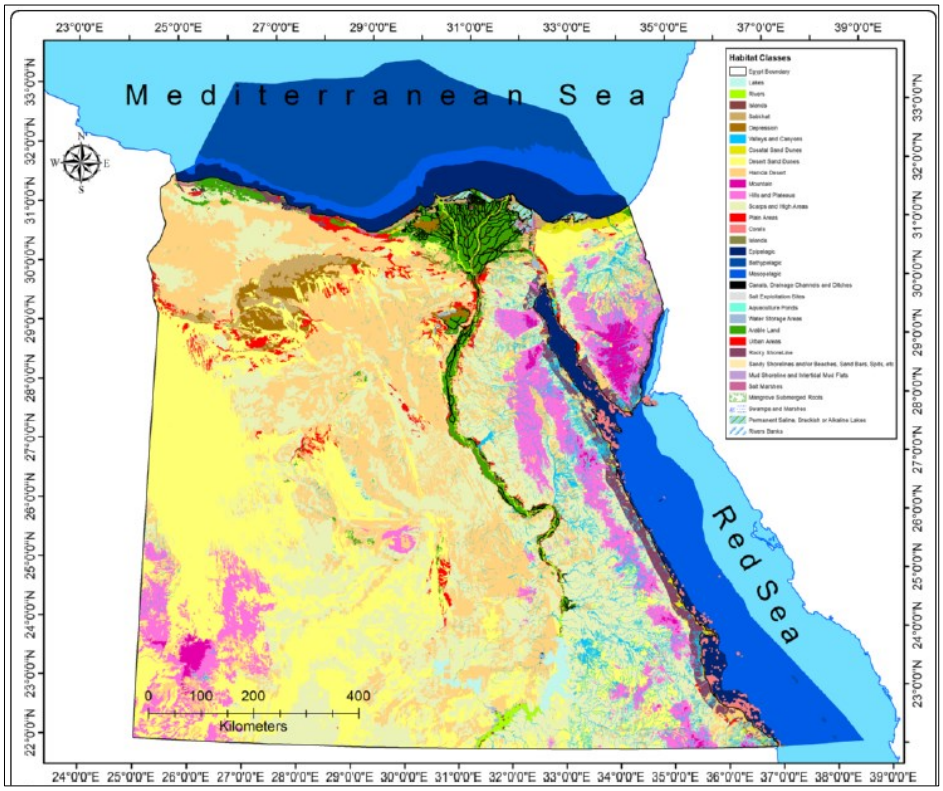
Source: Khaled Allam Harhash *et al.,* 2015: Conservation oriented habitat classification scheming and mapping of Egypt". Environmental Systems Research, a Springer Open Journal.

Map 2 Habitats sub-systems in Egypt



Source: Khaled Allam Harhash *et al.,* 2015: Conservation oriented habitat classification scheming and mapping of Egypt". Environmental Systems Research, a Springer Open Journal.

Map 3 Habitats classification of Egypt (36 habitats' classes)



Source: Khaled Allam Harhash *et al.,* 2015: Conservation oriented habitat classification scheming and mapping of Egypt". Environmental Systems Research, a Springer Open Journal.

Habitats with the greatest floral and faunal species diversity, or informally "the biodiversity hot spots" of Egypt, are roughly the mountains of South Sinai, the Gebel Elba region, and the Mediterranean littoral and coastal desert west of Alexandria. The fog deposition in Gebel Elba produces the only Egyptian example of an officially WWF endangered habitat, a Red Sea Fog Woodland. In addition, the Nile River itself and the Delta lakes support a considerable number of species. Marine and coastal habitats are confined to the Mediterranean and Red Sea. Marine biodiversity in Egypt benefits from having two completely independent elements, the Mediterranean and the Red Sea. Its Mediterranean fauna and flora are modest and shared with most of the countries of that region, while the very rich Red Sea equivalents are also probably shared with most of the countries bordering the Red Sea. Endemics are largely or wholly limited to Red Sea habitats, where Egypt has the most northerly coral and mangrove habitats of the world – possibly rendering them more important as climate changes occur. The shallow waters of the Suez Gulf are important areas for marine biodiversity and the contrast with the abyssal depths of the Gulf of Aqaba create a very important set of habitats (EEAA, 2014 - EEAA, 2015).

1.1. Main ecosystems in Egypt

The natural habitats of Egypt can be broadly divided into; (i) desert habitats; (ii) wetland habitats (iii) coastal and marine habitat; (iv) Mountain habitats; and (v) arable and urban landscapes:

1.1.1. Desert habitats

Dry and sub-humid desert habitats cover over 90% of Egypt's territory, combining different ecosystems. The Mediterranean coastal desert receives the highest rain fall in the country (up

to 200 mm annually) and has a fair amount of vegetation cover and the greatest national floral diversity. The influence of coastal rains extends up to 60 km inland. About 1,775 plant species have been recorded in desert ecosystems: 279 in North Sinai, 472 in South Sinai, 328 in North Coast, 66 in Halayeb, 250 in the Western Desert and 280 in the Eastern Desert. Most of the recorded plants are associated with traditional knowledge in Sinai, the North Coast and the Eastern and Western deserts (EEAA, 2014).

The Western Desert which occupies about two-thirds of the country's area (681 thousand km^2) is a harsh environment for plant growth because of the hot summers (sometimes above 50 °C), extreme daily temperature fluctuations in the winter (from above 30 °C in the day to below zero at night) and rare rainfall. Oases are the most prominent features of the Western Desert and are the only source of water and vegetation over much of this desert. Over a long history of human settlement, the local biota was severely affected by humans. Inside oases land was transformed into cultivated fields and orchards. As a result, it is difficult to ascertain what natural vegetation had been there before human interference. However, a total of 233 plant species (116 annuals and 103 perennials), belonging to 151 genera and 44 families, were recorded in the western Mediterranean sand dunes. Of these, some 30 species are known to be endemic to the Mediterranean. Additionally, a total of 219 plant species (116 annuals and 103 perennials), belonging to 154 genera and 47 families, were recorded in the Sallum area (EEAA, 2014).

In contrast, the desert bordering the Red Sea is very dry and the vegetation is typical of that of the Eastern Desert (223 thousand km^2), being largely restricted to mouths of larger wadies and along the coast where saltmarsh vegetation grows. As for the Sinai Peninsula (61 thousand km^2), it is considered to be a huge mass of basic formation with high rough peaks (St. Katharine Mountain), valleys and some oases. Wadies and mountains are characteristic of the landscape of much of the Eastern Desert and Sinai. Biological diversity recorded in El Omayed, a desert protected area, includes 251 plant species (1 endemic, 11 threatened, 17 endangered with extinction), 324 animal species including 39 bird species (4 endemic, 1 globally endangered, 19 rare); 10 mammals (1 endemic, 2 endangered with extinction, 4 rare); 33 reptiles (3 endangered with extinction, 12 under environmental threats); and 242 insect species (2 endangered with extinction). In the Wadi Allaqi PA biodiversity is represented by139 plant species (98 of them became extinct between 2000 and 2006 and 6 species are deteriorating due to over and random grazing);15 mammal species (including Barbary Sheep (*Ammotragus lervia*), Gazelle, Hyena, Sand Cat, fox, Mountain Rabbit, Jackal (Ibn Awa), and Wild Donkey); and100 bird species. Biological diversity reported in Siwa PA included 53 plant species, 28 wild mammals including 8 rare species threatened with extinction (namely cheetah, Striped Hyena, Egyptian Gazelle, White Gazelle, Red Fox, Wild Cat and Fennec fox), 32 reptile species**,** 164 bird species and 36 insects in addition to large number of invertebrates. In Wadi El Gemal and Hamata, 140 plant species, including 32 used in traditional medicine, 24 mammal species, 29 species of reptiles and amphibians and 45 bird species were recorded. There are several indicators used to assess the loss of biodiversity in desert ecosystems. One of these indicators is the loss of 40% of the plant species in the last 20 years in the Wadi Allaqi PA due to extreme dryness and overgrazing. Another indicator would be the disappearance of the Cheetah, which has not been seen in the Western Desert in the past two decades. In addition, the Egyptian desert was home to 6 species of Antelopes until the mid-1940s: Mountain Gazelle (*Gazella gazella*), Dorcas Gazelle (*Gazella dorcas*), Scimitar Horned Oryx (*Oryx dammah*), Rhim Gazelle (*Gazella leptoceros*), Addax (*Addax nasomaculatus)* andAfrican Wild Ass (*Equus asinus*). As a result of hunting activities and drought, the Mountain Gazelle, Scimitar Horned Oryx, Addax and African Wild Ass have

disappeared completely. Only the Dorcas Gazelle (*Gazella dorcas*) and Rhim Gazelle (*Gazella leptoceros*) are still present today, however, threatened with extinction. The Dorcas Gazelle is relatively widely distributed compared to the Rhim Gazelle, which had been monitored in limited areas of the Western Desert close to Siwa (EEAA, 2014).

1.1.2. Wetlands ecosystems

There are six major inland wetland areas in Egypt: the Nile River, Lake Nasser, Bitter Lakes, Wadi El Natrun, Lake Qarun, and Wadi El Rayan. In addition, there are many smaller wetlands scattered across the Nile delta and valley, and in oases located in the Western Desert. Oases are the only source of water over much of the western desert, the principal ones being Maghra, Siwa, Wadi El Rayan, Bahariya, Farafra, Dakhla, Kharga, Kurkur and Dungul. There are also six major coastal lagoons on the Mediterranean: Bardawil, Port- Fouad (Mallaha), Manzala, Burullus, Edku and Maryout. The Red Sea coastal habitats and wetlands include mudflats, reefs, mangroves and marine islands.

The aquatic fauna of the Northern Delta lakes is a mix of freshwater and marine species. The freshwater fauna is dominated by Tilapia species which make the majority of catch. Many Nile species also inhabit these lakes such as; *Hydrocynus forskahlii*, *Lates niloticus*, *Cyprinus carpio*, *Barbus bynni*, *Clarias lazera*, *Bagrus bajad*, *Lates niloticus*. Several marine species tolerant of freshwater are also found in the Delta lakes, including mullets, soles, seabream, seabass, meager, eels and shrimp (EEAA, 2014 - EEAA, 2015).

Lake Burullus is a substantial coastal wetland and a Ramsar site on the northern coast of Egypt. Despite the status of being declared as a protected area under Egyptian legislation, the environmental conditions in Lake Burullus witnessed adverse sever changes over the past 40 years. A total of 887 species had been recorded in Lake Burullus, 274 species of vascular plants (137 annuals and 97 perennials), 11 species of aquatic reeds (*Phragmites australis*), 276 species of phytoplanktons (145 of diatoms, 50 species of blue algae, 10 species related to other groups), 90 species of zooplanktons, 33 species of benthic animals, 127 species of land invertebrates (screwworms, molluscs, arthropods), 33 species of fish (but only 25 were recorded recently), 23 species of reptiles, 112 species of birds, and 18 species of mammals. During 1970's, 33 species of fish were recorded in Lake Burullus but at the beginning of this century 52 species were recorded (most of them were fresh water fish and migratory fish) while 8 species of marine fish disappeared. However, in spite of increasing primary productivity of the lake, the quality of fish (mostly freshwater fish) value had decreased dramatically (EEAA, 2014 - EEAA, 2015).

Lake Bardawil is listed as a Ramsar Wetland of International Importance, and its eastern part received national protection in 1985 (Zaranik Protected Area). In Lake Bradawil, a total of 2111 species had been recorded, 203 species of vascular plants (83 annuals and 120 perennials), 241 phytoplankton and 59 zooplankton species), 72 species of invertebrates including field worms, crustacea (shrimps), molluscs and echinoderms, 55 spiders, 202 species of insects, 45 fish species (bream and mullets), 23 species of reptiles, 241 species of birds (more than 50% of the recorded species in Egypt) and 21 species of mammals. Newer fishing practices, like bottom trawling, had reduced the sea bass population because fine mesh nets trap both adult and juvenile fishes. The declining sea bass population, combined with increased water salinity had attracted shrimps and crabs, the sea turtles' favorite food and the Lake had become an attractive wintering ground for sea turtles. In October 2012, over 90 sea turtles were found stranded dead in various stages of decomposition on the shores of

Lake Bardawil, suggesting that the killing had been going on for several months (Sarant, 2014; Yahia, 2012). Lake Bardawil is one of the least polluted bodies of water in the country.

At Wadi El-Rayan area, two successive lakes, separated by a waterfall, were created as a reservoir for agricultural drainage water. These lakes currently exceed the capacity of Lake Qarun. It is argued that the rapid change in salinity of Lake Qarun excludes the presence of endemic species in its fauna. Flora of Wadi El Rayan Protected Area was monitored (areas of water springs and Rayan lakes) and did not exhibit any significant changes in the status of species as 56 species of flora were monitored. Aquaculture ponds predominantly built in the fringes of the Lake at the account of shore line vegetation (marsh vegetation and reed) and non-irrigated agricultural lands increased from nearly 11.000 hectares in 1978 to nearly 17.000 hectares in 2011. Active management (mowing and removal of detritus) had prevented further encroachment of reed and greater loss of open water. The loss of open water, combined with the deteriorating water quality had a damaging impact on the biodiversity (7 valuable fish species disappeared) and the livelihoods of about 50.000 fishermen living around the Lake (EEAA, 2014 - EEAA, 2015).

The Nile River (6,650 km) runs 1,530 km in Egypt. The Nile supports most of the country's wetlands, which are some of Egypt's most important habitats supporting the greatest diversity and density of bird species. The Nile's water quality is relatively good from Aswan to Cairo but declines in quality in the Delta. Species diversity recorded includes 87 aquatic weeds, 100 zooplankton and 80 phytoplankton species (algae). At the beginning of the 20th century, a total of 82 fish species were recorded. After construction of the high dam and establishment of Lake Nasser only 58 species were recorded; today 22 species of these (*Tilapia* spp) are widely spread and 36 species are less spread or rarely found. Additionally, 31 amphibian species and reptiles previously recorded in the river including the Nile crocodile (*Crocodylus niloticus*) and Nile Chelonia (*Trionyx triunguis*) are now found only in Lake Nasser. Presently, mammals are not well represented in Nile River; 37 species were previously recorded and the Nile Rhino (*Ceratotherium cottoni*) was observed only up to the year1800 (Fisher and Khalifa, 2003). The most commonly found mammals are small ones, such as rats and bats. Less common mammals include mongoose, red fox, jungle cat and the Egyptian Jackal (*Canis aureus lupaster*) that are found mainly in cultivated Nile valley and Delta lands. Eleven macrophytic aquatic plants have been recorded in Lake Nasser in the Egyptian Nubia, before and after the completion of the Aswan High Dam. Two euhydrophytic species disappeared after the filling of Lake Nasser. Of the other nine species, three *Potamogeton* spp. (i.e. *P. crispus*, *P. trichoides*, *P. pectinatus*) which were recorded during the seventies and early eighties have no longer been observed in recent years. For bird species, 122 species were recorded in the Nile River and its islands. In Lake Nasser, more than 200,000 bird species were recorded (EEAA, 2014).

1.1.3. Marine and coastal ecosystems

The Egyptian coastal and marine environment is distinguished by specific habitats, namely coral reefs and mangroves where the greatest known species diversity of any marine ecosystem is found. Marine environment of both Mediterranean and Red seas is distinguished by many habitats and endangered species especially all marine mammals (17 species), marine turtles (4 species), sharks (more than 20 species) mangrove trees and many birds (white eyed gulls, sooty falcons, ospreys). This is in addition to the great marine biodiversity (more than 5000 species) represented in 800 species of seaweeds, 209 species of coral reefs, more than 800 species of molluscs, 600 species of crustaceans, 350 species of Echinodermata, in

addition to hundreds of species that have never been revealed until now especially in the Exclusive Economic Zone in the Red Sea and the Mediterranean (EEAA, 2014).

The conservation status of species found in the Mediterranean Sea, between southern Europe and northern Africa is Critical/Endangered. A total of 19 species of cetaceans can be found in the Mediterranean, with eight of them considered common to the Mediterranean (Fin Whale, Sperm Whale, Striped Dolphin, Risso's dolphin, Long Finned Pilot Whale, Bottlenose dolphin, Common dolphin, Cuvier's beaked whale), four considered occasional (Minke Whale, Killer Whale, False Killer Whale, Rough Toothed Dolphin) and 6 considered alien to the Mediterranean, but have been occasionally sighted in the last 120 years (the Humpback Whale among them). A few of the species that are endangered include the Mediterranean Monk Seal (*Monachus monachus*), Mediterranean Mussel (*Mytilus galloprovincialis*), Mullet (*Mugilidae*), Gilthead Sea Bream (*Sparus aurata*), Sea Bass (*Dicentrarchus labrax*) and the Greater Flamingo (*Phoenicopterus roseus*). Also found in this ecosystem are Loggerhead Sea Turtles (*Caretta caretta*), Green Sea Turtles (*Chelonia mydas*), and Leatherback Sea Turtles (*Dermochelys coriacea*). Although the Mediterranean Basin is rich in biodiversity, many of its species are threatened by a range of human activities. Among the most endangered marine vertebrate species are: the Mediterranean Monk Seal, Common Bottlenose Dolphin (*Tursiops truncatus*), Short-beaked Common Dolphin (Delphinus delphis), and Striped Dolphin (*Stenella coeruleoalba*), Sperm Whale (*Physeter macrocephalus*), Green Turtle, Leatherback Turtle and Loggerhead Turtle in addition to cartilaginous fishes (sharks, rays, and chimaeras) (UNEP, 2005).

Egypt is a home to over 1,800 km of diverse coral reef habitats along the western Red Sea coast and in the Gulfs of Suez and Aqaba. The Red Sea contains some of the world's unique coastal and marine environments. The most notable among them is the extraordinary system of coral reefs and their associated animals and plants. This environment supports rich biological communities and representatives of several endangered species. Egypt's coastline possesses a significant proportion and considerable range of the coral reefs found in the Red Sea with about 3,800 km^2 of reef area (Spalding *et al*. 2001) and 1,800 km long (PERSGA, 2010). The Red Sea is home to approximately 300 species of hard corals and 125 species of soft corals. Of the 300 hard coral species found in the Red Sea, two thirds are found in the Egyptian Red Sea, including some endemic species (Kotb *et al*. 2008). These numbers are higher than those recorded in the Caribbean and equal to the Indian Ocean. Egyptian reefs are fringing reefs alongside the coastline. The reefs extend in the North to the gulfs of Suez and Aqaba and to Ras Hedarba in the South at the border of Sudan. They are, however, not continuous because of the periodic flooding from wadies creating gaps between reef systems. The northern part of the Red Sea has the highest coral diversity and number of islands while the south has the highest terrestrial biodiversity for the whole country (Shaalan, 2005).

In addition to coral diversity, the Red Sea and Gulf of Aqaba are also home to a diversity of flora and fauna. Different taxonomic groups recorded in Red Sea coral reef ecosystems include more than 1,000 fish species, 500 species of crustaceans, 400 Mollusca species and hundreds of species of other organisms. There are 13 species of marine mammals, 4 marine reptiles and 2 species of mangroves. The dugong (*Dugong dugon*) and different marine turtle species (hawksbill, green turtle, leatherback and logger-head) are present in different areas across the Red Sea (Tiran Islands, Nabq and Abu Galum Park in the North). In the Gulf of Aqaba, 49 species of invertebrates were found living in the sea grass bed, of which about 70% were molluscs. There are 325 species of reef fish in the Egyptian Red Sea, of which 17% are endemic species. Butterfly Fish have declined in numbers in the Red Sea from an

average of 9.7 per 100 m^2 to 5.2 per 100 m^2 in 2002, and Sweetlips populations have dropped by 69% (Hassan *et al*. 2002). In addition, the abundance of groupers and parrotfish in the Egyptian Red Sea have also decreased and this has been attributed to the lack of law enforcement where poaching in the no take zones is high (Hassan *et al*., 2002). It has also been established that the southern reefs house a greater diversity of fish species than northern reefs (Abu Zaid, 2000). Exposed reefs contain higher fish diversity than sheltered reefs, which has been attributed to a lower incidence of SCUBA divers and fishermen in exposed areas (Pilcher and Abu Zaid, 2000). In areas with higher diving activity, mostly in the north, an average of 55 species can be found in and around non-degraded reefs of Hurghada and Sharm El Sheikh. In contrast, a little further down the coast in Marsa Alam, where the number of tourists and developments are considerably less, average fish diversity increases to 70 species in and around non-degraded reefs. There was a positive correlation between the number of Butterfly Fish and live coral cover (Abu Zaid, 2002).

There are two types of mangroves in the Red Sea: *Avicennia marina* and *Rhizophora mucronata*. The *Avicennia marina* is the most abundant, where it was recorded in 28 areas along the coast and islands of the Red Sea and the Gulf of Aqaba in Ras Mohammed and Nabq PAs. The second type, *Rhizophora mucronata*, was recorded in the southern region only (in and around Shalateen) and beyond the Egyptian borders. The most important areas with mangroves are the islands of Monkar and Qaysom, Wadi El-Gemal, Hamata and the southern coast of Safaga. Many terrestrial organisms and avifauna visit these mangroves for reproduction, food and shelter. Mangroves are surrounded by very rich habitats including coral reefs and sea grasses. They act as nurseries for juveniles of commercially important fish species. Different taxonomic groups so far recorded in Red Sea mangrove ecosystems include more than 22 fish species, 36 species of algae, 40 insect species, 82 crustacean species, 65 Mollusca species and 17 Echinodermata species (PERSGA, 2004).

1.1.4. Mountain Ecosystems

Mountainous areas are concentrated in three regions in Egypt: South Sinai, El Owaynat, and Elba in the Red Sea. They cover 0.7 % of Egypt's territory and are characterized by unique biodiversity given the variety of habitats found within their ranges, such as mountain peaks, rifts, mountain slopes, desert valleys, mountain valleys and caves. More than 600 plant species have been documented in Egypt's mountains. Of these plant species, 70 (indigenous and endangered species in Elba and St. Katherine Mountains) are said to have been lost. To date, the different taxonomic groups recorded in mountain ecosystems include: 472 plant species (including 30 endemic - 50 % of the endemic species found in Egypt - and 140 medicinal plants), 85 moss taxa (48% of taxa recorded in Egypt, including two the endemic *Tortula kneuckeri* and *Grimmia anodon*). There also exists one species of hepatics (*Riccia cavernosa*). In St. Katherine there are 41 mammal species, 36 reptile species, 50 bird species and 33 butterfly species. In the Eastern Desert, mountains are home to 361 plant species, including the diversity found in Elba, which comprises of 458 plant species (3 endemic), 36 mammal species, 38 reptile and amphibian species and 60 bird species. In Hamata, there are 150 plant species, In El Owaynat there are 71plant species (40 species became extinct in the last 20 years), 12 mammal species, 12 reptile species, 30 bird species and 24 invertebrate species. The Gelf Elkebir is home to 64 plant species. The most common mountain mammals include the Slender horned gazelle (*Gazella leptoceros*), Nubian ibex (*Capra nubiana*), Wild cat (*Felis silvestris),* Swamp cat (*Felis chaus),* Caracal *(Caracal caracal),* and Rock hyrax (*Procavia capensis)* (EEAA, 2014).

1.1.5. Agricultural Ecosystems

Agricultural cropland habitats have been declining since the late 1980s. These declines are thought to be related to changes in land use and agricultural practices. Agricultural land continues to be lost to human settlements. About 286,000 feddans (1 feddan = 1.038 ha) were lost from 1990 to 1996; it is estimated that some 47,700 feddans are lost every year. In addition, the introduction of high yielding varieties and their wide use led to the neglect and disappearance of traditional varieties and the erosion of crop plant genetic diversity. Currently, Egypt depends on four crops (wheat, corn, rice and potato) for 50% of its vegetarian food and 14 mammal and bird species for 90% of animal proteins. Invasive species such as palm weevil and invasive weeds are also of great concern and the excessive use of fertilizers and pesticides has led to the disappearance of important agricultural biodiversity such as owls, kites, and pollinators. Fertilizer use increased from 707,400 tons in 2001 to 996,000 tons in 2003 and 4000,000 tons in 2005. The Egyptian economy's losses were estimated at about EGP 13.5 billion /year due to usage of pesticides, which contributes to the loss of pollinators. Most of Egyptian botanical crops depend completely or partially on insect pollination in its production (EEAA, 2014).

1.2. Species diversity in Egypt

Egypt is home to a wide variety of ecosystems and terrestrial and aquatic life due to its unique geographic location midway between Africa and Asia. Many plant and animal species in Egypt represent tropical and Mediterranean environments, some of which go back millions of years. Egypt is a home to over 22,000 plant and animal species (888 threatened with extinction): 2,145 species and 220 infra-specific taxa of native and naturalized vascular plants, 175 species and subspecies of mosses, 13 hepatics, 111 mammals (72 threatened with extinction), 485 birds (60 threatened with extinction), 112 reptiles (47 threatened with extinction), 9 amphibians (2 threatened with extinction), more than 1,200 fish species (52 threatened with extinction), 800 Mollusca, 1,000 Crustacean, more than 325 species of coral reefs, 10,000 – 15,000 species of insects (including 63 butterflies), 2,420 species of fungi, in addition to thousands of algae, bacteria and viruses. A significant part of these species is found in nationally designated protected areas. However, few of Egypt's described species have been assessed to determine their conservation status (EEAA, 2018).

Efforts have also been undertaken to rehabilitate some endemic flora and fauna species to increase their numbers in their natural habitats to protect them from extinction. These included the cultivation of some plant species in St. Katherine PA, including Arfeja (*Antirrhinum pubscens*), Zayteia (*Nepeta septemcrenata*), Alloseeg (*Silene shimperiana*), Alghasah (*Ballota kaiseri*) and St. Katherine Thyme (*Origanum syriacum*); the rehabilitation of wild turtles (*Testudo kleinmanni*) within Zaranik protected area after its discovery in an area outside the PA; the reproduction of the Acacia tree (*Acacia raddiana*) in Wadi al Gemal PA; the reproduction of the Haglig tree (*Balanites aegyptiaca*) in the Elba PA; the reproduction of Sarh plant (*Maerua crassifolia*) in Wadi al Gemal PA (wild animals like gazelle, hyrax, hares and Al teatel pastures over seed, flowers and leaves of this plant); and the reproduction of the Nabq plant (*Ziziphus spina-christi*) known as the apple of the desert in the Nabq PA. Some of the most important endangered animal species that are currently under breeding are the Dorcas Gazelle(*Gazella dorcas dorcas*), the Nubian Ibex (*Capra ibex nubiana*), the Barbary Sheep (*Ammotragus lervia*), the Hyrax (*Procavia* species), the Fennec Fox (*Vulpes zerda*), the Striped Hyena (*Hyaena hyaena dubbah*), the Caracal (*Caracal caracal schmitizi*), the Swamp Cat (*Felis chaus*), the Addax Antelop (*Addax nasomaculatus*), Oryx (*Oryx dammah*) and the Leptocerus Gazelle (*Gazella leptocerus leptocerus*), which is

believed to be on the verge of extinction. These animals have all been bred successfully. Egypt embarked on the protection and documentation of traditional knowledge and their usage, particularly in protected areas. This was achieved through the registration of 38 species of medicinal plants in South Sinai, 45 species in North Sinai, 19 species in the Elba area, 13 species in the Western Desert and 16 species in the Eastern Desert (EEAA, 2018).

A very recent paper was published by Sultan *et al*, 2019 entitled Risk of biodiversity collapse under climate change in the Afro-Arabian region. Ensample species distribution models for 107 endemic mammal species were used to: (1) identify hotspot areas for conservation; (2) assess potential impact of the projected climate change on the distribution of the focal species; and (3) assign IUCN threats categories for the focal species according to the predicted changes in their potential distribution range. Two main hotspot areas were identified: Sinai and its surrounding coastal areas in the East; and the Mediterranean coast around Morocco in the west. Alarming results indicated that 17 % of the endemic mammals in the Afro-Arab region under the current climate change could go extinct before 2050. Over all, a substantial number of the endemic species will change from IUCN threat category Least Concern to critically endangered or Extinct in the coming decade. Thus, there are urgent needs for implementing proactive conservation actions for endemic species (Sultan *et al*, 2019).

The Egyptian coastal and marine environment is distinguished by specific habitats and threatened species, such as marine mammals (17 species), marine turtles (4 species), sharks (more than 20 species), sea cucumber, special bivalves (clams), coral reefs, mangrove trees and many birds (white eyed gulls, sooty falcons, ospreys). This is in addition to great biodiversity (more than 5000 species), including 800 species of seaweeds and sea grasses, 209 species of coral reefs, more than 800 species of molluscs, 600 species of crustacea, 350 species of Echinodermata, and many others yet to be discovered in the Exclusive Economic Zone in the Red Sea. The conservation status of species found in the Mediterranean Sea, between southern Europe and northern Africa is Critical/Endangered. A total of 19 species of cetaceans can be found in the Mediterranean, with eight of them considered common to the Mediterranean (Fin Whale, Sperm Whale, Striped Dolphin, Risso's dolphin, Long Finned Pilot Whale, Bottlenose dolphin, Common dolphin, Cuvier's beaked whale), four considered occasional (Minke Whale, Killer Whale, False Killer Whale, Rough Toothed Dolphin) and 6 considered alien to the Mediterranean, but have been occasionally sighted in the last 120 years (the Humpback Whale among them) (EEAA, 2014).

Studies done by remote sensing and field testing confirmed that the total area of mangrove trees increased to 700 hectares by the end of 2009, compared with 525 hectares in 2002. This is mainly due to impeding encroachment and starting transplantation programs in many areas along past years, where more than 50 feddan were cultivated with more than 50 thousand seedlings of both mangrove types (*Avicennia marina* and *Rhizophora mucronata*), and the establishment of nurseries in Nabq, Safaga, Wadi El-Gemal and Shalatin. In addition, a biological study was conducted on mangrove trees (height, volume, density, fruit production, and flowering period) proved that mangrove habitats are portrayed by high biodiversity. Biotic communities so far recorded in Red Sea mangrove ecosystems (Fig 5) included more than 22 fish species, 36 species of algae, 40 insect species, 82 Crustacean species, 65 Mollusca species and 17 Echinodermata species. However, the diversity of macro invertebrate fauna (crustacea, molluscs and echinoderms species) reported in 2006 (27 genera) were lower than those recorded in 2002 (33 genera) while the coral cover in the fringing reefs adjacent to the mangrove did not change (EEAA, 2014).

Loggerhead and Green Turtles have been listed as Endangered by the IUCN while the Leatherback Turtle is listed as Critically Endangered (UNEP, 2012). While the Loggerhead remains relatively abundant, it seems to have almost deserted the Western Basin. The Leatherback and Green Turtle are becoming increasingly rare. Marine turtle monitoring in the Red Sea and Mediterranean is considered to be one of the most successful monitoring programs in large part due to the existence of specialists in this field for more than 10 years. The Red Sea is known to host nesting sites for the endangered Green Turtle, the most important ones being located in Saudi Arabia, Djibouti, Sudan and Egypt. Nesting activities along the Egyptian coast was described as low-density and scattered with three major concentrations: Tiran Island (Northern Red Sea), Wadi Gemal National Park (Southern Red Sea, in-shore) and Zabargad Island (Southern Red Sea, off-shore). During 2009/2010 numbering of marine turtles along the Egyptian coast of the Red Sea was fulfilled. There were 47 green turtles on Zabarged island (Red Sea) in addition to monitoring 3 turtles numbered during 2006, getting the total number of numbered turtles on Zabarged Island to 121 one. Surveying of different regions ran throughout 2010, confirmed 1960 old nest and 1347 new one in Zabarged Island, which is well thought-out one of the most important nesting areas of the green sea turtle, Chelonia mydas, on the Egyptian coast. Marine turtles monitoring program in Red Sea and Mediterranean recorded four species of marine turtles (green, loggerhead, hawksbill and leather back) in 15 sites on the beach and islands. They have been monitored; with high percentage of nesting in El-Zabargadis land (5336 nests were found in 2007 and remained stable in comparison with 438 in 2001). El-Giftoun Island is rich with hawksbill turtles where 21 nests were found in 2001 and increased to 255 nests in 2007. A satellite tracking monitoring program for green turtles was imitated also in 2012 in Wadi El Gemal National Park. Results obtained from irregular surveys between 2001 and 2008 suggested that as many as 610 turtles could nest on the 3.5 km long beach on the island. Nesting success (NS) was calculated as the number of true nests divided by the total number of observed tracks. Recently, the total number of true nests on the island was estimated at 2,262.51±531.27 in 2009; 1,073.90±268.80 in 2010 and 1887.29±388.97 in 2012 while the total number of true nests was 227 in 2009, 130 in 2010and 510 in 2012. The Nesting success was 10%, 12%, and 27% in 2009, 2010, and 2012 respectively. Green turtle population in the Red Sea is estimated to be around 450 nesting females per year (El-Sadek et al., 2013 - EEAA, 2014).

In 2015 Shawky et al. photo identified 255 individual of spinner dolphin Stenella longirostris within a population size range of 567 to 637 individuals of dolphins utilizing Samadai area in daytime for resting and socializing. From the 255 identified dolphins, 33 individuals (12.9%) were re-sighted for 4-8 times and 131 individuals (51.4%) were only observed once. The discovery curve indicated the continuous entrance of new animals to Samadai reef, especially between May and December, this may represent a positive indicator of good environmental status in Samadai after implementation of conservation strategy (EEAA, 2014 - Shawky et al., 2015).

Whale shark is a threatened species as it is recorded in the Red List of IUCN hence requires unifying efforts to be protected from extinction. Researchers in Red Sea and Gulf of Aqaba conducted studies to monitor whale shark and conducted questionnaire on its distribution. Thirty-five whale shark, were watched from 2003 until February 2008 in Dahab, Sharm El-shikh, Ras Mohamed, Hurghada, Quseiur, Marsa Alam, Port Ghaleb, Elswany Islands, Elsayal, Elsokor, and Elafiston. The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) conducted a study about shark

species in the Red Sea indicated the presence of 33 species. While latest studies conducted by Red Sea Protected Areas indicated that the recorded species did not exceed 17 despite the availability of recent monitoring equipment such as appliances of diving, photography and measurement of water chemistry. Shawky and De Maddalena (2013) studied the human impact on the presence and behavior of sharks from June to November 2008 at some Red Sea diving sites. A total of 292 individuals belonging to eight species of sharks, the recorded species included: whale shark *Rhincodon* types (1 specimen), pelagic thresher shark *Alopias pelagicus* (12 individuals), silvertip shark *Carcharhinus albimarginatus* (1), grey reef shark *Carcharhinus amblyrhynchos* (61), silky shark *Carcharhinus falciformis* (2), oceanic white tip shark *Carcharhinus longimanus* (123), whitetip reef shark *Triaenodon obesus* (5), scalloped hammerhead *Sphyrna lewini* (87) (Shawky and De Maddalena, 2013 - EEAA, 2014).

Egyptian Desert was resided by six species of large mammals known by Antelopes, Mountain Gazelle (*Gazella gazella*), Scimitar Horned Oryx (*Oryx dammah*), Rhim Gazelle (*Gazella leptoceros*), and Africa Wild Ass (*Equus asinus*). These animals were prevalent in the deserts till mid-1940th of the last century. As a result of hunting and drought, Mountain Gazelle (*Gazella gazella*), Scimitar Horned Oryx (*Oryx dammah*), Rhim Gazelle (*Gazella leptoceros*), Africa Wild Ass (*Equus asinus)* exclusively disappeared and only the Dorcas Gazelle (*Gazella Dorcas dorcas*) and Rhim Gazelle (*Gazella leptoceros*) endured and are in jeopardy of extinction. The Dorcas Gazelle is moderately widely spread than Rhim Gazelle that had been monitored in limited areas of Western Desert close to Siwa oasis; while Dorcas Gazelle subsist in plentiful areas as it was monitored in eleven protected areas (Wadi El-Gemal, Siwa, White Desert, Elba, Wadi El-Rayan, Wadi El-Alaky, El-Asuti, Catharine, Degla, Nabeq and Taba). Studies designated that numbers of Gazelles are habitually decreasing with different rates according to their area of existence and range of threats they are exposed to. Dorcas Gazelle is well thought-out to be one of the indicators of biodiversity conditions in Egyptian environment that is eminent by its sprightly and quick movements to remote distances looking for graze (EEAA, 2014).

At the national level, several attempts have been made to provide a conservation assessment for different taxonomic groups in Egypt and in its protected areas. By the end of 2013, the conservation status of only the following taxonomic groups is available: mammals (111 species), insects (mainly butterflies: 63 species and Odonata: 40 species), four plant families (Apocyanaceae: 22 species, Euphorbiaceae: 51 species, Primulaceae: 9 species and Amaranthaceae: 25 species) and birds (43 species), which indicate a continuing increase in the risk of extinction. As of 2010, 364 species of the over 22,000 species described in Egypt had been assessed. This indicator shows the status ranking by taxonomic group. Of these 364 species, 41 % (152 species) are considered threatened with extinction, although this varies among taxonomic groups. Among selected mammals, insects and plant groups, between 70% and 25% of species are currently threatened with extinction, with the *Euphorbiacea* plant family facing the greatest risk. Of the mammals, butterflies, insect odonata, birds, *Apocynaceae*, *Euphorbiacea*, *Primulaceaa* and *Amaranthaceae* plant species assessed, 31%, 25%, 50%, 60%, 40%, 70%, 44% and 36%, respectively, are threatened. Global environmental reports predicted that about one quarter of the world's mammals will be endangered during the next 30 years. In Egypt, there are many species of desert mammals that had already gone extinct during first half of the 20th century. Of the 111-mammal species recorded in Egypt (ca. 27 endemic) in 2010, 40 are included in the IUCN Red list, which represents about one third of the mammals found in Egypt. Global environment reports expected that about one quarter of world mammals will be endangered during the next 30

years. In Egypt many species of desert mammals are already extinct during first half of the 20th century (EEAA, 2014).

Table 3 Conservation Status of Assessed Animal and Plant Taxonomic Groups

Red list Category	Mammals	Butterflies	Odonata	Birds	Apocynaceae	Euphorbiaceae	Primulaceae	Amaranthaceae
CR	4	1	3	10		7		
EN	11	1	7	6	2	7	1	3
VU	24	14	10	10	7	22	3	6
NT	36	17	11	11	11	15		
LC				5				
NE	21	14		1			3	11
DD	15	16	9		2		2	5
Total	111 species	63species	40 species	43 species	22 species	51 species	9 species	25 species

CR: Critically Endangered EN: Endangered VU: Vulnerable NT: Near Threatened LC: Least Concerned NE: Not Evaluated DD: Data Deficient

1.3. Genetic diversity in Egypt

Egyptian ecosystems are rich in wild plants and landraces which survived for hundreds of years. These landraces and wild relatives are widely adapted to biotic and abiotic stresses, as well as harsh conditions prevailing in the areas in which they grow. Genetic diversity is being lost in natural ecosystems and in systems of crop and livestock production due partly to the intensification of production, and also partly to the abandonment of rural areas for larger cities and urban areas. The continued loss of genetic diversity of such crops and livestock may have major implications on food security. Currently, Egypt depends on four crops (wheat, corn, rice and potato) for 50% of its vegetarian food and 14 mammal and bird species for 90% of animal proteins (EEAA, 2014).

In Egypt today, important progress is being made to conserve plant genetic diversity, especially using ex situ banks. A number of programs have been set up to collect different genetic varieties for cataloguing and storage for possible future use. Plant genetic resources of field and horticulture crops stored in the National Gene Bank (NGB) conservation facility situated in the Agricultural Research Center in Cairo was estimated to hold more than 35,000 genetic origins in 2006, 500 of which are vegetables collected from breeding programs and international gene banks. However, the NGB capacity is estimated at 200,000 genetic origin samples. Almost all plant collections in Egypt are kept in the herbaria of universities, research centers and botanical gardens (e.g. Aswan, Orman, Kobba Palace and Zohareya in Cairo; Montazah Palace and Antoniadis in Alexandria). Nine of these herbaria have been registered in the Index Herbarium of the New York Botanical Garden (EEAA, 2014).

To date, Egypt has no national legislation or administrative mechanisms pertaining to access to Egypt's genetic resources and associated traditional knowledge and benefit sharing from their utilization. The absence of legal and administrative mechanisms to regulate access to Egypt's genetic resources and to set conditions for benefit-sharing is a key constraint towards achieving more meaningful benefit sharing. However, a draft law on the regulation of access to genetic resources and related traditional knowledge and the equitable sharing of benefits from their use has been finalized and is being considered by the parliament. Egypt embarked on the protection and documentation of traditional knowledge and their usage, particularly in protected areas. This was achieved through the registration of 38 species of medicinal plants in South Sinai, 45 species in North Sinai, 19 species in the Elba area, 13 species in the Western Desert and 16 species in the Eastern Desert. Furthermore, handicrafts and linkages of cultural heritage with natural heritage in protected areas were registered. The recently

finalized draft law on the regulation of access to genetic resources and related traditional knowledge and the equitable sharing of benefits from their use covers the protection of traditional knowledge, innovations and practices of communities concerned with biological resources within a framework recognizing their individual and collective rights (EEAA, 2018).

Ministry of Environment is working closely with NGB, and also signed an MoU with the Desert Research Institute (DRI) to provide capacity building to staff from NCS and DRI. It has provided financial resources to carry out research on desert plant genetic resources, collect plant species from PAs, prepare herbaria, carry out field work on threatened, endangered and endemic species to propagate them and be reintroduced to PAs. A total of 171 plant species are preserved at DRI, and a photographic identification of all plants in each PA is being prepared (EEAA, 2018).

1.4. Ecosystem services in Egypt

Only few studies have been made to determine ecosystem services in Egypt due to high cost involved in conducting economic valuation of the natural system and the limited national expertise in this field. Ras Mohamed National Park coral reef economic values were calculated in terms of the recreational benefits that were thought to be the most important to the different stakeholders. Coral reef tourism in South Sinai is the pillar of the local economy. By using the travel cost method, the total recreational benefit was estimated to be above US$ billion per year. Reef-related tourism expenditures in Egypt parks alone is estimated at US$ 470 million per year, and reef-associated fishery US$40,428,000. The Total Economic Value (TEV) of the mangroves at Ras Mohammed estimated at US$ 182,000/year (US$ 91,000/ha/yr), and for Nabq Protected Area the figure could be as high as US$ 1,290,000/year (US$ 24,000/ha/yr.). Most other mangroves are likely to have a value in the order of US$ 13,000/ha/yr. for fisheries and perhaps in the order of US$ 13,000/ha/yr for non-use values (EEAA, 2018).

Additionally, the annual economic value (benefits) of RMNP ecosystems is found to be about US$ 294 million. This value, which includes the benefits of fishing activities, bio-prospecting, education and research and recreation functions of the most prominent ecosystems namely; coral reefs and mangrove, does not include consumer surplus and producer surplus. Among these ecosystem functions, recreation was found to be the most significant, as it accounts for more than 98% of the estimated total annual value.

Table 4 Total annual value of Ras Mohamed National Park Ecosystems

Ecosystem Function	Value (US$) /yr-[1]
Fishing Activities	1,201,960
Bio prospecting	2,468,000
Education and research	368,200
Recreation	293,986,200
Total	**293,988,160**

Other scientific publications were published recently on biodiversity and ecosystem services in Egypt that have contributed significantly to our knowledge on biodiversity including taxonomy, new species, new records, assessment of some species, habitats, and ecosystems. Examples include: coastal lakes as hotpots for plant diversity. About 402 plant species were

identified (about 19 % of the whole Egyptian flora), categorized into 45 plant communities. Five of them are endemics and 3 are near endemics. in addition, 70 % of plant species, many of them are aquatic, offer at least one potential or actual good (e.g. grazing, medicinal drugs, human food, fuel, and timber), while of them 60 % have at least one aspects of environmental services (e.g. sand controllers, shades, weed controllers, bank retainers, nitrogen fixers, and water purifiers). Most of the lakes receive excessive amount of agricultural and industrial drainage water that is loaded with different pollutants, except for only one lake (Bardawil). The vegetation and sediment of these lakes are effective as carbon sinks; therefore, they play a vital role in mitigation of global warming. A recent book on important plant areas in Egypt was published in 2016. Another important publication was on evaluating effectiveness of in-situ conservation on some endemic plant species in south Sinai. Other publications were on the conservation-oriented habitat classification scheming and mapping of Egypt; on the distribution of soft corals in the Egyptian coasts of the Red Sea and Gulf of Aqaba. Still many others deal with economics of some endangered species such as dugong, sharks, dolphins, and marine turtles (EEAA, 2018).

Tourism is one of the most important sectors in Egypt contributing 11.3% of GDP and with 12.6% of the total labor force employed in this sector. Tourism in the Egyptian Mediterranean is characterized by the dominance of internal tourism as opposed to foreign tourism. Apart from the traditional destination cities such as Alexandria, Port Said, Matrouh and Al-Arish, the north coast extending from Alexandria to Matrouh has emerged as a main attraction for local tourism during the last two decades. About two million Egyptians visit the northern coast in the summer season extending from May to September. This has been accompanied by extensive developments of resorts along the Mediterranean coast, thus representing an increased pressure on the coastline and the ecosystems. It is the intention of the Government to further develop the north coast to absorb the future population growth in the country and to make it an attraction for foreign tourists and investors. With the stabilization of the political situation in Egypt, it is expected that foreign tourism will even exceed the figures prior to 2010 levels of 14.7 million tourists. However, environmental degradation of the northern coastal areas will be a discouraging factor for foreign tourists to visit main Egyptian Mediterranean cities. The environmental impacts on coastal areas will be further exacerbated by increased levels of urbanization, volume of transport and consequently fuel consumption and CO_2 emissions, cruising and pleasure boating, as well as increased levels of ground water consumption and wastewater and solid waste generation and disposal (EEAA, 2018).

The agriculture, irrigation and fisheries sector contribute 14.7% to GDP. The contribution to GDP from the fisheries sector is about 0.4% of the Average GDP. More than 250,000 fishermen are employed in the fisheries sector in Egypt. A disruption in the sector is therefore likely to have an impact on direct and indirect employment. Agricultural exports constitute about 10% of total export activities in Egypt. In recent years; Egypt has experienced a boom in fish production, where it has increased from 790,000 tons in 2001 to 1.7 million tons in 2017. This increase in fish production has been mainly attributed to the expansion of aquaculture, which represented 74% of the total catch. Expansion in aquaculture in Egypt in recent years can be linked to the reduction of fish catch from the Mediterranean, and the northern lakes and River Nile. Main reasons for the decline in fisheries from other sources (excluding aquaculture) have been identified as over fishing, illegal fishing, pollution, overlap between coastal and offshore uses, lack of planning, and limited regulations regarding closed fishing season to take into account fish spawning and to let them grow and the use of non-selective fishing gear. This is in addition to other unsustainable fishing

practices, including the use of trawls and other mobile bottom gear, the use of dynamite and poison, and the disposal of debris such as food containers and plastics, and vessel debris. It should be pointed out that the size of four of the northern lakes, namely Manzala, Burullus, Edku, and Mariout have drastically declined reaching up to 95.5% reduction in size in some cases, as is the case for Lake Edku. Moreover, the northern lakes have been exposed to serious environmental degradation due to the disposal of industrial and agricultural waste, as well as municipal waste. Climate change is also expected to impact fisheries in Egypt as a result of the potential increase in seawater temperature and ph (EEAA, 2018).

Based on the above, these studies are far from being complete as many ecosystems in Egypt have not yet been assessed properly, particularly the arid environment, which represent more than 90% of the total area of Egypt, and marine environment. There are needs for detailed studies on the evaluations of all ecosystems' goods and services and their implication on human wellbeing. Therefore, the available evaluation studies are being used partially to inform decision making, such as those related to the coastal northern lakes of Egypt, as well as Governance and Knowledge Generation Socio-economic Evaluation of Maritime Activities study. However, the economics of some endangered and threatened species such as dugong, dolphins, sharks, sea turtles, coral reefs and Gazelles have been used in ecotourism, or when some individuals violate the law they are sent to the court for compensation for the damage they have caused by breaking corals or capturing these iconic animals (EEAA, 2018).

1.5. Threats to biodiversity in Egypt

Biodiversity in Egypt is deteriorating at the level of ecosystems, species and populations; genetic diversity is also declining. The losses are due to a range of threats including habitat loss and fragmentation, over exploitation and unsustainable use of natural resources, pollution, and invasive species. Limited human and financial resources have also contributed to the loss of biodiversity. These pressures are continuing to increase and are themselves driven by a range of socio-economic drivers, mainly the growing population and limited human and financial resources. Climate change will act synergistically with other threats with serious consequences for biodiversity.

Direct habitat loss is a major threat to terrestrial, marine and coastal ecosystems; freshwater ecosystems on the other hand are particularly severely affected by fragmentation. Land reclamation, urbanization and industrial activities destroy and alter critical natural habitats along with their plant and animal life. Egypt's wetlands are subject to a variety of human induced threats, which are leading to the degradation of this valuable national resource. There are multiple threats to wetlands and river ecosystems in Egypt. One of the major threats to wetlands, in the northern coastal lakes in particular, in Egypt is the drainage of water bodies for their conversion into agricultural and settlement developments, ultimately destroying habitat and reducing their areas. Other threats to wetlands include water withdrawal for irrigation, coastal erosion, invasive species, water pollution and overfishing. The severity of pollution varies from lake to lake, but they all share the same cause of pollution - the discharge of untreated or partially treated industrial and household waste water (mainly sewage) and the dumping of agricultural drainage loaded with fertilizer, pesticide and herbicide residues. The severity of pollution in these lakes can be as follows: Lake Maryout> Lake Manzala> Lake Edku> Lake Burullus. Excess agricultural runoff and domestic wastewater discharge into these water bodies causes an increase in the levels of nitrogen and phosphorous, a process known as eutrophication, causing harm to other forms of life

inhabiting these waters. Such malpractices can be traced back to a rapidly growing population and the increased human activity that comes with it (EEAA, 2014).

Pollution causes deterioration of critical habitats and species loss. A concrete example is the Delta wetlands. Excessive use and misapplication of pesticides also causes loss of rare species including those that act as pollinators and natural biological control agents. Pollution of all forms in air, water, and soils are the main driver of biodiversity loss. Monitoring water and air quality is being carried out for almost 20 years, and numerous measures were implemented to reduce the impact of pollution on biodiversity. However, we are still far from achieving this goal as all activities of governmental development agencies and even there exist inter-ministerial committee, the existing policies and regulations are not yet effective due to the flowing main drives; 1) the ever increasing human populations, internal migration to cities from villages, and expansion of urbanization, 2) limited financial resources, 3) Public perceptions towards environment and waste, 4) increased rate of production and consumption of hazards waste, 5) weak human resources and capacities and limited institutional capacities. The main pressures related to pollution include; increase in number of unplanned landfill sites, human behavior to throw waste everywhere including aquatic channels, increase the amount of medical waste with limited facilities to deal with it, and industrial waste and emissions. Therefore, the current drivers and pressures are being evaluated to provide responses which included establishment of Waste Management Regulatory Agency in 2015, implementable a national programme for municipality waste, establishment a supreme national committee to deal with hazards waste in accordance with related international convection such as Basel, Management of Agricultural waste and other countries. A national cleaner production center (SWITCHMED) was established as a center of Excellence for green industries and resource efficiency and cleaner production in Egypt. It is being implemented by several projects and policy measures, raising awareness and capacity building on energy and upgrading local industries and upscale adoption of best practices. Successful case studies are available, all and finally mainstreaming of biodiversity into industrial sectors through innovations and environmentally friendly industries (EEAA, 2018).

Invasive alien species (IAS) in Egypt is a very serious problem, like elsewhere. However, tremendous efforts have been done over the last few years. There are many governmental agencies at the Ministries of Agriculture, Water Resources and Irrigation and Environment as well as universities and research centers that are involved in (IAS). Terrestrial and freshwater species are the responsibilities of the Ministries of Agriculture and Water Resources and Irrigation where they have been working for a long time on many species of water hyacinth and red palm weevil and others, it was decided that Ministry of Environment will focus its efforts on marine invasive alien species. A national action plan was made in accordance with CBD guidelines and RAC/SPA of UNEP/MAP, and was validated in 2017 which calls for preparing the list of species, priorities, pathways, and management. Consequently, a survey along the Suez Canal and the Egyptian Mediterranean Sea was made 4 times in two years. This program aims to establish a database of marine organisms, their environmental origins, their paths and methods of transport, their environmental and socio-economic impacts as well as physio-chemical characteristics of Suez Canal and Egyptian Mediterranean Sea. Details of the study are provided as link. Genetic studies on molecular identification of some available species were also made. A total of 411 species were recorded as non- indigenous species Among the different animal groups, 374 species demonstrate Lessepsian behavior (Movement from Red Sea to Mediterranean Sea) with percentage of 91%, while 37 exhibit anti-lessepsian behavior (Movement from Mediterranean Sea to Red Sea) with percentage of 9% of total species recorded. Priority is being given to only invasive species which do not

exceed 5 %, and the rest are of commercial value. Recent publications on the alien vascular plants in the Egyptian flora included an evaluation of the total aliens which approximates 136 species categorized as follows: 49 casuals, 81 naturalized and 6 invasive species (Shaltout 2014). Other publications deal with evaluation of only one alien such as *Ipomoea carnea* (Eid *et.al*. 2017).

Invasive species continue to be a major threat to all types of ecosystems and species in Egypt. Currently available information about invasive species in Egypt is still insufficient or is not readily available. Exerted efforts to control and eradicate existing invasive species and to prevent the introduction of new ones are still limited in spite of the fact that invasive species represent real threat to Egyptian ecosystems, the economy and human health. Combating invasive species is beyond the country's current potential in terms of human, financial and technical resources, and requires participation of all concerned agencies (EEAA, 2018).

During the last ten years, considerable changes occurred regarding to the impact of tourism on biodiversity due to the political situation in the Middle East, hence number of tourists fluctuated greatly from 14.7 million tourists in 2010 to 5.4 million tourists in 2017. Although, huge efforts were made during the last few years such as framework of ecotourism strategy, ecotourism activities, and numerous studies on the economics of some important sites such as Sharm El-sheikh and Wadi El- Rayan (based on UN guidelines on Biodiversity and Tourism Development which represent a wide range of opportunities to manage activities in an ecological, economic and sustainable manner), critical problems and risks still exist including inability to retain trained staff, under-funding, lost opportunities to generate substantial revenues, and adapt to manage rapid and multi-faced systems, complexity and change. Proposed correction actions for PAs management were approved and there is currently a project on self-financing PAs funded by GEF (EEAA, 2018).

Ecosystems Vulnerable to Climate Change have been identified. Egypt is one of the most vulnerable countries to climate change, although its gas emission is only 0.6%. The most vulnerable sites and sectors include Nile Delta, agriculture, tourism, coastal urbanization and human health. The main contribution from gas emission comes from energy (59%), industrial processes (16.9%), agriculture (10.9%) and solid waste (7.7%). Adaptation and mitigation measures are being implemented, including studies on different ecosystems (arid, coastal, marine, mountains). PAs have proven to be good examples for climate change adaptation. Risk of biodiversity collapse under climate change in the Afro-Arabian region has shown 17% of (107 endemic mammals' species) could go extinct before 2050. Good news from climate change studies includes the positive role of wetlands and mangroves in Egypt in carbon sequestration process. In addition, coral reefs in the northern Red Sea live below bleaching threshold, thus represent a thermal refuge of global importance (EEAA, 2018).

Recently the fifth IPCC assessment report during 2014 confirmed that the Nile Delta is considered one of the most vulnerable sights in the world due to climate change inputs. Biodiversity impacts of climate change include shifts in species distribution and range, and the impacts of mitigation activities. There are also concerns that existing protected area networks may not be adequate for biodiversity conservation in a time of changing climate. Moreover, the Mediterranean Sea is becoming warmer; its salinity is increasing, and the rise in sea level is accelerating. The Nile Delta is considered one of the most vulnerable sites in the world due to climate change inputs. Tropical reefs have been impacted by thermal anomalies caused by global warming that induced coral bleaching and mortality events globally. However, there have been very few recordings of bleaching within the Red Sea

despite covering a latitudinal range of 15° consequently it has been considered a region that is less sensitive to thermal anomalies. Osman *et al*, (2017) examined historical patterns of sea surface temperature (SST) and associated anomalies (1982 – 2012) and compared warming trends with a unique of corresponding coral bleaching records from throughout the region. These data indicated that the northern Red Sea has not experienced mass bleaching despite intensive Degree Heating Weeks (DHW) of > 15°C-weeks. Severe bleaching was restricted to the central and southern Red Sea DHWs have been more frequent, far less intense (DHWs <4°C-weeks). A similar pattern was observed during the 2015 – 2016 El Nino event during which northern Red Sea did not bleach despite high thermal stress (i.e. DHWs > 8°C-weeks), and bleaching was restricted to the central and southern Red Sea despite the lower thermal stress (DHWs <8°C-weeks). Heat stress assays carried out in the northern (Hurghada) and central (Thuwal) Red Sea on four key reef-building species confirmed different regional thermal susceptibility, and that central Red Sea corals are more sensitive to thermal anomalies as compared to those from the north. Together, data demonstrate that corals in the northern Red Sea have a much higher heat tolerance than their prevailing temperature regime would suggest. In contrast, corals from the central Red Sea are close to their thermal limits, which closely match the maximum annual water temperatures. The northern Red Sea harbours reef-building corals that live well below their bleaching thresholds and thus we propose that the region represents a thermal refuge of global importance (EEAA, 2018).

Climate change is likely to exacerbate many of the risks associated with above mentioned stress and reducing the choices open to individuals and policy makers. Systematic quantitative assessments are needed to determine how changes in biodiversity would impact the provision of ecosystem services, or how the production of ecosystem services has impacted on biodiversity. Wetlands which are some of Egypt's most important habitats in terms of biodiversity (second only to the Red Sea's coral reefs), supporting both the greatest diversity and density of bird species, are subject to a variety of human induced threats leading to the degradation of this valuable national resource. Most Egyptian wetlands and river systems have been degraded drastically during the past 50 years as a result of multiple pressures. One of the major threats to wetlands, in the northern coastal lakes in particular is the drainage of water bodies for their conversion into agricultural and settlement developments, ultimately destroying habitat and reducing their areas. Other threats to wetlands include water withdrawal for irrigation, coastal erosion, invasive species, water pollution and over-fishing (EEAA, 2018).

As a result of the increased scientific evidence of the danger of climate change phenomenon and its impacts on Egypt, the National Committee on Climate Change was established in 2007 (Prime Minister Decree #272). The committee includes representatives from the Ministries of Foreign Affairs, Water Resources & Irrigation, Agriculture & Land Reclamation, Electricity & Energy, Petroleum, Trade & Industry, Economic Development and Defense, besides experts from national and relevant agencies. The National Committee is concerned with developing mitigation and adaptation strategies to address phenomenon of climate change and reviewing and activating the National Strategy for Climate Change with the preparation of plans and programs required in the short term and long term as well as integrating these into national action plans for development in Egypt. A number of efforts have been undertaken by the Government of Egypt to achieve the objectives of the convention. They included Technology Cooperation Agreement Pilot Project (TCAPP), promotion of wind energy for electricity generation, fuel cell bus demonstration project, hybrid-electric bus technology, natural gas motorcycles, methane recovery from landfills, and integrated solar thermal/natural gas power plant at Kuraymat, energy efficiency improvement

and emissions reduction project as well as fuel switching. Other measures taken by Egypt included observations, networking, research and technology development, education, training and raising of public awareness (EEAA, 2018).

The Egyptian coastal and marine environment is distinguished by specific habitats, namely coral reefs and mangroves. The Red Sea is renowned for its coral reefs and mangroves where the greatest known species diversity of any marine ecosystem is found. Coastal habitats have come under pressure from many forms of development including tourism, urban infrastructure and port facilities. Major threats to marine ecosystems are unregulated tourism, exploitation of marine resources, over-fishing and fishing in illegal areas (e.g. breeding grounds) and coastal pollution. At present, 20% of Egyptians live in coastal areas, which are also visited annually by 11 million tourists. In addition, more than 40% of industrial activity occurs in the coastal zone. Coastal development, intensive tourism and land reclamation for agriculture put pressure on key wildlife habitats in the Mediterranean. Contributing factors to the decline of wildlife habitat in the Mediterranean include historical overexploitation, degradation of beach nesting habitat due to sand extraction, entanglement in fishing gear, loss of sea grass meadows, pollution and increased ship traffic. In the eastern Mediterranean, seabirds are threatened by habitat loss due to drainage, water diversion, changes in annual water regime, eutrophication, reed cutting, landfills, chemical pollution and hunting (UNEP/MAP 2012). For example, the vast tracts of what might have been suitable habitat for the Egyptian Tortoise (*Testudo kleinmanni*) in the North Coast are now uninhabitable for the species. Perhaps the most serious threat to *T. kleinmanni* is the complete (and possibly irreversible) destruction of habitat caused by agricultural activities. Local and regional problems related to pollution, specifically effluents from domestic and industrial sources, oil transportation, refineries and agricultural runoff are also beginning to have serious impacts on wildlife. Major threats to Red Sea coral reefs include land filling, dredging for coastal expansion, destructive fishing methods, shipping and maritime activities, sewage and other pollution discharges, damage from recreational SCUBA diving, lack of public awareness and the insufficient implementation of legal instruments that promote reef conservation. In addition, increasing atmospheric carbon dioxide is expected to alter the alkalinity of the world's oceans over the next century making it increasingly difficult for corals and other carbonate secreting organisms to grow. Present predictions are that calcification rates may slow by as much as two-thirds over the next 50 years, with potential for catastrophic effects on reef growth and marine biodiversity in general (Kleypas *et al*., 1999 - EEAA, 2014).

The main threats to desert biodiversity are habitat loss and land degradation. The cause of land degradation in the northern coast of Egypt is due to overgrazing, where grasslands have been converted to accommodate seasonal agriculture. Other causes of habitat loss and degradation are air and water erosion, poor land management, limited and ineffective popular participation by locals in conserving the land and the establishment of several developmental projects. Other threats include increased dryness, which hinders the ability of plants to reproduce; the overharvesting of plants, especially medicinal plants; the hunting of wild animals outside protected areas; logging activities in the Eastern and Western Desert for fire; increased urban development and safari tourism in unpopulated areas; landmines left after World War II in El-Alamein (nearly 17.5 million mines occupying more than quarter million feddans suitable for agriculture); and climate change, which is believed to have led to more droughts, increased temperatures and decreased rainfall (EEAA, 2014). The impacts of land use changes on the distribution of selected important plant species in an arid landscape in the northwest coastal desert of Egypt was assessed using a random forest modelling approach (Halmy *et al*., 2015). Out of 244 species found in the area, the distributions of only seven

important species were modeled. Important species were defined as those serving crucial functions and providing important services in any ecosystem. This could include, for example, sand stabilizing and nitrogen-fixing plants. The results indicate that the changes in land use in the area over the last 23 years have resulted in habitat loss for all the modeled species. Projected future changes in land use revealed that all the modeled species would continue to suffer habitat loss (Halmy *et al.,* 2015).

Agricultural cropland habitats have also been declining since the late 1980s. These declines are thought to be related to changes in land use and agricultural practices. Agricultural land continues to be lost to human settlements. It is estimated that some 47,700 feddans (1 feddan = 1.038 ha) are lost every year. The intensification of crop and livestock production, along with the abandonment of rural areas for urban ones, has caused the loss of genetic diversity. This loss in genetic diversity may have serious implications on food security; especially given Egypt's dependency on four crops (wheat, corn, rice and potato) for 50% of its vegetarian food and 14 mammal and bird species for 90% of animal proteins (EEAA, 2018). The main threats to agricultural biodiversity in Egypt are: i) urbanization expansion on agricultural land despite the strict legislation governing the destruction of agricultural lands; ii) the introduction of high yielding varieties and their wide use that has led to the neglect and disappearance of traditional varieties and local breeds, the erosion of plant crops and the reduction in livestock genetic diversity; iii) the abandonment of traditional agricultural practices, causing the loss of cultural landscapes and associated biodiversity; iv) the introduction of invasive species, such as the Red Palm Weevil (*Rhynchophorus ferrugineus*), invasive weeds and various agricultural pests, which cause significant economic losses; v) the excessive use of fertilizers and pesticides that has led to the disappearance of important agricultural wildlife (pollinators, kites, owls, foxes, mongoose and wild cats) and groundwater contamination; vi) the absence of suitable successive agricultural cycles; viii) the use of surface flooding irrigation methods, which led to land degradation, reduction of soil fertility and increased soil salinity; and ix) the increased migration from rural to urban areas with an increasing burden on resources (EEAA, 2014).

Species diversity is also in decline and continues to be threatened by the same threats observed on the ecosystem level: habitat destruction, unsustainable use of natural resources, pollution, invasive species and over-exploitation. Few of Egypt's described taxonomic groups or species have been assessed to determine their conservation status. The distribution of threatened species in freshwater habitats in Egypt is poorly known, but regional assessments from the Mediterranean Basin indicate that freshwater species are, in general, at much greater risk of extinction than terrestrial taxa. By the end of 2013, 364 species of the over 22,000 species described in Egypt had been assessed and the conservation status of only the following taxonomic groups is available: mammals (111 species), insects (mainly butterflies: 63 species and Odonata: 40 species), four plant families (Apocynaceae: 22 species, Euphorbiaceae: 51 species, Primulaceae: 9 species and Amaranthaceae: 25 species) and birds (43 species), which indicate a continuing increase in the risk of extinction. Major efforts are needed to assess taxonomic groups or species that have not been assessed to determine their conservation status including crop genetic diversity and animal genetic resources. Of the assessed 364 species, 41 % (152 species) are considered threatened with extinction, although this varies among taxonomic groups. Among selected mammals, insects and plant groups, between 70% and 25% of species are currently threatened with extinction, with the Euphorbiaceae plant family facing the greatest risk (EEAA, 2018).

On the other hand, the rate of loss of ecosystems and genetic diversity is poorly known and exerted efforts are still limited, but a good example of the loss of genetic diversity in Egypt is that of cotton, having lost its varieties greatly onward from the 1950s. Genetic diversity is being lost in natural ecosystems and in systems of crop and livestock production due partly to the intensification of production, and also partly to the abandonment rural areas for larger cities and urban areas. The loss of biodiversity will ultimately impact the ecosystems functions and their ability to deliver essential goods and services. As a result, serious social, economic, cultural and ecological implications are expected. The continuing decline of biodiversity puts these crucial ecosystem services at stake, ultimately affecting the well-being of Egyptians (EEAA, 2018).

2. Climate change in Egypt

The Arab Republic of Egypt is located in the north-eastern corner of Africa. The topography of Egypt ranges from 133 m below sea level in the Western Desert to 2,629 m above sea level in the Sinai Peninsula. Egypt's coastal zones extend for over 3,500 km along the Mediterranean and Red Sea. The Mediterranean shoreline is most vulnerable to sea level rise due to its relative low elevation compared to the land around it. The Delta and its north coast are hosts to several primary towns and cities such as Alexandria, Port Said, Damietta, and Rosetta, all with populations of several million, and large investments in industrial, touristic and agricultural activities as well as in the infra structure serving these activities (EEAA, 2016 - CRP-Egypt, 2021).

Egypt is classified as a lower-middle income country (**Table 3**), the government has been relatively successful in implementing macro-economic and structural reforms in order to stabilize the economy, sustain growth, and support more dynamic participation of the private sector (World Bank 2020a). Egypt has a population of 102 million people (2020) with an annual population growth rate of 1.9% (2020) (World Bank 2020b), and is projected to reach 120.8 million people by 2030 and 159.9 million by 2050. An estimated 43% of the current population resides in urban areas, which is expected to reach 56% in 2050. The country has a Gross Domestic Product (GDP) of $250.9 trillion (2018) and $363.1 trillion (2020), and has experienced relatively volatile growth rates over the past decade; Egypt has a current annual growth rate of 5.3% in 2018 (World Bank 2020b).

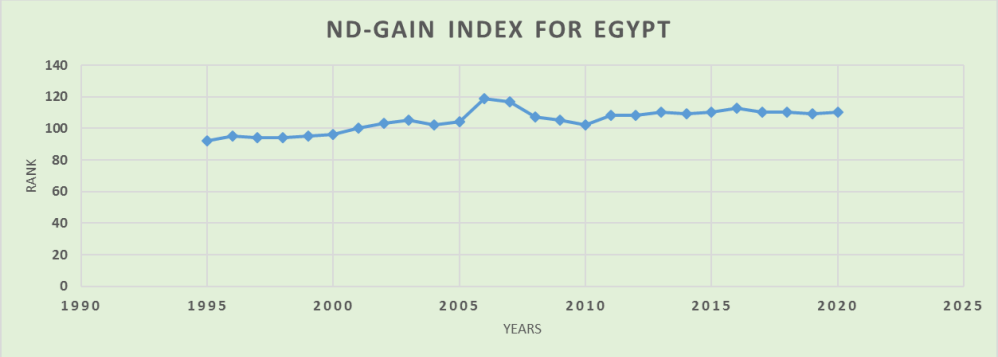
Table 5 Data snapshot: Key development indicators for Egypt

Indicators	2018	2020
Life expectancy at birth, total (years)	71.8	71.8
Population density (people per sq. km land area)	98.9	99
% of Population with access to electricity	100%	100%
GDP per capita (current US$)	$ 2549.1	$ 3523.7

Source: World Bank, Egypt, 2020

According to the ND-GAIN Index, which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience, Egypt is recognized as highly vulnerable to climate change impacts, ranked 110 out of 181 countries in the 2021 ND-GAIN Index. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 1** is a time-series plot of the ND-GAIN Index showing Egypt's progress (University of Notre Dame 2021).

Figure 1 ND-GAIN Index for Egypt (1995 – 2020)



Source: University of Notre Dame, Egypt 2021

Egypt is considered highly vulnerable to climate change due to its primary dependence on the Nile River, which serves needs for potable water, agriculture, industry, fish farming, power generation, inland river navigation, mining, oil and gas exploration, cooling of machinery and power generation. This dependence on the Nile River's water makes the country vulnerable to rising temperatures, reduced rainfall for the upper Nile Basins as well as the reduction of rainfall on the east Mediterranean coastal zone (EEAA, 2016 - CRP-Egypt, 2021).

2.1. Climatology

Egypt's climate is dry, hot, and dominated by desert. It has a mild winter season with rain falling along coastal areas, and a hot and dry summer season (May to September). Daytime temperatures vary by season and change with the prevailing winds. In the coastal regions, temperatures range between average winter minimums of 14°C (November to April) and average summer maximums of 30°C (May to October). Temperatures vary widely in the inland desert areas, especially during the summer, where they range from 7°C at night to 43°C during the day. During winter, temperatures in the desert fluctuate less dramatically, but can reach 0°C at night and as high as 18°C during the day (EEAA, 2016). Egypt also experiences hot wind storms, known as "khamsin", which carry sand and dust and sweep across the northern coast of Africa. These khamsin storms typically occur between March and May and can increase the temperature by 20°C in two hours; and can last for several days (USAID, 2018 - CRP-Egypt, 2021).

Egypt is a highly arid country and receives very little annual precipitation. The majority of rain falls along the coast, with the highest amounts of rainfall received in the city of Alexandria, of 200 mm of precipitation per year. Alexandria has relatively high humidity, however sea breeze modulates moisture. Precipitation decreases southward and Cairo receives a little more than one cm of precipitation each year, although it experiences humidity during the summer months. Areas south of Cairo receive only traces of rainfall, yet can suddenly experience extreme precipitation events resulting in flash floods. Sinai receives somewhat more rainfall than other desert areas, and the region is dotted by numerous wells and oases, which support small population centres that were former focal points on trade routes. Water drains toward the Mediterranean Sea from the main plateau and supplies sufficient moisture to permit some agriculture in the coastal area, particularly near Al Arish. The combination of the country's high evaporation rate and the virtual absence of permanent surface water over large parts of the country result in water as a highly scarce resource. Primary challenges are centred around water resource availability, changing precipitation patterns and increasing population demands (EEAA, 2016 - CRP-Egypt, 2021).

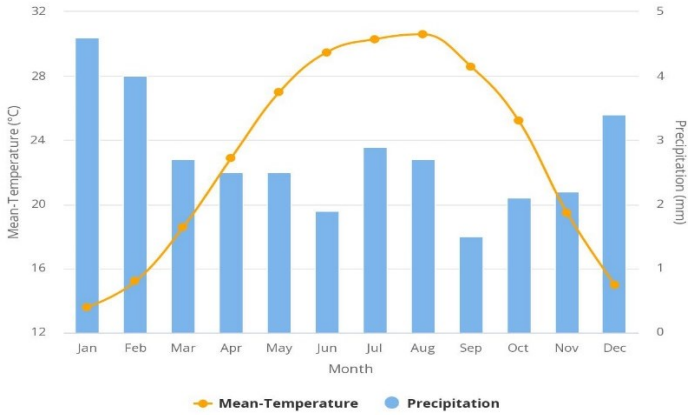
Analysis of data from the World Bank's Climate Change Knowledge Portal (CCKP) (**Table 4**) shows historical information for 1901–2020. Mean annual mean temperature for Egypt is 22.5°C, with average monthly temperatures ranging between 30°C (July) and 13°C (January). Mean annual precipitation is 33.3 mm, with highest rainfall occurring December to February, with very low levels of precipitation occurring nearly all year round (**Figure 2**). **Figure 3** shows the spatial variation of observed average annual precipitation and temperature across Egypt (CCKP, 2020).

Table 6 Summary statistics of climate variables, Egypt (1991 – 2020)

Climate variables	1991-2020
Mean Annual Temperature (°C)	22.5 °C
Mean Annual Precipitation (mm)	33.3 mm
Mean Maximum Annual Temperature (°C)	29.9 °C
Mean Minimum Annual Temperature (°C)	15.1 °C

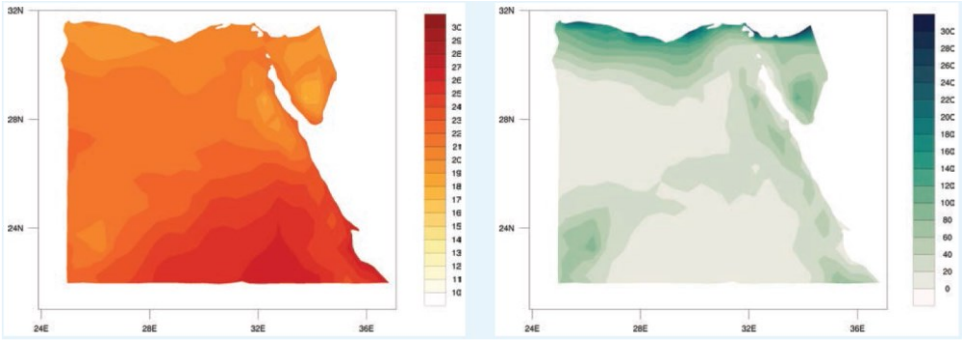
Source: CCKP, 2020

Figure 2 Average monthly temperature and rainfall of Egypt for 1991–2019



Source: CCKP, 2020

Map 4 Map of average annual temperature (left); annual precipitation (right) of Egypt, 1901–2019



Source: CCKP, 2020

Temperatures in Egypt have increased at a rate of 0.1°C per decade on average between 1901– 2013. However, substantially stronger warming was observed over the past 30 years,

with average annual temperatures increasing by 0.53°C per decade. Warming has been most pronounced during the summer than the winter with 0.31°C and 0.07°C per decade increase in average temperatures since 1960, respectively. Additionally, daily minimum temperatures have increased throughout Egypt, with a reduction in cool nights and an increase in warm nights since 1960 (USAID, 2018 - CRP-Egypt, 2021).

Egypt is expected to experience a change in annual mean temperature from 1.8°C to 5.2°C by the 2080s. Maximum temperatures are expected to increase by 2.1°C to 5.7°C by the 2080s, with minimum temperatures increasing by 1.5°C to 4.6°C over the same period. Heat waves will also increase significantly in their severity, frequency and duration, with heat waves expected to last an additional 9 days to as much as an additional 77 days; cold spells will decrease. By mid-century, temperatures are expected to increase between 2°C to 3°C, with the highest increases occurring in the summer months of July to September, with more rapid increases experienced across the country's interior regions. Across all emission scenarios, temperatures will continue to increase for Egypt throughout the end of the century. Under a high-emission scenario, average temperatures will increase rapidly by mid-century. Across the seasonal cycle, temperature increases will spike will be felt from October to April. Increased heat and extreme heat conditions will result in significant implications for human and animal health, agriculture, water resources, and ecosystems (USAID, 2018 - CRP-Egypt, 2021).

Egypt has observed a statistically significant reduction of annual total precipitation amounts over the past 30 years, a reduction by approximately 22%. This has resulted in reduced water availability in some areas and increased periods of drought and dry spells. Decreases in precipitation occurred in the winter and early spring months. The frequency and severity of flash flooding in recent years also was also observed. Rainfall trends in Egypt are highly variable where the reduction in precipitation, observed over the past 30 years, is expected to continue by the end of the century, with projections indicating a trend of even longer dry spells and the possibility of dry spells to increase by 75 days by the 2080s. Reduced precipitation and increased temperature are expected to impact evaporation, water balance as well as drought conditions. Water routing, storage and other management options can be highly varied depending if the precipitation input comes frequently or with long periods of aridity in between rainfall. While overall, annual mean precipitation is expected to decrease, the intensity of heavy rain events is expected to increase by the 2080s (USAID, 2018 - CRP-Egypt, 2021).

2.2. Climate related natural hazards

Egypt has a high degree of risk to natural hazards and is highly vulnerable to climate change impacts. Egypt's Nile Delta is recognized as one of the world's three 'extreme' vulnerability hotspots (UNDP, 2018). Future projections indicate Egypt will suffer from sea level rise, water scarcities and deficits, as well as an increase in the frequency and intensity of extreme weather events such as heat waves, sand and dust storms, flash floods, rock slides and heavy rains. The country is expected to become generally hotter and drier under a projected future climate. Egypt is already severely impacted by and susceptible to droughts, which are expected to be more frequent and pronounced. Additionally, sea level rise is projected to lead to the loss of a sizable proportion of the northern part of the Nile Delta due to a combination of inundation and erosion, with consequential loss of agricultural land, infrastructure and urban areas. Key sectors impacted include water resources, agriculture, fisheries, health, housing, biodiversity, telecommunications, energy, tourism, and coastal zones (UNDP, 2018).

Climate change is expected to be a source of pressure on coastal zones, particularly with the impact of the sea level rise on low land and the recurrence of severe storms and extreme weather events (IDSC, 2011). The coastal area of the Nile Delta is highly prone to flooding as a result of sea level rise. This may be accompanied by soil subsidence at varying rates, depending on topographical and geological characteristics. Delta coastal zones can be divided into three sub-zones, based on the degree of vulnerability of the location to sea level rise and erosion.

- Sub-zone 1: These low-lying locations are usually vulnerable to sea level rise and erosion, and are therefore considered high risk. Sub-zone 1 locations include Manzala Lake shore, the Tarh area, east and west of Rosetta City, the area between Gamasa and the port of Damietta, Al Gamiel, and the Al Tina Sahl on the Sinai coast.
- Sub-zone 2: Shores in this zone are characterized as relatively safe. Due to the presence of natural barriers such as sand dunes, the risk of inundation is minimized. In addition, sedimentation rates in this zone range from 3-10 meters annually, which act as a natural defense to flooding and erosion.
- Sub-zone 3: Locations in this zone are either naturally or artificially protected areas. It is important to note that around 17% of the delta coastal areas are protected by concrete or hard structures such as seawalls that rise between 6 and 8 meters above sea level.

Climate change is expected to increase the risk and intensity of water scarcity and drought across Egypt. The primary sectors affected are water, agriculture, forestry, human health, and livestock. Additionally, increased frequency of intense precipitation events will lead to a heightened risk of flooding, river bank overflow and flash flooding. This may also result in soil erosion and water logging of crops, thus decreasing yields with the potential to increase food insecurity; particularly for subsistence-scale farmers. Higher temperatures, coupled with increased aridity may also lead to livestock stress and reduced crop yields. This is likely to result in economic losses, damage to agricultural lands and infrastructure as well as human casualties. Furthermore, land degradation and soil erosion, exacerbated by recurrent flood and drought adversely impacts agricultural production, further affecting the livelihoods of the rural poor. Small rural farmers, are more sensitive to impacts of disasters (floods, dry periods) because they have limited resources with which to influence and increase adaptive capacity (FAO, 2018).

The Egyptian Government is focused on advancing the country's disaster risk management (DRM) efforts and capabilities. A dedicated crisis and disaster management department was established in 2000 at the Information and Decision Support Centre of the Egyptian Cabinet of Ministers (IDSC). This department has a mandate to set up national DRM policies and guidelines. This has culminated in the development of the country's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction. The Strategy includes plans for risk reduction, mitigation, and adaptation across different sectors. In order to strengthen DRM in the country, the department requires additional financial resources and institutional capacity. These priorities include, strengthening regional coordination and investment in technological innovations to address water scarcity; exploring disaster risk financing and insurance mechanisms; enhancing early warning systems; and, building the capacity and financial resources of its Information and Decision Support Centre. Additional areas of needed investment include strengthening the country's early warning system; developing disaster risk financing mechanisms; and, integrating resilience into urban infrastructure investments (GFDRR, 2019 - CRP-Egypt, 2021).

Over the last 20 years, natural hazards have killed nearly 1,500 people, with estimated economic damages resulting in $346.7 million. In 2009, a rockslide buried an informal settlement south of Cairo, causing severe damage to infrastructure and significant loss of life. In 2010, heavy flooding displaced thousands of people and over 4,000 houses were damaged or completely destroyed. Climate change is expected to increase the potential impact of hazards for Egypt (GFDRR, 2019).

The number of extreme weather events have increased significantly in Egypt over the last ten years inducing casualties and economic losses. The following are examples of incidents that have been observed:

- Extreme heat temperature: Based on historical daily temperature data from 1990 – 2015 collected by the Central Laboratory for Agricultural Climate in 11 Governorates representing the different agro-ecological zones in Egypt, two extreme heat temperatures have occurred: (1) the first in 1998; and (2) the second during 2010 with significant negative impact on strategic crops production according to the statistics of the Agricultural Economic Affairs Sector under Ministry of Agriculture and Land Reclamation (MALR). Results indicated that increase in minimum, maximum and mean temperatures in the winter of 2010 at different stations in Egypt were above normal by an average of 2.2 °C. This extreme temperature increase caused decrease in wheat yield in Egypt during crop season 2010 as compared with crop season 2009. The Upper Egypt Governorates had the highest decrease in wheat yield by -21.2% and the Nile Delta Governorates had the lowest decrease by -8.2% (Khalil and Hassanein, 2016).
- Extreme cold temperature: A cold wave occurred in January 2008 where the maximum and minimum temperatures during this month were below normal. Damage caused to agricultural crops was 50% for citrus, 40% for beans, 40% for bananas, 30% for mangos, 20% for tomatoes, and 2% for potatoes (Khalil and Hassanein, 2016).
- Extreme wind: During November 2004, a locust attack on different agricultural regions in Egypt took place over a 60 km front along the Mediterranean coast, unprecedented in the previous 50 years. This has been linked to changes in wind direction (Khalil and Hassanein, 2016).
- Flash floods: In January 2010, heavy rain exceeding 80 mm/day, led to the worst flash-floods in Egypt since 1994 leading to 15 deaths, evacuation of 3500 people and estimated material losses of 25.3 million US dollars. The floods affected the Sinai Peninsula, Red Sea coast, and Aswan Governorate in Upper Egypt (Attaher and Medany, 2011).
- Snow and rain storms: In December 2010, snow and rain storms caused temperatures to plunge to below freezing in some places with wind speeds up to 60 km per hour, ending weeks of unseasonably warm and dry dust storms. Eighteen people were killed and 59 injured in traffic accidents associated with bad weather, closed several ports and airports, and disrupted traffic in the Suez Canal (Attaher and Medany, 2011).

2.3. Climate change impacts to key sectors

2.3.1. Agriculture

Egypt's agricultural sector, located primarily along the coastline, is particularly vulnerable to climate change, due to its dependence on the Nile River as the primary water source, its large traditional agricultural base as well as the intensifying development and erosion along coastal areas. The country's water scarcity, dependence on the Nile River and high temperatures make agriculture productivity increasingly vulnerable to climate variability and future

projected climate change trends. An estimated 55% of the labor is engaged in agricultural activities, a sector which consumes about 80% of the freshwater resources and contributes about 13.5 % of GDP. Just 2.8% of Egypt's land is arable, largely located along the Nile and some oases in the Sinai Peninsula. The country's agriculture is predominantly irrigated and almost entirely dependent upon the flow of the Nile River (USAID, 2018 - CRP-Egypt, 2021).

Egypt's agricultural land can be classified into: 'Old-land' comprising the lands of the Nile Valley and the Nile Delta, which have been irrigated and intensively cultivated since early civilizations in the area, and represent about 80% of the cultivated area. 'New-land' includes lands that have been reclaimed relatively recently or are in the process of being reclaimed, representing approximately 20% of the cultivated area. Cultivation and modern irrigation techniques in new lands are relatively well-developed (CRP-Egypt, 2021).

Due to the different soil, availability and quality of water, as well as climate characteristics, there are two primary cropping seasons per year: winter (November to April) and summer (May to October) cultivation seasons. In some areas, farmers can cultivate a third crop during the period between summer and winter. Fruit trees are the country's most important perennial crops. Cultivated field crops include maize, rice, cotton, and sugarcane in the summer, and alfalfa, wheat, barley, green bean, clover, and sugar beet in the winter. The productivity of field crops has increased significantly over the last two decades, primarily due to the use of new cultivars, modern agricultural technologies and improved management activities (enhanced irrigation systems, modern cultivation methods, etc.) (EEAA, 2016).

Projected climate change impacts to food production, agricultural livelihoods and food security in Egypt are significant national concerns. Impacts on food production and food security are linked to future projected water supply constraints as well as temperature rise. Subsistence dry-land farmers are more vulnerable to climate change than commercial farmers due to their small scale and reliance on rain-fed agriculture and existing water resources. Egypt's agriculture sector is vulnerable to higher temperatures, particularly concerning the ecological regions for some deciduous fruits, expected to shift towards northern Egypt. Fruit species are grown under marginal chilling conditions and are susceptible to even small increases in warming trends. Additionally, these trends are expected to adversely impact yields, which will have varying effects on irrigated yields across regions as all crops grown are expected to experience significant yield declines. This is likely to result in price increases for the most important agricultural crops: rice, wheat, and maize (EEAA, 2016).

It is anticipated that crops will consume more water as the evaporation rates increase, leading to a decrease in the productivity of staple foods (wheat, maize, rice, tomatoes), and also sugar cane and milk. Reduction in the growth rates of cattle and poultry are also anticipated due to higher temperatures and possibility of reduced nutrition (UNDP, 2018). Crops such as wheat, rice, maize, and citrus are expected to decrease between 10% and 20%; cotton yields are expected to increase by as much as 20% by the 2060s (USAID, 2018).

In Egypt, livestock production represents approximately 24.5% of the agricultural GDP. In general, meat production is more important than milk, with cows, buffaloes, sheep, goats, and camels dominating the sub-sector. The majority of farms are family farms of less than one hectare, with mixed livestock and crop production. During the last 20 years, stocking numbers have increased sharply (except for camels). However, these increases remain insufficient to meet the requirements of a rapidly growing population. Especially for dairy

products, the rapidly growing demand is increasingly met by imports. The direct impacts of climate change on livestock are related to heat, including the effects of radiation, temperature, humidity and wind speed. Under present climate conditions, heat stress makes it difficult for animals to keep up with heat dissipation, rendering them vulnerable to heat stress during, at least, part of the year. Heat stress has a variety of detrimental effects on livestock, but can include reductions on milk production and reproduction, particularly for dairy cows. Extreme events, such as heat waves, may particularly affect beef and dairy cattle. The projected increased heat will increase stress on crops and is also likely to alter the length of the growing seasons. Decreased water availability is likely to reduce yields and the reduction in soil moisture may alter suitable areas for agriculture or the production of specific crops. Increased heat and water scarcity conditions are likely to increase evapotranspiration, expected to contribute to crop failure and overall yield reductions. An increased likelihood of droughts and prolonged dry periods will also exacerbate land degradation. As temperatures rise, so will the likely increase of pests and risk of fire. Increased frequency and intensity of extreme events may change or impact species composition and alter 'regulating services' such as soil water maintenance, base flows, and filtration (EEAA, 2016).

Egypt's agriculture sector already faces challenges due to environmental degradation, disease outbreaks, and higher input costs as well as challenges regarding land rights and inequality. Adaptation strategies in the country include the implementation of climate smart agriculture practices, improved water management, improved monitoring and early warning, the development of knowledge and decision-support systems, and the development of new crop varieties and technologies to support farming. Additionally, the allocation of land and production to high value crops and changed breeding for livestock could help to increase adaptation success and improve income generation as well as adoption of drought resistant crops and the further development of water harvesting techniques throughout the country will lessen the impacts of climate change (EEAA, 2016). Egypt is committed to improving the biological diversity of livestock, fishery and poultry for improved food security. Developing agro-economic systems and introducing new structures to more efficiently manage crop productivity is aimed at protecting land from degradation, as well as improving the effectiveness of the agricultural systems ability to manage and respond to climate change related stress (MoE, 2016).

2.3.2. Water

Water is of primary importance for Egypt. Rain only falls effectively on the North Coast running parallel to the Mediterranean. The intensity varies from 300 mm/year on the far eastern border city of Rafah and decreases towards the west direction until it reaches 200 mm/year at Port Said, 150 mm/year at Alexandria and it increases again towards the west reaching 250 mm/ year at El-Salloum on the border with Libya. Rainfall diminishes quickly the further south and internally to the country where it reaches 30 mm/year at Cairo and practically zero at the far southern end at Aswan. The Red Sea area enjoys high intensity rates of rain at the southern end in Halayeb, Shalatin and Abu Ramad which sometimes is close to 500 mm/year, while the northern oil cities Hurgada, Kousair, Safaga and Marsa Alam have less intensity of 100 mm/year and less. The Red Sea area can be subject to flash floods which occur once every number of years (5–10) caused by differences in pressures coming from cool Europe and warm Asia. The flash flood waters are also effective for the recharge of groundwater aquifers and storage for use by humans and animals (CRP-Egypt, 2021).

As the majority of the country is composed of a very large desert area, which remains largely uninhabited, Egypt is solely dependent on the Nile river for water. This wide range of water utilization increases concern and vulnerability regarding climate change trends which may impact the natural flow of the River Nile due to the reduction of rainfall on the upper Nile Basins, reduction of rainfall on the east Mediterranean coastal zone as well as the effect of sea level rise on the quality of groundwater in the coastal aquifers (EEAA, 2016).

There remains significant uncertainty regarding the anticipated impacts of climate change on Nile River flows, with some studies suggesting increased evaporation rates due to rising temperatures could decrease water availability by up to 70%, while other studies suggest that increased rainfall in the Ethiopian highlands and Blue Nile Basin may increase flows by 15% to 25%. As the Nile River's sources are located outside Egypt, the country is highly vulnerable to changing climate conditions and shocks both within and outside the country's borders. Additionally, the majority of the population lives in close proximity to the Nile River, increasing potential exposure to flood events, with the urban poor particularly exposed and vulnerable. The expected impacts from increased temperatures and decreased rainfall is likely to increase water demand, particularly from the agricultural sector which currently consumes approximately 80% of all available freshwater resources. Water demand will not only be tied to rising temperatures but also by the rising population for the North African region, which is projected to be home to nearly a billion people by mid-century (USAID, 2018). Additional projected climate impacts on the Nile include, the Upper Blue Nile River Basin becoming wetter and warmer in the 2050s. However, the potential of planned future dam projects is unlikely to significantly affect water availability to Egypt and Sudan (EEAA, 2016).

One of the most recent developments posing a risk on fresh water availability in Egypt is the construction of the Grand Ethiopian Renaissance Dam (GERD) expected to be commissioned in 2018. Concerns have risen over the implications the GERD would have on the downstream countries of the Nile basin. It is expected that during the filling of the GERD reservoir and during GERD operation in years of low flows, the Nile water flows to Egypt would be reduced by 25%. Egypt is currently highly dependent on the river Nile as the main source of freshwater for economic activity and livelihoods. As Egypt has already been experiencing a sharp decline of renewable freshwater per capita (from 900 cubic meters in 2000 to 600 cubic meters in 2017), it is expected that the effect of the GERD - in addition to climate change impacts - would only exacerbate the water issue in Egypt, edging the country closer to severe water scarcity of 500 cubic meters per capita in the future (Gad, 2017).

Rainfall and evaporation changes also impact rates of surface water infiltration and the recharge rates for groundwater. Low-water storage capacity increases the country's dependence on unreliable rainfall patterns. Changes in rainfall and evaporation translate directly to changes in surface water infiltration and groundwater re-charge. This has the potential for further decreased reliability of unimproved groundwater sources and surface water sources during droughts or prolonged dry seasons. Increased strain on pumping mechanisms leading to breakdowns if maintenance is neglected and the potential for falling water levels in the immediate vicinity of wells or boreholes, particularly in areas of high demand. Additionally, temperature increases have the potential to result in increased soil moisture deficits even under conditions of increasing rainfall (CRP-Egypt, 2021).

To enhance and secure the long-term sustainable management of its water resources, diplomatic discussions and agreements are required as source waters of the Nile are outside

of Egypt's boundaries. Appropriate management of this resource requires continued and increased diplomatic discussions with all regional countries relying on the Nile River: Ethiopia, Sudan, Uganda. Egypt has already implemented national adaptation actions aimed at improving water resource management, including water conservation measures for agriculture, industry and municipal supplies, upgrading water quality and sanitation to minimize pollution, constructing new infrastructure for water collection in flash flood areas (e.g. Sinai, Red Sea, and Upper and Middle Egypt), increasing use of renewable energy (solar and wind) for water desalination, increasing storage of drainage and fresh water in coastal lakes, and improving public awareness campaign on water scarcity and water shortage (EEAA, 2016). Egypt is committed to increasing its investment in modern irrigation systems developing policies to encourage citizens for responsible water use, as well as cooperating with Nile Basin countries to reduce water evaporation and safeguard river flows (MoE, 2016).

2.3.3. Energy

Egypt is the largest non-OPEC oil producer in Africa and the country's energy systems are largely driven by fossil fuels. Crude oil reserves are estimated at 4.4 billion barrels. New oil discoveries boosting oil reserves have been made every year since 2008, particularly in the Western dessert. Egypt's oil production comes from the Gulf of Suez, Nile Delta, Western Desert, Eastern Desert, Sinai, and the Mediterranean Sea. The majority of production is derived from relatively small fields that are connected to larger regional production systems. Overall production for the country is in decline, particularly from the older fields in the Gulf of Suez and Nile Delta. However, declines have been partially offset by small new finds, particularly in the Western Desert and offshore areas. While in the mid-1990s, Egypt's output began to decline as oil fields matured, natural gas liquids output has increased over the past decade as a result of expanding natural gas production, which has offset some of the decline in crude oil production. A continued challenge for the country's energy sector is to satisfy an increasing domestic demand for oil amid falling domestic production. Total oil consumption grew by an annual average of 3% over the past decade (EEAA, 2016).

Planned dams upstream of Egypt, which are designed to improve energy availability across the continent, also have the potential to significantly reduce flows for Egypt. This could impact not only agricultural, industrial and domestic water consumption, but also cut hydropower generation at the Aswan Dam, the country's largest. Climatic and international pressures on the Nile River also have high potential to not only affect economic activity and water availability in Egypt, but also to raise tensions amongst users of the river (EEAA, 2016).

As a result of Egypt's growing domestic energy demand, the government is working to diversify its energy supply and to increase the amount of power generated from renewable sources, particularly wind and solar. The country is also fostering nuclear power development. However, electricity consumption continues to outpace generation capacity and expansion. Coal imports are rising in order to meet immediate demands. The country is working on innovative new regulatory models to increase energy production and use-efficiency, especially for utilities and, ultimately, their customers through energy savings programs and new approaches to transmission and accounting. To improve its adaptive capacity in the energy sector, Egypt has committed to conducting comprehensive studies of the energy sector to define the role that climate will play in energy demand and supply, and also to identify appropriate adaptation measures, and estimate the economic cost of the proposed adaptation measures. The government has committed to building the institutional

and technical capacities of different units in the energy sector, particularly with regards to climate change (MoE, 2016).

2.3.4. Health

The Egyptian health care system faces multiple challenges in improving and ensuring the health and wellbeing of the Egyptian people. Egypt has a highly pluralistic health care system, with multiple public and private providers and financing agents. Health services are currently managed, financed, and provided by agencies in all three sectors of the economy: government, parastatal, and private. As in many lower- and middle-income countries, the government health services are organized as an integrated delivery system in which the financing and provider functions are included under the same organizational structure (USAID, 2017). Health challenges continue to disproportionately affect the rural poor and have the potential to impact the country's economic prosperity more broadly over the long-term. Current threats include high rates of stunting as a result of chronic malnutrition and one of the highest rates of Hepatitis C in the world, as 7% of Egyptians between the ages of 15 and 59 suffer from chronic Hepatitis C (USAID, 2019).

Egypt's health sector is currently investing on health surveillance, risk mapping, and monitoring systems to address the potential adverse outcomes to health and strengthen the country's knowledge management and communication networks. Research underway aims to identify key health vulnerabilities, such as urban heat islands, as well as vector borne and communicable diseases. The Ministry of Health and Population (MOHP) is working to integrate laboratory and epidemiological services to optimize public health practices. The country is also working to expand its health system, including the expansion of district health offices, surveillance systems and vaccination for children (EEAA, 2016). Egypt has committed to raising community awareness about climate change induced risks and adaptation options, increasing the efficiency of the healthcare sector to improve the capacity for dealing with climate change related health concerns, and to provide greater support to the MOH (MoE, 2016).

3. International policy agreements

3.1. History of Egypt efforts in biodiversity conservation before joining the CBD

The legislative tools for biodiversity conservation and sustainable development in Egypt pre-date the ratification of CBD. They were issued as laws and ministerial decrease and can be summed up in chronological order as follows:

1. Law 53 of 1966 (also known as "The Law of Agriculture"). Among the numerous articles and clauses of this law, article 117 prohibits the hunting of birds and other wild animals useful to agriculture. It also bans the trading and killing of these birds as well as the distraction of their nests. Article 118 of the same law prohibits the cultivation of plants harmful to these birds and wild animals, bans the importation of material used in their hunting and prevents the use of all forms of traps. The prevention of cruelty to animals is spelled out explicitly in article 119.
2. Ministerial Decree 28 of 1967 specified the species of birds and other wild animals under protection covered by article 117 of the previous law.
3. Law 72 of 1968 concerning the prevention of pollution of sea water by oil.
4. Ministerial Decree 349 of 1979 established the Egyptian Wildlife Service as the first governmental authority concerned with the protection of wildlife in the country.

5. Ministerial Decree 66 of 1982 prohibited hunting all species of birds and other wild animal in certain areas of the Sinai Peninsula, as well as fishing and catching all species of molluscs and corals in various other specified regions.
6. Law 48 of 1982 for the protection of the River Nile and other water courses against pollution. It prohibits the discharge of solid, liquid and gaseous wastes with certain levels of pollutants into the Nile and all freshwater bodies; while the Ministry of Irrigation determined the maximum allowable levels of polluting elements in such wastes, the Ministry of Health is empowered to carry out the required analysis of samples of these wastes.
7. Law 102 of 1983 set up the legal framework for the declaration and management of protected areas and regulates the conservation of natural resources.
8. Law 101 of 1985, levied an additional tax on airplane tickets issued locally, in order to secure a suitable source of funding to finance programmes for developing tourism and environmental protection.
9. Law 4 of 1994 is by far the most comprehensive environmental legislation to date. It defines (in article 2-13) the scope and responsibilities of the Egyptian Environmental Affairs Agency (EEAA).
10. In August 1997 the EEAA has become part of the newly established Ministry of State for Environmental Affairs (currently Ministry of Environment).

Also, Egypt is party to a large number of regional and international conventions, treaties and agreements dealing with the conservation of nature in general and biodiversity in particular since 1936 (i.e. 59 years before the government of Egypt ratify the CBD. The following list of International Treaties and other Agreements in the field of environment that Egypt joined before becoming party within the CBD:

1. Convention relative to the Preservation of Fauna and Flora in their natural state. London, 1933 (ratified in 1936).
2. Agreement for the Establishment of a General Fisheries Council for the Mediterranean. Rome, 1951.
3. International Plant Protection Convention. Rome, 1953
4. International Convention for the Prevention of Pollution of the Sea by Oil. London, 1963.
5. Phyto-sanitary Convention for Africa. Kinshasa, 1968.
6. African Convention on the Conservation of Nature and Natural Resources. Algeria, 1968. (ratified in 1972).
7. Convention for the Protection of the Mediterranean Sea Against Pollution. Barcelona, 1976 (ratified in 1978).
8. Convention on International Trade in Endangered Species of Wild Fauna and Flora. Washington, 1978.
9. International Convention for Regulation of Whaling. Washington, 1981 (ratified in 1989).
10. Convention on the Conservation of Migratory Species of Wild Animals. Bonn, 1979 (ratified in 1982).
11. United Nations Convention on the Law of the Sea. Montego Bay, Jamaica, 1982 (ratified in 1983).
12. Protocol Concerning Mediterranean Specially Protected Areas. Geneva, 1983 (ratified in 1986).
13. Convention on Wetlands of International Importance especially as Waterfowl habitat. Ramsar, Iran, 1971 (1975), (ratified in 1988).

14. Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment. Jeddah, 1990.
15. Convention on Biological Diversity, Rio de Janeiro, 1992 (ratified in 1994).

3.2. Convention of Biological Diversity (CBD)

After the end of the First and Second World Wars and after the beginning of the Industrial Revolution in the various countries of the world with the aim of achieving economic and social development of human beings, demands of some scientists, activists and international organizations began to appear on the international scene about the importance of studying the negative effects of this economic development on the environment. The relationship between economic development and environmental degradation was first included in the international agenda in 1972, at the United Nations Conference for Human & Environment, held in Stockholm. After this conference, the United Nations Environment Organization (UNEP) was established as a global organization working to protect the environment on the planet. During the subsequent years of this conference, the global interest was to integrate environmental considerations into national economic planning and decision-making processes, but this was done very slowly, which led to the continued deterioration of the environment and increase in pollution rates, destruction of many natural resources, extinction of many species around the world, depletion of the ozone layer, increase the global warming, and water pollution, all of this is done at an extremely rapid and alarming rate and directly affects the wheel of economic development and human health (CBD, 2021).

During the eighties, a global debate occurred about whether this environmental degradation around the world is only a side effect of the global industrial revolution with just a limited impact that can be overcome later, or whether this environmental degradation is in fact a matter of life for developing countries. After many international discussions during that period, the concept of "sustainable development" began to appear on the horizon as an alternative approach based on economic development and meeting the needs of current generations without compromising the ability of future generations to meet their own needs. At the end of the eighties, the United Nations General Assembly called for the United Nations Conference on Environment and Development (Rio Conference) in order to agree on how to achieve sustainable development that would support economic and social development and in the same time prevent the continued deterioration of the environment in order to ensure a healthy future for the planet (CBD, 2021).

In 1992, the largest meeting of world leaders was held at the United Nations Conference on Environment and Development (Earth Summit) in Rio de Janeiro, Brazil. As a result of this growing international concern about achieving sustainable development, the countries of the world signed a historic set of agreements binding on countries, which are: (1) Climate Change Convention: which aims to reduce industrial emissions and other greenhouse gases such as carbon dioxide; (2) The Convention on Biological Diversity: It is the first global agreement on the conservation and sustainable use of biodiversity. As the CBD gained rapid and widespread acceptance, more than 150 governments signed the document at the Rio Conference, and since then more than 196 countries have ratified the convention (CBD, 2021).

The "Convention on Biological Diversity", since its inception during the "Earth Summit" in 1992, has focused on three main objectives, which are: (1) Preserving the world's biodiversity; (2) The sustainable use of the three components of biodiversity (ecosystems -

species - genetic resources); (3) The fair and equitable sharing of benefits arising from other uses of genetic resources.

It is clear from these goals that they are holistic goals that address issues extremely vital to the future of humanity where these objectives aim to:

- Recognizes - for the first time - that conservation of biodiversity is a "common concern of humankind" and an integral part of the development process for the benefit of humankind.
- Covers all components of biodiversity (ecosystems, organisms and genetic resources).
- The conservation efforts of biodiversity are linked to the economic development represented in the sustainable use of its biological resources and components.
- Laying down principles for the fair and equitable sharing of benefits arising from the use of genetic resources, especially those designated for commercial use.
- It covers the field of biotechnology and deals with technology development, transfer, benefit-sharing and biosafety of genetically modified organisms.
- Most importantly, the Convention is legally binding, so that the states that join it are obligated to implement its provisions.

The Convention addresses decision-makers around the world that natural resources are not infinite. It has set a new philosophy for the twenty-first century, which is the sustainable use of those resources in a manner and at a rate that does not lead to long-term degradation of biodiversity. The agreement, as an international treaty, identifies common problems at the international level that cause the loss of biodiversity. It also sets general goals, policies and commitments that regulate technical and financial cooperation at the international level, but the actual responsibility for achieving the objectives of the agreement and implementing its obligations lies to a large extent on the shoulders of the signatory states themselves, Economic entities, private companies, landowners, fishermen, farmers, and those responsible for implementing development activities for the benefit of human well-being carry out development activities in their entirety that cause the loss of biodiversity at high rates. Therefore, here comes the role of state governments to play their pioneering role in setting policies and rules governing the sustainable use of natural resources that protect biodiversity. Under this convention, governments are obligated to conserve biodiversity and use it in a sustainable manner, and all countries are required to develop national strategies and action plans for the conservation of biodiversity, in addition to making parallel efforts to integrate the concepts of biodiversity conservation into their national development plans. The Convention on Biological Diversity also includes other obligations on state governments, which can be summarized in the following points (CBD, 2021):

- Identification and monitoring of important components of biodiversity that need to be conserved and used sustainably.
- Establishing a national network of protected areas (PA) to preserve biodiversity while promoting environmentally sustainable development around these PAs.
- Rehabilitating and restoring degraded ecosystems and promoting the restoration of endangered species in cooperation with the local population.
- Respecting and preserving the traditional and heritage knowledge of indigenous peoples and local communities associated with the sustainable use of biodiversity.
- Preventing the introduction and control of alien and invasive species that may threaten ecosystems and other species.
- Control of risks posed by genetically modified organisms, using biotechnology applications.

- Promoting public participation for all, especially when it comes to assessing the environmental impacts of development projects that threaten biodiversity.
- Educating people and raising awareness of the importance of biodiversity and the need to conserve it.

3.2.1. Cartagena Protocol on Biosafety:

One of the outcomes of the United Nations Conference on Environment and Development (Earth Summit) held in Rio de Janeiro, Brazil, was the issuance of 27 principles to support sustainable development. One of these principles was the "precautionary principle", which called on the countries of the world that "in order to protect the environment, all countries, on a large scale, apply the precautionary approach according to their capabilities, which means that when there are and/or the possibility of threats that may cause serious harm or irreversible deterioration to the environment under complete scientific uncertainty about the consequences of this deterioration, this uncertainty may not be used as a pretext to postpone taking effective measures to prevent environmental degradation (CBD, 2021).

One of the strong reasons for adopting this principle during the Earth Summit was the acceleration in the use of biotechnologies, including the techniques of genetic mutation (also known as genetic engineering or modern biotechnology) as promising technologies to support economic development processes in many countries, especially developed countries. As these biological techniques depend on the laboratory devising of modified and / or genetically modified organisms, which can penetrate the natural barriers between other organisms and biological groups and thus they are organisms that cannot exist in nature. As the economic development wheel in the past decades has stimulated some countries to use biotechnology applications in the fields of medicine production, health care, food production, seeds, farm animals and environmental protection, as well as in the production of many industrial materials, so that the use of modified and / or genetically modified organisms has become part of an increasing number of products used by humans, including foods, food additives, beverages, medicines, adhesives, fuels, and the accompanying use of a new global biotechnology industry worth billions of dollars (CBD, 2021).

Biotechnology is similar to all recently developed technologies in that it is not free from potential risks to both humans and the environment. The potential dangers of the use of genetically modified organisms and their manufactured products and their release into the environment are concentrated in their negative impact on biodiversity - as genetically modified organisms affect some ecosystems and lead to the loss of their biodiversity - and in their potential impact on human health and in their negative effects on the social and economic aspects of society as well as on national security. Safety comes from these risks by providing absolute transparency on all data and information related to these genetically modified products (such as: information on the methods of their development and modification - information about their risks to human health and the environment - information on how to manage these risks - etc.) to all regulatory authorities before permitting them to be traded in the markets (CBD, 2021).

This international discussion resulted in the importance of seriously dealing with the risks of genetically modified products, in fact, to an international mechanism known as the "Cartagena Protocol on Biosafety" under the umbrella of the Convention on Biological Diversity, to which Egypt joined in November 2003 (some of its accession to the Convention on Biological diversity in 1994).

This protocol regulates the rules and procedures for the transfer, handling and use of genetically modified organisms, with a special focus on the transnational movement of these organisms. Where the protocol includes a set of procedures, such as:

- Pre-agreement procedures for living modified organisms that will be intentionally introduced into the environment or those intended to be used directly as food or as feed (such as: agricultural crops - animal feed - etc.).
- Procedures related to environmental and health safety when handling genetically modified organisms during their packaging and transport.
- Procedures related to documents used and accompanying shipments of GM products that are transported across borders (such as: identity documents for genetically modified organisms - identity documents of the recipient of the shipment - etc.).
- Procedures for making decisions about whether or not to accept shipments of GM products in the event that relevant scientific information is insufficient.
- Procedures related to the development and implementation of measures to manage any risks in the event of an accidental release of LMOs into the environment.

3.2.2. Nagoya Protocol for the Equitable Sharing of Benefits Arising from the Uses of Genetic Resources

As one of the 27 principles of sustainable development adopted at the Earth Summit resulted in the emergence of the "Cartagena Protocol on Biosafety" (see above). Also, one of these important principles at the same summit was the call for states to take measures to conclude an international system in order to enhance sharing, fair and equitable benefits arising from the use of genetic resources. Whereas, during the year 2010, a supplementary protocol to the Convention on Biological Diversity was adopted called the “Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization” (ABS), which is an agreement complementary to the convention that provides a transparent legal framework for the effective implementation of the third objective of the Convention on Biological Diversity related to fair and equitable sharing of benefits arising from the use of genetic resources (CBD, 2021).

The urgent need for such a protocol emerged as a result of modern development in the life sciences during the second half of the twentieth century, as this development encouraged some developed countries to grant exclusive intellectual property rights to the creators of some strains of biodiversity, which resulted in huge economic returns to be acquired without participation. Countries of origin from the third world (countries that contain the original strains in which the modified genetic content is present), which alerted the minds to the imperative of recognizing the sovereignty of states over their national biodiversity and related heritage knowledge and their participation in the benefits of innovation (CBD, 2021).

This protocol includes the basic principles of access and benefit-sharing among potential users of resources based on the prior informed consent of the state in which the genetic resource is located before obtaining this resource, by negotiating and agreeing on the terms and conditions for obtaining and using this resource by stipulating agreed terms and shared it between all users. The Nagoya Protocol also covers the fair and equitable sharing of genetic resources as well as traditional knowledge associated with genetic resources, as well as the benefits arising from their use. In addition, the protocol created a set of measures that states must work to achieve, such as:

- Taking measures to obtain access to the genetic resources of countries according to prior (informed) consent, including the contractual terms agreed upon to preserve the property rights of all countries.

- Determining the procedures and rules to be followed in cases of violation of intellectual property rights and the sovereignty of countries over their genetic resources.
- Defining contractual provisions for settling disputes on terms agreed upon between states.
- Allowing states to have recourse to the courts in the event of disputes arising from agreed conditions.

Given the importance of this protocol in preserving the rights and sovereignty of states over their genetic resources, the process of declaring and adopting such a protocol faced complications and problems to slow the actual implementation of its provisions by some countries. Where many different institutions (scientific and economic) in developed countries rushed to collect samples of biodiversity in developing countries, illegally or semi-legitimate, to acquire it before monitoring it by developing countries that own it and then preserve their right to their ownership in what has become referred to as "Biological piracy". " As a precaution to respond to this biological piracy, many developing countries have resorted to issuing legislations regulating access to and then access to national biodiversity and heritage knowledge related to it, and linking it to specific national agreements to share the benefits arising from exploitation and to put in place the necessary guarantees for the return of sharing proceeds to their owners. At the same time, developing countries have also resorted to recording their biodiversity and heritage knowledge in national registers that preserve their rights therein (CBD, 2021).

3.3. United Nations Framework Convention on Climate Change (UNFCCC)

The climate of our planet changes over the course of the geological history spanning for millions of years ago, which included many remarkable fluctuations in temperature. Despite this, the temperature has been rising more rapidly in recent times than in previous times. It has become clear that humankind is responsible for the warming of the last century by causing the release of heat-trapping gases - often referred to as greenhouse gases - to power our modern life. We do this through burning fossil fuels, agriculture, land use, and other activities that drive climate change. Greenhouse gases are currently at their highest levels ever in recent years. This rapid temperature rise is a problem because it is changing our climate at a very rapid rate for species to be unable to adapt to it. Climate change is not only related to rising temperatures, but also includes extreme weather events, rising sea levels, changing wildlife populations, natural fauna and flora habitats, and a range of other impacts (UNFCCC, 2021).

There is an overwhelming scientific consensus that global warming is predominantly man-made: 97% of climate scientists came to this conclusion. The biggest driver of global warming is the burning of fossil fuels - coal, gas and oil - which has increased the concentration of greenhouse gases - such as carbon dioxide - in our atmosphere. This burning of fossil fuels, coupled with other activities such as land reclamation for agriculture, is causing the average temperature of our planet to rise. Indeed, scientists are sure of the link between greenhouse gases and rising temperatures on the planet as they are about the link between smoking and lung cancer but this is not a recent conclusion. The scientific community has been collecting and studying data on this subject for decades. Warnings about global warming had been in the headlines since the late 1980s. In 1992, 165 countries signed an international treaty, the United Nations Framework Convention on Climate Change. These countries have held annual meetings since then (called the "Conference of the Parties"), to develop goals and methods for reducing climate change, as well as adapting to its impacts.

Today, 197 countries are bound by the United Nations Framework Convention on Climate Change (UNFCCC).

The effects of climate change are already being felt now, but they will only get worse. Global warming is about 1 degree Celsius above pre-industrial levels. Every half degree (or even less) of the Earth's global warming counts. It is important to keep in mind that there is no single list of the effects of climate change on Earth and people. It is very likely that heat waves will occur more frequently and will last for longer periods, and the occurrences of heavy rains will become more intense and frequent in many areas in the near future. The oceans will continue to get warmer and acidify, and the level of water levels in the seas will continue to rise. All of this will have, and is already starting to have, a devastating impact on human lives (UNFCCC, 2021).

By the mid-1980s, scientists warned that global warming was occurring beyond its natural potential and that this was due in large part to human activities and to increased emissions of anthropogenic greenhouse gases. Advances in computational technology have contributed to the development of complex and more realistic models of causal relationships and the risks of climate change to humans and the ecosystem. At an international conference held in 1985 in Villach, Austria, to assess the role of carbon dioxide and other greenhouse gases on climate variability and its associated effects, political scientists called for cooperation in exploring policies aimed at mitigating human-induced climate change. The discovery of the ozone hole and the heat wave that occurred in 1988 created an additional feeling of urgent need for action in this regard (UNFCCC, 2021).

In a short time, an international consensus was achieved, calling on states to also develop a legally binding convention on climate change, which addresses greenhouse gas emissions that are not covered by the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. The first step was the creation by the World Meteorological Organization and the United Nations Environment Program, in 1988, of the "Intergovernmental Panel on Climate Change" as an intergovernmental scientific body that provides decision-makers with an assessment of the latest developments in research and its implications for policies aimed at mitigating and adapting to climate change. In 1990, at the Second World Climate Conference in Geneva, it became clear that there was a split between "North-South" countries over how developed and developing countries view climate change. Whereas developed countries saw at that time that the issue was an environmental scientific issue, developing countries stressed the effects it would have on poverty and development (UNFCCC, 2021).

In a major negotiation process involving more than 140 countries and lasting less than seventeen months, the United Nations Framework Convention on Climate Change was finalized and opened for signature at the United Nations Conference on Environment and Development from 4 to 14 June 1992, then at the headquarters of the United Nations in New York until June 19, 1993. By that date, the agreement had been signed by 165 parties, and it entered into force on March 21, 1994. The framework agreement has nearly universal membership, with 197 states signed up to now (UNFCCC, 2021).

The long-term objective of the related convention is to “stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (Article 2). The agreement includes a set of general obligations that fall on all states parties, while the special obligations only apply to developed

countries (listed in the first and second annexes of the agreement). The convention recognizes the existence of other international agreements that regulate greenhouse gas emissions; In particular, it states that the obligations under the convention do not apply to greenhouse gases already under the control of the Montreal Protocol. The convention also requires states to provide national greenhouse gas emissions inventories, and to complete them regularly, as a scientific basis for future planning and for achieving the agreement's long-term goal. Other general obligations include long-term national planning, diffusion of emissions control technologies and related processes, adaptation of environmental policies, information exchange, as well as the promotion of education, training and public awareness (UNFCCC, 2021).

3.3.1. Kyoto Protocol

The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol. In short, the Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically. The Kyoto Protocol is based on the principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries, and places a heavier burden on them under the principle of "common but differentiated responsibility and respective capabilities", because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere. In its Annex B, the Kyoto Protocol sets binding emission reduction targets for 37 industrialized countries and economies in transition and the European Union. Overall, these targets add up to an average 5 percent emission reduction compared to 1990 levels over the five-year period 2008–2012 (the first commitment period) (UNFCCC, 2021).

One important element of the Kyoto Protocol was the establishment of flexible market mechanisms, which are based on the trade of emissions permits. Under the Protocol, countries must meet their targets primarily through national measures. However, the Protocol also offers them an additional means to meet their targets by way of three market-based mechanisms (UNFCCC, 2021):

- International Emissions Trading
- Clean Development Mechanism (CDM)
- Joint implementation (JI)

These mechanisms ideally encourage GHG abatement to start where it is most cost-effective, for example, in the developing world. It does not matter where emissions are reduced, as long as they are removed from the atmosphere. This has the parallel benefits of stimulating green investment in developing countries and including the private sector in this endeavor to cut and hold steady GHG emissions at a safe level. It also makes leap-frogging—that is, the possibility of skipping the use of older, dirtier technology for newer, cleaner infrastructure and systems, with obvious longer-term benefits—more economical (UNFCCC, 2021).

The Kyoto Protocol also established a rigorous monitoring, review and verification system, as well as a compliance system to ensure transparency and hold Parties to account. Under the Protocol, countries' actual emissions have to be monitored and precise records have to be kept of the trades carried out:

- Registry systems track and record transactions by Parties under the mechanisms. The UN Climate Change Secretariat, based in Bonn, Germany, keeps an international transaction log to verify that transactions are consistent with the rules of the Protocol.
- Reporting is done by Parties by submitting annual emission inventories and national reports under the Protocol at regular intervals.
- A compliance system ensures that Parties are meeting their commitments and helps them to meet their commitments if they have problems doing so.
- The Kyoto Protocol, like the Convention, is also designed to assist countries in adapting to the adverse effects of climate change. It facilitates the development and deployment of technologies that can help increase resilience to the impacts of climate change.
- The Adaptation Fund was established to finance adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol. In the first commitment period, the Fund was financed mainly with a share of proceeds from CDM project activities. In Doha, in 2012, it was decided that for the second commitment period, international emissions trading and joint implementation would also provide the Adaptation Fund with a 2 percent share of proceeds.

3.3.2. Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at UNFCCC COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century. The Paris Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects (UNFCCC, 2021).

Implementation of the Paris Agreement requires economic and social transformation, based on the best available science. The Paris Agreement works on a 5- year cycle of increasingly ambitious climate action carried out by countries. By 2020, countries submit their plans for climate action known as nationally determined contributions (NDCs). In their NDCs, countries communicate actions they will take to reduce their Greenhouse Gas emissions in order to reach the goals of the Paris Agreement. Countries also communicate in the NDCs actions they will take to build resilience to adapt to the impacts of rising temperatures (UNFCCC, 2021).

To better frame the efforts towards the long-term goal, the Paris Agreement invites countries to formulate and submit by 2020 long-term low greenhouse gas emission development strategies (LT-LEDS). LT-LEDS provide the long-term horizon to the NDCs. Unlike NDCs, they are not mandatory. Nevertheless, they place the NDCs into the context of countries' long-term planning and development priorities, providing a vision and direction for future development (UNFCCC, 2021).

The Paris Agreement provides a framework for financial, technical and capacity building support to those countries who need it. The Paris Agreement reaffirms that developed countries should take the lead in providing financial assistance to countries that are less endowed and more vulnerable, while for the first time also encouraging voluntary contributions by other Parties. Climate finance is needed for mitigation, because large-scale

investments are required to significantly reduce emissions. Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate (UNFCCC, 2021).

The Paris Agreement speaks of the vision of fully realizing technology development and transfer for both improving resilience to climate change and reducing GHG emissions. It establishes a technology framework to provide overarching guidance to the well-functioning Technology Mechanism. The mechanism is accelerating technology development and transfer through its policy and implementation arms. Not all developing countries have sufficient capacities to deal with many of the challenges brought by climate change. As a result, the Paris Agreement places great emphasis on climate-related capacity-building for developing countries and requests all developed countries to enhance support for capacity-building actions in developing countries (UNFCCC, 2021).

With the Paris Agreement, countries established an enhanced transparency framework (ETF). Under ETF, starting in 2024, countries will report transparently on actions taken and progress in climate change mitigation, adaptation measures and support provided or received. It also provides for international procedures for the review of the submitted reports. The information gathered through the ETF will feed into the Global stocktake which will assess the collective progress towards the long-term climate goals. This will lead to recommendations for countries to set more ambitious plans in the next round (UNFCCC, 2021).

3.4. Other global agreements and science-policy platforms

3.4.1. Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES)

In January 2005, the Paris Conference on Biodiversity, Science and Governance proposed to initiate consultations to assess the need, scope, and possible form of an international mechanism of scientific expertise on biodiversity as part of the Millennium Assessment follow-up process. Supported by the Government of France, the consultative process on an International Mechanism of Scientific Expertise on Biodiversity (IMoSEB) was conducted through an International Steering Committee and a series of regional consultations from 2005 to 2007. At its final meeting in November 2007, the Steering Committee invited donors and governments to provide support for the further consideration of the establishment of a science-policy interface. It also invited the Executive Director of the UN Environment Programme (UNEP) and others to convene a meeting to consider establishing such an interface (IISD, 2021).

Following this invitation, stakeholders also agreed that the follow-up to the IMoSEB process and the MA follow-up process initiated under UNEP in 2007 should merge. A joint meeting took place in March 2008 to develop a common approach. In the same year, the ninth Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) welcomed the decision of the UNEP Executive Director to convene an *Ad Hoc* Intergovernmental and Multi-Stakeholder Meeting on an IPBES and requested the CBD *Ad Hoc* Working Group on Review of Implementation to consider the meeting's outcomes (IISD, 2021).

From 2008 to 2010, the establishment of a science-policy interface was further discussed in a series of *Ad hoc* Intergovernmental Multi-Stakeholder Meetings. The first meeting (November 2008, Putrajaya, Malaysia) recommended UNEP undertake a preliminary gap analysis on existing interfaces. Based on this analysis, the second meeting (October 2009,

Nairobi, Kenya) developed options to strengthen the science-policy interface, and functions and possible governance structures of an IPBES. At the third meeting (June 2010, Busan, Republic of Korea), delegates adopted the Busan Outcome, which recommended inviting the UN General Assembly (UNGA) to take appropriate action for establishing an IPBES. The sixty-fifth session of the UNGA (December 2010) requested UNEP to fully operationalize the platform and convene a plenary meeting to determine the modalities and institutional arrangements of the platform at the earliest opportunity. The 26th session of the UNEP Governing Council/Global Ministerial Environment Forum (February 2011, Nairobi, Kenya) also called for convening a plenary session for an IPBES (IISD, 2021).

The Intergovernmental Platform on Biodiversity and Ecosystem Services is an independent, intergovernmental body established in 2012, to provide evidence-based, objective, and policy-relevant information to decision makers regarding the planet's biodiversity, ecosystems, and the benefits they provide to people. The Platform's work is divided into four functions (IISD, 2021):

- developing assessments on specific themes or methodological issues at global and regional scales;
- providing policy support through the development of tools and methodologies, and facilitating their use;
- building the capacity and knowledge of Members; and
- ensuring impact through an effective communication and outreach strategy.

The Platform's main governing body is the IPBES Plenary composed of representatives of Members. Non-member states, UN organizations, non-governmental organizations, and other organizations can attend as observers. The work of the Plenary is supported by the Bureau overseeing the Platform's administrative functions, and the Multidisciplinary Expert Panel (MEP) overseeing the Platform's scientific and technical functions. To date, the Platform has 137 Members (IISD, 2021).

The first two sessions of the IPBES Plenary (January 2013, Bonn, Germany, and December 2013, Antalya, Turkey) focused on developing the Platform's structure and processes. IPBES-2 adopted the Antalya Consensus, which included decisions on the development of a work programme for 2014-2018. Delegates also adopted a conceptual framework considering different knowledge systems, and rules and procedures for the Platform on, *inter alia*, the preparation of the Platform's assessments and other deliverables (IISD, 2021).

The first IPBES work programme (2014-2018) was adopted at the Platform's third Plenary session (January 2015, Bonn, Germany) together with the stakeholder engagement strategy, a communication and outreach strategy, and the Platform's rules of procedure. With these decisions, IPBES became fully operational and able to initiate its first assessments. The following assessments were produced during the first work programme (IISD, 2021):

- Thematic Assessment on Pollinators, Pollination, and Food Production (IPBES-4, February 2016, Kuala Lumpur, Malaysia);
- Methodological Assessment on Scenarios and Models of Biodiversity and Ecosystem Services (IPBES-4);
- Regional Assessment of Biodiversity and Ecosystem Services for Africa (IPBES-6, March 2018, Medellín, Colombia);
- Regional Assessment of Biodiversity and Ecosystem Services for Asia and the Pacific (IPBES-6);

- Regional Assessment of Biodiversity and Ecosystem Services for the Americas (IPBES-6);
- Regional Assessment of Biodiversity and Ecosystem Services for Central Europe and Asia (IPBES-6); and
- Assessment on Land Degradation and Restoration (IPBES-6).

At its sixth session (17-24 March 2018, Medellín, Colombia), IPBES approved four regional assessments and an assessment on Land Degradation and Restoration. The meeting also adopted: a decision on implementation of the first work programme, including the initiation of work on two new assessments in 2018 on the sustainable use of wild species, and on tools and methodologies regarding multiple values of biodiversity to human societies; the initiation of an assessment on invasive alien species in 2019; and a decision on the development of a strategic framework up to 2030 and elements of a rolling work programme (IISD, 2021).

At its seventh session (29 April-4 May 2019, Paris, France) IPBES approved the summary for policy makers (SPM) and accepted the chapters of the Global Assessment on Biodiversity and Ecosystem Services, the first intergovernmental global assessment of this kind and the first comprehensive assessment since the MA released in 2005. IPBES-7 further adopted the IPBES rolling work programme up to 2030, including new assessments on: the nexus between biodiversity, water, food, and health; the determinants of transformative change; the impact and dependence of business on biodiversity; and a technical report on biodiversity and climate change to be prepared jointly with the Intergovernmental Panel on Climate Change (IPCC) (IISD, 2021).

3.4.2. Intergovernmental Panel on Climate Change (IPCC)

In 1979 the first "World Climate Conference" organized by the World Meteorological Organization (WMO) expressed a concern that "continued expansion of man's activities on earth may cause significant extended regional and even global changes of climate". This Conference appealed to nations of the world "to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity" (IPCC, 2010).

In 1985 a joint UNEP/WMO/ICSU Conference was convened in Villach (Austria) on the "Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts". The conference concluded, that "as a result of the increasing greenhouse gases it is now believed that in the first half of the next century (21st century) a rise of global mean temperature could occur which is greater than in any man's history. As a follow-up, UNEP, WMO and ICSU set up the Advisory Group on Greenhouse Gases (AGGG) to ensure periodic assessments of the state of scientific knowledge on climate change and its implications (IPCC, 2010).

In 1987, the 10th Congress of the WMO recognized the need for objective, balanced, and internationally coordinated scientific assessment of the understanding of the effects of increasing concentrations of greenhouse gases on the earth's climate and on ways in which these changes may impact socio-economic patterns. In its follow up the WMO Executive Council asked the Secretary General of WMO in co-ordination with the Executive Director of UNEP to establish an *ad hoc* intergovernmental mechanism to provide scientific assessments of climate change (IPCC, 2010).

At its 40th Session in 1988 the WMO Executive Council decided on the establishment of the Intergovernmental Panel on Climate Change (IPCC). The UNEP Governing Council

authorized UNEP's support for IPCC. It was suggested that the Panel should consider the need for:

(a) Identification of uncertainties and gaps in our present knowledge with regard to climate changes and its potential impacts, and preparation of a plan of action over the short term in filling these gaps;
(b) Identification of information needed to evaluate policy implications of climate change and response strategies;
(c) Review of current and planned national/international policies related to the greenhouse gas issue;
(d) Scientific and environmental assessments of all aspects of the greenhouse gas issue and the transfer of these assessments and other relevant information to governments and intergovernmental organizations to be taken into account in their policies on social and economic development and environmental programmes.

WMO and UNEP set up the IPCC Secretariat at WMO headquarters in Geneva. In November 1988 the IPCC held its first Plenary Session. The Panel agreed to establish three working groups that would prepare assessment reports on: (a) Available scientific information on climate change; (b) Environmental and socio-economic impacts of climate change; and (c) Formulation of response strategies (IPCC, 2010).

At the same time various other fora including the United Nations General Assembly (UNGA) recognized the need for international cooperation on climate change with a view for adopting effective measures within a global framework. In its resolution on "Protection of the global climate for present and future generations of mankind" the 43rd UNGA (1988) endorsed the action of WMO and UNEP to establish the IPCC and requested as soon as possible "a comprehensive review and recommendations with respect to: (a) The state of knowledge of the science of climate and climatic change; (b) Programmes and studies on the social and economic impact of climate change, including global warming; (c) Possible response strategies to delay, limit or mitigate the impact of adverse climate change; (d) The identification and possible strengthening of relevant existing international legal instruments having a bearing on climate; (e) Elements for inclusion in a possible future international convention on climate" (IPCC, 2010).

In 1989, the 44th session of the UNGA requested the report by the IPCC to be submitted to its 45th Session and it agreed to take, after the adoption of the IPCC report, a decision on ways, means and modalities for pursuing negotiations of a framework convention. Such negotiations would be coordinated with the preparations for the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. UNGA called also for a wider participation in the IPCC work, in particular of experts from developing countries (IPCC, 2010).

Responding to this request, the IPCC adopted its first assessment report on 30 August 1990 in Sundsvall, Sweden. To meet the information needs of the negotiating process for the Climate Convention, the IPCC prepared in 1992 Supplementary Reports and in 1994 a Special Report that comprised updated information on radiative forcing of climate change, an evaluation of the IPCC IS92 emission scenarios, the "IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptation" and the "IPCC Phase I Guidelines for National Greenhouse Gas Inventories" (IPCC, 2010).

After entry into force of the UN Framework Convention on Climate Change (UNFCCC) in 1994 the IPCC remained the most important source of scientific, technical and socio-economic information. The relationship between the UNFCCC and the IPCC became a model for interaction between science and decision-makers (IPCC, 2010).

In 1991, the IPCC decided to prepare a second comprehensive assessment report (IPCC SAR). At that time the membership of the IPCC was also expanded to all member countries of WMO and UNEP, and measures to enhance the participation of developing countries were put in place. It was agreed that each Working Group should be led to two Co-Chairs, one from a developed and one from a developing country. The IPCC Panel agreed to establish three working groups: (a) Working Group I highlighted considerable progress in the understanding of climate change since 1990; (b) Working Group II broadened the scope of its assessment to include information on the technical and economic feasibility of a range of potential adaptation and mitigation strategies; and (c) Working Group III addressed, as a new feature, the social and economic dimensions of climate change over both the short and long term. This IPCC SAR provided substantive input to the further development of the UNFCCC in particular the negotiations for the Kyoto Protocol which was adopted in 1997. At the Second Conference of the Parties (COP-2) in 1996, Ministers and other heads of delegations present at COP-2 recognized the SAR as "currently the most comprehensive and authoritative assessment of the science of climate change, its impacts and response options now available (IPCC, 2010).

The IPCC's Third Assessment Report (IPCC TAR) was initiated in 1997 and completed in 2001where: (a) Working Group I presented improved understanding of climate processes, forcing agents and feedback and addressed the question of human influence on today's climate. Projections of future climate were based on new scenarios and a wider range of models; (b) Working Group II provided updated information on impacts, vulnerabilities and adaptation, and implications for sustainable development; and (c) Working Group III assessed mitigation options, their costs and co-benefits as well as barriers, opportunities and policy instruments. It also placed climate change mitigation in the context of sustainable development (IPCC, 2010).

In the IPCC's Fourth Assessment Report (IPCC AR4) (2007) Working Group I provided new knowledge on human and natural drivers of climate, a detailed assessment of past climate changes and its causes and stronger evidence on attribution of climate change including an assessment for every continent. Working Group II assessed observational evidence of impacts of climate changes, identified some of the most vulnerable places and people and mapped projected impacts against future warming trends, taking into consideration aspects such as development pathways and multiple stresses. Working Group III further evaluated emissions trends, mitigation options 6 and pathways towards stabilization of greenhouse gas concentrations in the atmosphere, along with associated costs in the near and longer term. Compared to previous assessments the report paid greater attention to the integration of climate change with sustainable development policies, the relationship between mitigation and adaptation (IPCC, 2010).

In 2007 all those involved in the IPCC were delighted to hear the following news: "The Norwegian Nobel Committee has decided that the Nobel Peace Prize for 2007 is to be shared, in two equal parts, between the Intergovernmental Panel on Climate Change (IPCC) and Albert Arnold (Al) Gore Jr. for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed

to counteract such change." The IPCC accepted this prize on behalf of all experts who had contributed to its assessment work during the past 20 years. It further decided to use the award money to create a Scholarship Programme aimed at enhancing the knowledge and research base and at creating opportunities for young scientists in developing countries highly vulnerable to climate change (IPCC, 2010).

3.5. Sustainable Development Goals (SDGs)

In 2015, the 193 countries of the United Nations (UN) General Assembly adopted the 2030 Development Agenda, which commits all countries and stakeholders to act in collaborative partnership to end poverty and hunger, and to protect the planet from degradation, so that it can support the needs of present and future generations (UN 2015). At its core, the 2030 Agenda includes 17 Sustainable Development Goals (SDGs) comprising 169 targets to be achieved by 2030. These SDGs, which took effect in January 2016, are applicable to all countries, regardless of development status. They build on the UN's Millennium Development Goals (MDGs) (UN 2000), drawing on several years of multi-stakeholder consultations, including with the private sector, and intergovernmental negotiations (Tosun and Leininger 2017), and integrate targets from other conventions, such as the UN Convention on Biological Diversity (CBD) Aichi Biodiversity Targets (CBD 2010).

The 17 SDGs, and their targets, present a new and coherent way of thinking about diverse issues related to development, such as hunger, gender and climate change, and were conceived as "integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental" (UN 2015). Economic, social and environmental targets are intertwined in the unified framework of 17 SDGs, forming an 'indivisible whole' (Griggs *et al*. 2013; Nilsson *et al*. 2016). Implicit in the SDGs logic is that the goals, and targets, relate to and depend on each other—but views on exactly how are evolving (Nilsson *et al*. 2016).

The aim of the SDGs was to stimulate action over the coming 15 years in areas of critical importance for humanity and the planet (UN 2015). Progress towards the SDGs depends on action by national governments and a wide range of actors, including the private sector, civil society organizations and millions of individuals. Progress in implementing the 2030 Agenda is tracked through voluntary reviews, which address subsets of the SDGs but explicitly address interactions between goals primarily through annual reporting on SDG 17 (UN 2016).

Linkages between the environment and humans play a central role in sustainable development (MA 2005; Díaz *et al*. 2015), and the environment has been recognized as fundamental for the achievement of many or all of the SDGs (e.g. UNEP 2015; Waage *et al*. 2015; Folke *et al*. 2016). A textual analysis confirms that the environment is integral to most SDGs (13 SDGs contain at least one environment-related word, aspects of the environment are mentioned in 62 of 150 targets [excluding SDG 17 and its 19 targets], and three SDGs with 27 targets are focused entirely on the environment [SDGs 13, 14, 15]. For some SDGs, action addressing environment–human linkages (i.e. ways in which environment and humans affect one another) are central to achieving all their targets (SDGs 13, 14 and 15), whereas for others, environment–human linkages most likely form a smaller part of the overall action required to achieve the goal (e.g. SDGs 4 and 10).

On one hand, environment–human's linkages include both nature's contributions or services to people (e.g. provisioning of oil, regulating of climate, etc.) and the negative disservices it

provides (e.g. foods, disease, etc.) (Díaz *et al*. 2015, 2018). On the other hand, these linkages also include the impacts humans have on the environment, both positive (e.g. protecting and restoring ecosystems, conserving species, etc.) and negative (e.g. pollution of water, degradation of soils, etc.).

3.5.1. SDGs and biodiversity

The 2030 Agenda for Sustainable Development with its 17 Sustainable Development Goals (SDGs) aims to meet the needs of people and nature (UN 2015). The functioning of the biosphere is vital for human resilience, livelihoods and well-being (UN 2015 – Naeem *et al*., 2016). Accordingly, SDGs with a focus on the biosphere play a foundational role for our societies, economies, and our quality of life. In the face of ongoing demographic growth and behavioral changes leading to increased consumption, our societies depend on the supply of more natural resources than ever before, imposing high costs on the biosphere and causing an unprecedented global decline in biodiversity. Nearly one million species face extinction, ecosystems are being degraded, and ecosystem services are declining. This is particularly the case for many regulating and supporting services such as the provision of clean water, climate regulation, risk and disease protection, inspiration, or a sense of place (Diaz *et al*., 2018 – IPBES, 2019).

Substantial economic, social, and environmental benefits can be obtained from the well-coordinated implementation of the SDGs and intentional use of synergies among goals. Several studies on SDG interactions have demonstrated that actions or inactions toward specific goals positively or negatively affect progress towards other goals (Nilsson *et al*. 2016). These findings support a growing scientific consensus that coherent policies to achieve the SDGs require an understanding of the interactions between SDGs (Pham-Truffert *et al*., 2020 – Bennich *et al*., 2020), even if they are, in certain cases, more direct than in others. Among the many interactions between the SDGs, the two biodiversity-focused SDGs 14 and 15, appear particularly important in achieving progress towards sustainability. As shown in a recent analysis, (Pham-Truffert *et al*., 2020) progress on SDGs 14 and 15 contributes in most cases to the achievement of multiple other goals. That is, biodiversity-focused SDGs emerge as multipliers of co-benefits across all goals, and further serve to buffer negative interactions (Pham-Truffert *et al*., 2020). In this way, measures to implement SDGs 14 and 15 are most likely to foster multiple co-benefits across the 2030 Agenda, while entailing relatively small risks of trade-offs.

Conversely, a short-sighted implementation concentrating only on the social or economic dimensions of sustainable development while neglecting the environmental dimension inevitably leads to 'human-driven decline of life on Earth (Diaz *et al*., 2019). In addition, when measures to reach other SDGs are taken without accounting for potential negative impacts on natural resources (under SDGs 6, 12, 14, 15), the latter are likely to suffer collateral damage (Pham-Truffert *et al*., 2020). Based on existing data, negative interactions or trade-offs between biodiversity objectives and other SDGs are mainly related to the provision and extraction of material – Nature's Contributions to People (NCP), such as food, water and energy (Diaz *et al*., 2018 – IPBES, 2019).
The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) will specifically address these interactions in an upcoming 'Nexus Assessment' which aims to provide policy options for addressing such key interactions.

The following table presents quick snapshot on the linkages between biodiversity and SDGs:

Table 7 Quick snapshot on the linkages between biodiversity and SDGs

SDGs	Linkages with biodiversity
Goal 1: End poverty in all its forms everywhere	Biodiversity and healthy ecosystems provide the essential resources and ecosystem services that directly support a range of economic activities, such as agriculture, forestry, fisheries and tourism. Subsistence and small-scale agriculture and fisheries provide livelihoods for many of the world's rural poor. Ecosystem services and other non-marketed goods are estimated to make up between 50% and 90% of the total source of livelihoods among poor rural and forest-dwelling households – the so-called 'GDP of the poor'. The conservation and sustainable use of biodiversity, including through sustainable agriculture based on ecosystem approaches, along with the restoration and safeguarding of ecosystems and the valuable services they provide, can help to prevent men and women from falling into poverty and can help to lift them out of it by increasing their income and reducing their vulnerability to external economic shocks or environmental disasters.
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	Biodiversity is a key factor for the achievement of food security and improved nutrition. All food systems depend on biodiversity and a broad range of ecosystem services that support agricultural productivity, soil fertility, and water quality and supply. Furthermore, at least one-third of the world's agricultural crops depend upon pollinators. Low-input and ecosystem-based approaches to agriculture are particularly adapted to supporting the conservation and sustainable use of biodiversity. Genetic diversity in agriculture is one key element of food security. It helps to ensure the evolution of species that can adapt to changing environmental conditions, as well as resistance to particular diseases, pests and parasites. This diversity has been managed or influenced by farmers, livestock keepers and pastoralists, forest dwellers and fisher folk for hundreds of generations and reflects the diversity of both human activities and natural processes. It can also reduce farmers' vulnerability to climate change. Further, it can provide a diversity of foods with a variety of nutritional benefits. In addition, many people depend on food gathered from natural ecosystems, such as forests, grasslands, oceans and rivers. Products supplied from nature are an important source of nutrition and thus contribute to household food security. For indigenous communities, wildlife hunting can represent the primary source of animal protein. The use of sustainable approaches for agriculture offers opportunities to meet growing food demands while reducing adverse impacts on the natural resources that underpin its long-term viability. Traditional knowledge and practices inherited over generations by indigenous and local communities can often provide invaluable and proven measures of conservation and sustainable use of plant species and animal breeds.
Goal 3: Ensure healthy lives and promote well-being for all at all ages	Nearly 1 in 4 of total global deaths is attributed to environmental risk factors. The link between biodiversity and human health is increasingly recognized. Many pests and diseases are consequences of ecosystem disturbance. Healthy ecosystems help to mitigate the spread and impact of pollution by both sequestering and eliminating certain types of air, water and soil pollution. Forests regulate water flow and improve water quality. Further, many medicines have been derived from biological products and a substantial proportion of the world's population depends on traditional medicines derived from biodiversity for their health care needs. In addition to these direct links, there are many indirect links between biodiversity and human health. For example, diverse agricultural ecosystems contribute to sustainable production increases and to the reduced use of pesticides and other chemical inputs, all of which can have positive impacts on human health. Minimizing unnecessary disturbance to natural systems can help to avoid or mitigate the potential emergence of new pathogens and reduce the risk and incidence of infectious diseases, including zoonotic and vector-borne diseases.
Goal 4: Ensure inclusive	Raising awareness of the importance of biodiversity for sustainable development

SDGs	Linkages with biodiversity
and equitable quality education and promote lifelong learning opportunities for all	through education systems will be key to achieving this and other SDGs. Increasing awareness and knowledge of biodiversity and ecosystems is a key element for sustainable development and sustainable lifestyles. Traditional and indigenous knowledge are important to the conservation and sustainable use of biodiversity and these knowledge systems should be harnessed through culturally sensitive educational initiatives, including agricultural extension services
Goal 5: Achieve gender equality and empower all women and girls	Women play a vital role in managing biological resources, and are disproportionally affected by the loss of biodiversity and ecosystem services. Biodiversity loss and degraded ecosystems can perpetuate gender inequalities by increasing the time spent by women and children in performing certain tasks, such as collecting valuable resources including fuel, food and water, and reducing time for education and income generating activities. Ensuring equal rights to land, inheritance and natural resources is an important measure in enabling women to promote sustainable agricultural and land management practices, especially as women become increasingly responsible in agriculture due to male emigration in many cases. Secure tenure rights can provide incentive and capacity to commit to conservation measures. With land title, women can have access to support services that would enhance their capacity to manage the land in a sustainable way that contributes to biodiversity conservation
Goal 6: Ensure the availability and sustainable management of water and sanitation for all	Healthy ecosystems underpin the delivery of water supplies, water quality, and guard against water-related hazards and disasters. For example, wetlands play an appreciable role in surface, sub-surface and ground water storage, as well as preserving dry season river flows and reducing the risk of flooding in wet seasons. They also serve to retain, process and dilute wastes and other pollutants, helping maintain water quality. Meanwhile, vegetation such as grasslands and forests offer a critical source of watershed protection in upland areas. They provide land cover which helps to slow the rate of runoff, guards against erosion, even out seasonal peaks and troughs in water flow, and minimise silt and sediment loads carried downstream. Ecosystem based approaches to agriculture limit nutrient losses to surface water and groundwater, and the subsequent polluting effects of eutrophication, algal blooms, red tides and fish kills, and contamination of drinking water sources. They also promote practices that are efficient in water use, enhance soil water retention, and value locally adapted crops that require less water. These services typically have extremely high economic value for downstream water users, and help prolong the lifetime and productivity of water infrastructure such as reservoirs, supply facilities, irrigation schemes and hydropower dams. In addition, managing ecosystems to maintain these services is a more cost-effective option than employing artificial technologies or taking remedial measures when these essential functions have been lost or disrupted due to environmental degradation. For example, maintaining wetlands for flood control and mitigation are usually substantially cheaper than rebuilding roads, bridges and buildings that get washed away in flooding events. Conserving an upstream forest typically costs far less than investing in new water filtration and treatment plants downstream, or implementing expensive de-siltation activities in dams and reservoirs.
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	Globally, 3 billion people rely on biological resources including wood, coal, charcoal or animal waste for cooking and heating. Bio-energy produced from renewable biomass such as forestry byproducts and agricultural residues, and other forms of renewable energy generated based on ecosystems such as hydropower systems, can provide major opportunities for supplying cleaner and affordable energy. By optimizing the use of natural, local and renewable resources, ecosystem-based approaches to food production reduce dependency on fossil fuels

SDGs	Linkages with biodiversity
	and external synthetic inputs.
Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Biodiversity supports the provision of ecosystem services which are central to economic activities. Marine and terrestrial ecosystems underpin many national and global economic sectors providing employment such as agriculture, forestry, fisheries, energy, tourism, transport and trade. Biodiversity conservation and restoration, by enhancing ecosystems functions and services, can lead to higher productivity and more efficient resource use. Almost all provisioning services and some regulating services provide inputs to the economy, and hence contribute to value for productive and consumptive uses. Recent assessments show that ecosystem services deriving from the management of natural resource stocks (soils, water, minerals, forests, wildlife) form the most important component of assets for nearly all countries in Sub-Sahara Africa. For example, it is reported that natural capital accounted for 41% of the total wealth of low-income countries in 1995 and 30% in 2005. Biodiversity also offers opportunities for business development. For instance, tourism accounts for about 10% of global GDP and generates one in eleven jobs. Major tourism attractions are closely linked to biodiversity and natural landscapes such as protected areas, mountains and beaches, wildlife and native cultures, as well as eco- and agri-tourism. Ecotourism is one of the fastest-growing sectors that can serve as a key engine of development for least developed countries and small island developing states.
Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Biodiversity and healthy ecosystems can provide reliable and cost-effective natural infrastructure. For example, coral reefs and mangrove forests protect coasts against flooding that are expected to increase with climate change. Natural infrastructure such as vegetation in cities can reduce the run-off of pollution into water bodies. Such green infrastructure can offer multiple benefits and are often more effective than built infrastructure in terms of cost, longevity and effectiveness.
Goal 10: reduce inequality within and among countries	Larger income inequality within countries is known to have correlation with greater biodiversity loss, although further analyses are necessary to identify the causality. Socio-political aspects of inequality, including gender and ethnicity, are also inextricably linked with the conservation and sustainable use of biodiversity. This is because indigenous peoples and local communities and women are important custodians of biodiversity and related traditional knowledge, although they are often marginalized and disadvantaged. Recognizing rights to sustainable management of natural resources, enhancing values of biodiversity and related knowledge, and building an environment for equitable benefit-sharing has the potential to improve socioeconomic and political inequality among social groups.
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	The global urban population is expected to reach 5 billion by 2030, and over 60% of the land projected to become urban by 2030 is yet to be developed. Ecosystems and biodiversity underpin the day-to-day functioning of cities and human settlements by delivering the basic services and conditions that enable, support and protect human production, consumption and habitation. Healthy ecosystems can provide protection and resilience from extreme weather events and disasters. Urban planning that integrates the consideration of biodiversity can not only benefit biodiversity but can also contribute to more sustainable human settlements. For example, strategic placement of trees in urban areas can cool the air between 2°C and 8°C. Furthermore, trees properly placed around buildings can reduce air conditioning needs by 30% and save energy used for heating by 20% to 50%. Many of the world's natural heritage sites are biologically diverse, and thus protecting biodiversity supports the preservation of such important areas. Nature-based solutions to the challenges of urban well-being, such as ecosystem-based approaches to climate change adaptation (EbA) and disaster risk reduction (Eco-

SDGs	Linkages with biodiversity
	DRR), enable safe human settlements.
Goal 12: Ensure sustainable consumption and production patterns	Consumption and production of all goods and services require the transformation of many natural resources, which in turn impacts biodiversity. Current unsustainable consumption and production patterns can undermine the ability of ecosystems to provide services for industries and communities that rely upon them. Utilizing cleaner and more resource-efficient approaches that minimize material footprint, waste and pollutants can bring about economic opportunities and better quality of life for consumers and producers alike, and at the same time benefit biodiversity. Shifting consumption patterns will require active involvement of the public as more countries and population adopt the consumption patterns of economically advanced societies. Raising awareness and access to information on various dimensions of sustainable development including biodiversity and ecosystem are prerequisites for shifting consumption choices and lifestyles.
Goal 13: take urgent action to combat climate change and its impacts	According to the Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Current global warming is already affecting species and ecosystems around the world, particularly the most vulnerable ecosystems such as coral reefs, mountains and polar ecosystems. Furthermore, it has impacts on the ecosystem services on which people's livelihoods depend, such as rainfalls and soil fertility which are essential to agricultural production. Human, animal and plant health are affected through increased transmission of vector-borne diseases. The efforts to protect and restore habitats not only benefit biodiversity but also offer cost-effective and proven measures to mitigate and to adapt to climate change. Ecosystems such as forests, rangelands, croplands, peatlands and wetlands represent globally significant carbon stores. Their conservation, restoration and sustainable use is included as a part of many Intended Nationally Determined Contributions, and is therefore a critical element for the fulfilment of the Paris Agreement under the United Nations Framework Convention for Climate Change, a global commitment toward the mitigation of dangerous changes to the Earth's atmospheric temperature and climate system. Biodiversity and healthy ecosystems are also important resource for increasing resilience and reducing the risks and damages associated with negative impacts of climate change. They can serve as natural buffers against extreme climate and weather events such as changing patterns of rainfalls, droughts, storms, and other disasters. Diversified and integrated production systems offer more options for adapting to a changing climate. Ecosystem based production systems reduce the reliance on synthetic inputs and the associated emissions of greenhouse gases. Breeding drought, salt and disease resistant plant varieties, livestock breeds and fish will become important to ensure food security in the advance of climate change.
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	The conservation and sustainable use of biodiversity in marine and coastal ecosystems is a key aspect of sustainable development. Biodiversity underpins all fishing and aquaculture activities, as well as other species harvested for foods and medicines. Because breeding in aquaculture is so far limited to few species, wild fish still play an important role for aquaculture stocks. 18 Conservation and sustainable use of marine and coastal biodiversity, including the use of marine protected areas, is essential to ensure that the world's oceans, seas and marine resources remain vital for current and future generations. The more effective management of fisheries that are used for food, protection of the marine environment from pollution, including from mari-culture, and destructive actions are critical actions to be taken. Effective management of terrestrial ecosystems, particularly agroecosystems, is also critical to minimizing nutrient losses to marine systems and negative impacts on the marine environment and its resources.

SDGs	Linkages with biodiversity
Goal 15: protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss	The conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems is essential for sustainable development and for achieving SDG15. Target 15.9 of this goal include a call to integrate ecosystem and biodiversity values into national and local development planning, poverty reduction strategies and accounts. Other targets highlight the importance of particular ecosystems, including freshwater, forests, deserts and degraded lands, and mountain ecosystems. 20 Forests cover around 30% of the Earth's land area, containing 80% of terrestrial biomass and providing habitat for over half of the world's known terrestrial plant and animal species. Although the net annual rate of forest loss has slowed down over the past decades, it is still a matter of concern because the loss is occurring in areas with particularly high ecological value. While there is a marked increase in protected areas over the past century, many key biodiversity areas are not adequately covered by protected area status. Globally there are more than a billion hectares of deforested and degraded forest land that could be restored, a vast area with the potential to enrich biodiversity and improve ecosystem functions. SDG 15 also addresses biodiversity in the inland water through sustaining ecosystems and ecosystem services such as water flows and water quality, which are critical for many life stages of aquatic and migratory species in particular. A number of targets contained under this goal relate to other SDGs. For example, Target 15.9 refers to poverty reduction strategies and is therefore relevant to SDG 1, and Target 15.6 relates to Target 2.5 on genetic diversity of seeds, cultivated plants and farmed and domesticated animals. Ecosystem approaches to farming and grazing that foster biodiversity in soil microorganisms and soil macro and micro-fauna promote and maintain the soil's physical and ecological health, thus preventing its erosion, while preserving and rebuilding soil fertility.
Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Environmental crime such as wildlife trafficking, illicit fishing and illegal timber trade undermine sustainable development and threaten global security by benefiting organized crimes and non-state armed groups. Natural resources worth USD 91-258 billion annually are estimated to be stolen by criminals, depriving countries of revenues and development opportunities. Conflicts over natural resources, environmental degradation and contamination can also be one of the factors leading to social insecurity and violence, which often disproportionately affects vulnerable people. Enhancing the role of law and equity for governance of biodiversity, natural resources and ecosystems can contribute to the fundamental process toward building an inclusive society based on justice and democratic decision-making.
Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development	Under the Convention, Parties work together to disseminate knowledge and technologies for environmental management, enhance South-South cooperation, and strengthen national and local capacities for policy and science. Such capacities and wealth of knowledge are essential for the implementation and monitoring of the 2030 Agenda for Sustainable Development. 23 At the national level, National Biodiversity Strategies and Action Plans (NBSAPs) are adopted as policy instruments for achieving the Strategic Plan for Biodiversity, and hence are a ready pathway for national implementation of the SDGs. Efforts to integrate biodiversity and ecosystems into national, subnational and sectoral development policies through NBSAPs and the contribution of NBSAPs into implementation of the SDGs, help enhance policy coherence. The implementation of UNEP's and FAO's instruments and global partnerships fostering sustainable management of biodiversity and natural resources contribute to SDG 17. Many UN organizations provide support to countries in data collection and the monitoring of SDG indicators.

Source: CBD, 2016

3.5.2. SDGs and climate change

Through the 2015 Paris Agreement on Climate Change, 197 countries have committed to ambitious efforts to combat climate change, adapt to its effects, and provide enhanced support to developing countries. Alongside such commitments by national governments, endorsements of the Paris Agreement by companies, civil society and subnational governments have proliferated globally. In 2015 UN member countries also adopted the 2030 Agenda for Sustainable Development—a comprehensive global plan of action for "people, planet and prosperity" comprised of 17 Sustainable Development Goals (SDGs) and 169 Targets to be achieved by 2030, including Goal 13 on climate action. These ambitious global commitments collectively mark the beginning of a new 'post-2015' era of sustainable development. They aspire for transformative change in a world confronted by grave social, economic, political and environmental challenges. They also require governance processes that cut across multiple sectors, stakeholders, and countries. Here we appraise the status of scientific evidence concerning relationships between one set of commitments and the other. We also highlight the urgent need for, and promising progress towards, better coordination between governance processes and structures for climate change, and other sustainable development challenges (Fuso Nerini *et al*., 2019).

Specifically, climate change will affect the achievability of goals relating to material and physical wellbeing such as prosperity and welfare, poverty eradication and employment, food, energy and water availability and health. For example: climate change impacts may exacerbate the distribution of disease vectors and disaster-related health risks (Targets 3.3–3.4). Climate change-driven water shortages can directly impact health by reducing access to clean drinking water and sanitation (6.1–6.2, 6.4). Climate change may also impact the productivity of agricultural lands, causing malnutrition as well as loss of livelihoods and prosperity (1.1–1.5 2.1–2.5, 8.1, 8.3–8.5, 12.1–12.2) (Fuso Nerini *et al*., 2019).

Climate change also undermines efforts to achieve justice and equality across the world. There is evidence that climate change hurts the poorest most, both within and between countries, exacerbating inequality and hampering poverty reduction (1.1–15, 10.1–10.2). Climate induced resource stresses - including on water, agricultural crops or other biotic resources - could exacerbate competition and conflict, threatening the peace and inclusivity of societies, and undermine social justice (12.1, 16.1). Climate change related impacts and disasters are also key drivers of human displacement and mass migrations (8.8, 10.7). Climate change can worsen gender inequalities, for example in cases where girls are the first to be withdrawn from schooling in response to drought or other climate-related shocks (4.1–4.2, 4.5). Climate-related disasters can lead to increased vulnerability of women and girls to violence, for example if they cause a shift in family power relations, or lead to women and girls being vulnerably housed (5.1–5.2. Women's unequal access to economic resources can also compound their vulnerability to climate impacts (5.4–5.5, 5.a–5.c) (Fuso Nerini *et al*., 2019).

Climate change poses a major stress for all ecosystems. For example, marine ecosystems face the threats of temperature change and ocean acidification (14.1–14.3, 14.7, 14.b) while terrestrial ecosystems may be profoundly altered through deglaciation of mountain systems, increased desertification, invasive species, habitat loss, and other climate-related factors (15.1–15.6, 15.8). Finally, different levels of climate change will have different impacts across national and subnational contexts. A 1.5 degrees global warming trajectory could result in fewer people exposed to climate risks, reduced food and water insecurity, and

reduced health impacts and economic losses when compared with a 2 degrees trajectory. There is also evidence that climate change could have limited positive impacts, at least for some time, in certain areas of the world. For example, increased temperatures in temperate zones could support efforts to increase agricultural productivity (2.3). However, literature reports that these positive impacts are most likely to be experienced by currently high income countries, thereby increasing inequality between high and low income countries (Fuso Nerini *et al*., 2019).

Fuso Nerini (2019) identifies evidence of synergies between climate action and 134 Targets across all SDGs where climate action can enable and reinforce building prosperous, equal and peaceful societies. It provides a foundation for building strong, functioning and capable institutions (Targets 17.1–17.19), and has synergies with Targets concerning poverty reduction, welfare and jobs Targets (1.1–1.2, 1.4– 1.a, 8.1–8.2, 8.4–8.5, 8.8–8.9, 8.1). The north-to-south and the south-to-south mechanisms embedded in climate action are consistent with commitments to both 'contract and converge' emissions and 'level the playing field' across countries, decreasing inequalities among and within countries (10.1–10.2, 10.7, 14.7, 15.6).

Climate action will require efforts to better plan and manage resources in an integrated way. Many of the Targets on food- (2.1- 2.b) water- (6.1–6.a) and energy- (7.2–7.3) systems are reinforcing or indivisible with climate action. Progress on several Targets concerning sustainable consumption and production (12.1-12.6) will advance climate action by reducing emissions related to wastes and production. climate action is also indivisible from the achievement of several environmental and health Targets. We found synergies between climate action and the management and conservation of other environmental resources, such as marine (14.1–14.5) and terrestrial (15.1–15.5, 15.8–15.9) ecosystems. Climate action can improve global health outcomes (3.3–3.4, 3.9) by reducing local pollution in households and cities, that harm billions of people every day. Finally, evidence shows sustainable cities and human settlements (11.1-11-6) will have to play a key role in both climate mitigation and adaptation efforts (Fuso Nerini *et al*., 2019).

Notably, there are approximately four times fewer trade-offs than synergies between climate action and the delivery of the SDGs (34 Targets across 12 Goals). Those trade-offs nevertheless have the potential to block climate action—or conversely other development gains—for two broad reasons: First, climate mitigation policies can be costly in the short term in macro-economic terms, especially for carbon intensive and energy exporting regions (8.1), and could impair carbon intensive activity and industries (9.2) (while boosting others). In the energy sector alone, it is estimated that investing USD 3.5 trillion each year between 2016 and 2050, will be needed to stay on a 1.5 degrees trajectory. Climate action could also adversely affect millions of workers globally and their communities working in the fossil fuel industries absent a "Just Transition" plan. Second, climate policies, if not properly designed can be socially and economically regressive, exacerbating inequality and poverty (1.1–1.2). For instance, certain climate policies can impact land and food prices (1.4, 2.3–2.4) increasing the risk of leaving behind small agricultural holders (2.3–2.4). Some national climate adaptation programs have even resulted in violence, conflict, and death. In the energy sector, while climate action would underpin the adoption of efficient and renewable energy (7.2–7.3) it might affect the delivery of affordable, reliable and modern energy services for all by 2030 (7.1)—as fossil fueled energy can be cheaper in certain energy poor areas (Fuso Nerini *et al*., 2019).

III. Global context of Nature based solutions

1. Origin and history of Nature based Solutions

The concept of Nature-based Solutions (NbS) arose in response to the neglect of nature in national and global agendas. Although ecosystem management has been central to the Convention on Biodiversity since it was established[2], in practice ecosystem management is poorly addressed in national policy and investment. There is growing understanding that nature is essential for life and that by degrading nature and natural resources we contribute to many societal challenges, including climate change, food security and disaster risks.

IUCN popularized the concept of Nature Based Solutions for Societal Challenges over the past decade. The concept was used to develop pathways for sustainable management of ecosystem services to address societal needs arising from climate change, disaster risks, water and food security, human health and wellbeing, and socio-economic development. The NbS concept builds on established approaches to inclusive and participatory natural resource governance and is designed to take these approaches to scale to simultaneously address the needs of biodiversity and human wellbeing.

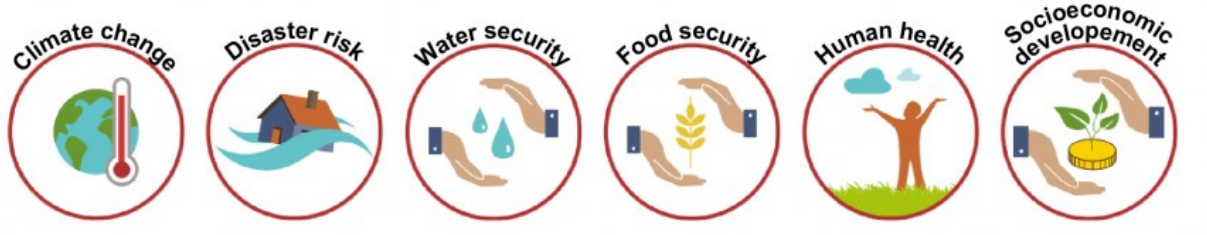
Central to the concept of NbS is the need to work with ecosystems, rather than relying on conventional engineered solutions. Nature based Solutions have been shown to provide a powerful defence against the impacts and long-term hazards of climate change, which is the biggest threat to biodiversity. Research has shown that NbS can provide around 30% of the cost-effective mitigation needed by 2030 to stabilise global warming to below 2°C. NbS have been deployed to 'green' cities, contributing to significant energy savings and health benefits. Many countries have included NbS in their national climate strategies and to ensure consistency and adherence to good practices.

NbS approaches are usually derived from established and widely used practices, such as forest landscape restoration, integrated water resource management, regenerative agriculture, ecosystem-based adaptation, and ecosystem-based disaster risk reduction. Since 2020, the adoption of NbS has been boosted by adoption of the NbS Standard, which is outlined later in this chapter. By following this standard, NbS offer great potential for achieving sustainable development and will make a major contribute to many SDG targets, including those on land, water and climate.

2. The definition of Nature-based Solutions

IUCN members adopted the first global definition of NbS in 2016, under resolution WCC-2016-Res-069, as: "actions to protect, sustainably use, manage and restore natural or modified ecosystems, which address societal challenges, effectively and adaptively, providing human well-being and biodiversity benefits". This definition is taken from an earlier IUCN publication outlining the NbS framework (Cohen-Sacham, 2016). The provision of societal benefits is fundamental to NbS, provided by protecting, sustainably managing and restoring ecosystems.

[2] https://www.cbd.int/doc/publications/ea-text-en.pdf



NbS have been popularised through the climate change discourse and increasingly included in climate change mitigation and adaptation plans. Two-thirds of the governments supporting the Paris Agreement included NbS actions in their national climate plans. The estimated global benefits in ecosystem services from Nature based Solutions that focus on climate could be as high as US$ 170 billion. NbS can provide up to 37% of our climate change mitigation needs (Griscom *et al*., 2017) and they can reduce the impact of climate change on people and nature by decreasing the impact of disasters and strengthening resilience. A popular example is the restoration of mangroves to reduce climate risks in coastal areas. Mangrove forests have potential to reduce annual flooding for more than 18 million people globally (Beck et al., 2018), averting flood damage estimated at up to US$57 billion in China, India, Mexico, the United States and Vietnam each year (Reguero et al., 2018).

The term Nature based Solution is used in different ways by different actors, which has led to some misuse of the concept and in some cases has created distrust of the concept. For example, climate mitigation actions that involve planting monocultures of trees can be harmful to biodiversity and land health. Actions to restore nature that do not consider off-site risk factors or consequences can be harmful to both biodiversity and human welfare. Restoration actions that depend heavily on water in dry environments can cause water scarcity and exacerbate drought. Whilst such solutions may be based on nature, they would not be considered Nature based Solutions.

3. Classification of nature-based solutions

IUCN has proposed to treat NbS as an umbrella concept, with several categories[3]:

Table 8 Categories of NbS approaches

Category of NBS approaches	Examples
Ecosystem restoration approaches	Ecological restoration; Ecological engineering; Forest landscape restoration
Issue-specific ecosystem-related approaches	Ecosystem-based adaptation; Ecosystem-based mitigation; Climate adaptation services; Ecosystem-based disaster risk reduction
Infrastructure-related approaches	Natural infrastructure; Green infrastructure
Ecosystem-based management approaches	Integrated coastal zone management; Integrated water resources management
Ecosystem protection approaches	Area-based conservation approaches including protected area management

The European network BiodivERsA has proposed a typology for NbS, organised along two gradients: 1) the degree of engineering of biodiversity and ecosystems and 2) the number of ecosystem services and stakeholder groups targeted[4]. They distinguish 3 types of NbS:

- Type 1 – Minimal intervention in ecosystems (for example, protection of mangroves);
- Type 2 – Some interventions in ecosystems and landscapes (for example, innovative planning of agricultural landscapes to increase their multi-functionality);
- Type 3 – Managing ecosystems in extensive ways (for example, artificial ecosystems with new assemblages of organisms for green roofs and walls to mitigate city warming and clean polluted air).

Type 1 and 2 are closely aligned with the IUCN framework but Type 3 may not be. IUCN differentiates between 3 ways of working with nature: Nature based Solutions, as outlined in this chapter; nature-derived solutions, such as wind farms; and nature inspired solutions, such as biomimicry.

4. Advantages and challenges of NBS

Nature based Solutions can offer cost-effective alternatives to grey infrastructure. By restoring ecosystems, NbS generate a multitude of societal benefits, sometimes call co-benefits. For example, forest landscape restoration may be primarily motivated by the desire to mitigate climate change, but can generate co-benefits that range from rehabilitation of water sheds, reduction in drought and flood risk, economic benefits from non-timber forest products, habitat for biodiversity, cultural and aesthetic values and many more.

One of the significant challenges of NbS is estimating and rewarding these co-benefits, many of which are treated as public goods. The values may accrue to land users off-site or downstream, and may fall under the remit of different public institutions. Incentivising these co-benefits through market mechanisms requires innovative approaches to financing and has created challenges in scaling up proven approaches. Simply coordinating natural resource use to deliver NbS often requires new institutional arrangements to achieve optimal outcomes across sectors: for example, collaboration in landscape planning between ministries of agriculture, forests, water and others.

[3] Cohen-Shacham, E., G. Walters, C. Janzen, S. Maginnis (eds). 2016. Nature-based solutions to address global societal challenges. Gland, Switzerland: IUCN. Xiii + 97 pp. Downloadable from https://portals.iucn.org/library/node/46191

[4] "BiodivERsA: home". www.biodiversa.org

Due to these challenges of monitoring impact across multiple societal benefits, overall evidence in support of NbS is currently weak, and sometimes controversial. Under-estimation of the value of NbS, for example by neglecting to measure significant co-benefits, can be used to weaken support for NbS. While evidence of effective NbS exists across different sectors, it needs to be brought together in a robust evidence base and business case to connect the natural capital and finance world to NbS and help secure further resources and interventions.

If NbS are only implemented as uncoordinated small-scale pilots and applications, their potential to address societal challenges will not be fulfilled. Worse, weak or mislabeled NbS projects can weaken support for the NbS approach, de-incentivising its use, eroding donor confidence and misdirecting efforts. Funders, investors and decision makers need to be confident that the NbS initiatives they support are effective and scalable and consider potential externalities. Yet many may lack the resources or expertise to analyse and evaluate NbS projects.

NbS often require unique skill sets that leading actors – such as public institutions or local land users – do not have. Landscape restoration often depends in the first place on securing community rights over resources, which requires a painstaking process of stakeholder consultation, trust building, and enabling the use of local and indigenous knowledge. Such approaches can be challenging to traditionally trained engineers, who feel that their hard-earned technical skills should be superior to local knowledge.

Some commentators have criticised NbS for lacking evidence to support claims of multiple benefits and cost effectiveness, but the evidence base is steadily being constructed. The Royal Society[5] reports that emerging evidence shows that NbS provide low-cost solutions to many climate change-related impacts and offer key advantages over engineered solutions in certain contexts. This is particularly due to NbS delivering a wider range of ecosystem services, especially to more vulnerable sectors of society, to protect us against multiple impacts and to be deliverable at lower cost. Inevitably, providing a range of values comes with the attendant challenging of measuring impact, and underestimating the aggregate value. The Royal Society reports that evidence still remains weak, particularly in relation to cost-effectiveness of NbS compared to alternatives. It is argued that, rather than framing NbS as an alternative to engineered approaches, more attention should be given to finding synergies among different solutions.

5. The Global Standard on Nature-based Solutions

The IUCN Global Standard for NbS[6] is a tool to help governments, communities, business and NGOs implement strong, effective NbS projects that are ambitious in scale and sustainable, prevent misuse and safeguard people and planet. The Global Standard was published in 2020 and was developed through public consultation in over 100 countries with state and non-state actors. It consists of eight criteria and associated indicators that address the pillars of sustainable development (environment, economy and society) and that can be used to operationalize best-practice principles of NbS. The governance structure of the IUCN

[5] Seddon, N., Chausson, A., Berry, P., Girardin, CAJ., Smith, A. and Turner, B. 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society. https://doi.org/10.1098/rstb.2019.0120

[6] https://portals.iucn.org/library/node/49070

Global Standard will revise the criteria every four years to enable improvement and incentivize engagement with NbS across sectors.
Implementers of NbS can use the Global Standard, its user guide and self-assessment tool to consistently design effective NbS projects that are ambitious in scale and sustainability, creating a shared language for stakeholders and facilitating innovative partnerships. Donors and financers can invest in NbS with the Global Standard as a benchmark minimising risks and providing increased security. The Global Standard can be used to:

1. Design new NbS;
2. Upscale pilots by identifying gaps and;
3. Verify past projects and future proposals.

The Global Standard can be downloaded from the IUCN website: https://portals.iucn.org/library/node/49070. The following section provides a summary of the eight criteria and is for illustration purposes only. Refer to the full standard for further details, including guidance on the application of indicators.

Criterion 1: NbS effectively address societal challenges

Criterion 1 ensures NbS respond to societal needs by involving all stakeholders, especially rights holders and beneficiaries of the NbS, in the decision-making process.

- Indicator 1.1: The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised
- Indicator 1.2: The societal challenge(s) addressed are clearly understood and documented
- Indicator 1.3: Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed

Criterion 2: Design of NbS is informed by scale

Criterion 2 encourages NbS that recognise the complexity and uncertainty that occur in living, dynamic land and seascapes. Scale refers to the geographic extent as well as the influence of economic systems, policy frameworks and the importance of cultural perspectives.

- Indicator 2.1: The design of the NbS recognises and responds to interactions between the economy, society and ecosystems
- Indicator 2.2: The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors
- Indicator 2.3 The design of the NbS incorporates risk identification and risk management beyond the intervention site

Criterion 3: NbS result in a net gain to biodiversity and ecosystem integrity

NbS design and implementation must enhance the functionality and connectivity of the ecosystem and must avoid undermining ecosystem integrity.

- Indicator 3.1: The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss
- Indicator 3.2: Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed
- Indicator 3.3: Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS
- Indicator 3.4 Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy

Criterion 4: NbS are economically viable

NbS must pay close attention to economic viability, return on investment, efficiency and effectiveness of the intervention, and equity in the distribution of benefits and costs. This includes balancing long-term gains with short-term costs, generating evidence of the value of nature and NbS contributions to markets and jobs, and encouraging financing of NbS to increase the likelihood of long-term success.

- Indicator 4.1: The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented
- Indicator 4.2: A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies
- Indicator 4.3: The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities
- Indicator 4.4 NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance

Criterion 5: NbS are based on inclusive, transparent and empowering governance processes

NbS should acknowledge, involve and respond to the concerns of a variety of stakeholders, especially rights holders. They must adhere to and align with prevailing legal and regulatory provisions, being clear on where legal responsibilities and liabilities lie, complemented with ancillary mechanisms that actively engage and empower local communities and other stakeholders.

- Indicator 5.1: A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated
- Indicator 5.2: Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)
- Indicator 5.3: Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention
- Indicator 5.4: Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders
- Indicator 5.5: Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions

Criterion 6: NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits

NbS interventions should acknowledge and equitably manage trade-offs in the values of land and natural resource management and follow a fair, transparent and inclusive process to balance and manage trade-offs. This involves a credible assessment combined with full disclosure and agreement among the most affected stakeholders on how the trade-offs should be addressed. Fair and transparent negotiation of trade-offs and compensation among potentially affected parties for any damages or trade-offs to local opportunities and livelihoods provides the basis for successful long-term NbS outcomes.

- Indicator 6.1: The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions

- Indicator 6.2: The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected
- Indicator 6.3: The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS

Criterion 7: NbS are managed adaptively, based on evidence

NbS implementation plans should include provisions to enable adaptive management as a response to uncertainty and as an option to effectively harness ecosystem resilience. The foundation of adaptive management is evidence from regular monitoring and evaluation, drawing on scientific understanding as well as indigenous, traditional and local knowledge.

- Indicator 7.1: A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention
- Indicator 7.2: A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle
- Indicator 7.3: A framework for iterative learning that enables adaptive management is applied throughout the intervention lifecycle

Criterion 8: NbS are sustainable and mainstreamed within an appropriate jurisdictional context

This Criterion requires that NbS interventions are designed and managed with a view to long-term sustainability and that they take account of, and align with, other policy frameworks. All approaches to mainstreaming NbS rely on strategic communications and outreach. Audiences to consider include individuals (e.g. the public, academics), institutions (e.g. national government, start-ups, businesses, and organisations) and global networks (e.g. Sustainable Development Goals, Paris Agreement).

- Indicator 8.1: The NbS design, implementation and lessons learnt are shared to trigger transformative change
- Indicator 8.2: The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming
- Indicator 8.3: Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

6. Global context of Nature based Solutions

The concept of Nature based Solutions has been widely endorsed and adopted by a number of International Organizations, United Nations agencies, and Inter Governmental Bodies. For example, NbS – with healthy and biodiverse ecosystems at their core – are central to achieving the objectives of the EU Biodiversity Strategy for 2030[7]. The EU Strategy aims to secure healthy, resilient, biodiversity-rich ecosystems that deliver the range of services essential to the prosperity and well-being of citizens, tackling wider societal, economic and environmental challenges. The European Commission states that NbS "inspired and supported by nature, cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience"[8]. In 2020, the EC definition was updated to further emphasise that "nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services"[9].

[7] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

[8] "Nature-Based Solutions - European Commission". Retrieved 10 December 2019.

[9] Wild, T., Freitas, T., and Vandewoestijne, S. (2020). Nature-based Solutions – State of the Art in EU-funded Projects

The World Wildlife Fund defines NbS as "Ecosystem conservation, management and/or restoration interventions intentionally planned to deliver measurable positive climate adaptation and /or mitigation benefits that have human development and biodiversity co-benefits managing anticipated climate risks to nature that can undermine their long-term effectiveness"[10]. WWF emphasises forests as, "probably the most well-known nature-based solution for climate change", but acknowledges many others, including peatlands, mangroves, wetlands, savannahs, and coral reefs. It should be noted that WWF lists habitats and ecosystems rather than solutions *per se*, but they promote actions to protect, restore and sustainably manage ecosystems to address society's challenges and promote human well-being as Nature based Solutions for climate.

The United Nations Environment Programme endorses the NbS concept and promotes NbS through agroforestry, reforestation and afforestation programmes, particularly in tropical regions, to reduce land degradation and increase carbon storage. The agency works with governments to promote ecosystem-based adaptation to climate change and support development of national adaptation plans. They also work with the United Nations Food and Agriculture Organization, the United Nations Development Programme, and the UN-REDD Programme to promote NbS for reducing emissions from deforestation and forest degradation[11].

NbS provide biodiversity benefits, and help raise attention to restoring and sustainably managing ecosystems. According to UN Water, NbS can use natural processes to enhance water availability (e.g. soil moisture retention, groundwater recharge), improve water quality (e.g. natural wetlands and constructed wetlands to treat wastewater, riparian buffer strips), and reduce risks associated with water-related disasters and climate change (e.g. floodplain restoration, green roofs)[12].

The Nature-based Solutions Initiative from the University of Oxford has defined NbS as "actions that work with and enhance nature so as to help people adapt to change and disasters"[13] and identifies NbS as actions that maintain healthy, resilient and diverse ecosystems (whether natural, managed or newly created), which provide solutions for the benefit of societies and overall biodiversity.

Support for NbS has grown since 2020 due to the Covid pandemic and a widespread interest in "building back better". COVID19 has underscored that human health is connected to our relationship with the natural world and has strengthened understanding of the need to preserve biodiversity and invest in Nature based Solutions. NbS are also gaining popularity through the Climate Change discourse, due to their role in both mitigating and adapting to climate change. NbS therefore demonstrate an important common set of responses to the Rio Conventions, since they conserve biodiversity by definition, and play a leading role in addressing climate change and land degradation. In the 2019 UN Climate Action Summit, Nature based Solutions received significant attention as an effective method to combat

[10] https://wwf.panda.org/discover/our_focus/climate_and_energy_practice/what_we_do/nature_based_solutions_for_climate/?

[11] https://www.unep.org/unga/our-position/unep-and-nature-based-solutions

[12] UN-Water (2018) World Water Development Report 2018, Geneva, Switzerland. http://www.unwater.org/publications/world-water-development-report-2018/

[13] Eggermont, H., Balian, E., Azevedo, JMN., Beumer, V., Brodin, T., Claudet, J., Fady, B., Grube, M. and Keune, H. (2015). "Nature-based Solutions: New Influence for Environmental Management and Research in Europe" (PDF). Gaia - Ecological Perspectives for Science and Society. 24 (4): 243–248. doi:10.14512/gaia.24.4.9.

climate change. A "Nature Based Solution Coalition" was created in 2019, including dozens of countries, led by China and New Zealand[14].

The Paris Climate Agreement calls on all Parties to acknowledge "the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases" and to "note the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth"[15]. Article 5.2 of the agreement encourages Parties to adopt "…policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation and sustainable management of forests and enhancement of forest carbon stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches". One hundred and thirty Nationally Determined Contributions (NDCs) – representing 65% of signatories to the UNFCCC – commit to Nature based Solutions in their climate pledges[16].

Several countries that signed the Paris Agreement, including India, Argentina and Nigeria, are implementing Nature based Solutions through restoration and conservation projects and sustainable ecosystem management. However, concerns have been raised over the lack of quantified targets and the need for better defined objectives and indicators for measuring impacts.

Protecting and restoring habitats can remove carbon dioxide from the atmosphere and help mitigate climate change by storing carbon. Conserving ecosystems, such as mangroves can help reduce the impacts of climate change, such as floods and storm surges. A strong example is the restoration of mangroves along coastlines, which provides a number of societal benefits. They moderate the impact of waves and wind on coastal settlements, reducing risks and helping to control coastal erosion resulting from sea level rise. They sequester CO_2 and contribute to mitigating climate change. They also provide nurseries for marine life and contribute to sustaining fish stocks that are important to local economies (ref).

7. Ecosystem-related approaches within NbS

The NbS concept grew out of the ecosystem management approach, developed by IUCN and was adopted by the Convention on Biological Diversity (CBD) in 2004[17]. The ecosystem approach is described as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way". This aligns closely with NbS, and NbS can be considered as the natural development of the ecosystem approach, placing more explicit emphasis on societal benefits.

The ecosystem approach led to the concept of Ecosystem based Adaptation (EbA), which has the potential to increase adaptive capacity and social and ecological resilience to climate

[14] Political and financial support for new efforts to scale up use of nature-based solutions to be announced at Climate Action Summit. Climate Action Summit 2019. https://www.un.org/en/climatechange/assets/pdf/release_nature_based_solutions.pdf

[15] https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

[16] "Ecosystem-based adaptation: a win–win formula for sustainability in a warming world?" https://pubs.iied.org/17364iied?k=Ecosystem-based%20Adaptation%20EbA&p=3

[17] COP 7 Decision VII/11 https://www.cbd.int/decision/cop/?id=7748

change in both developed and developing countries[18]. In a review of Nationally Determined Contributions up to 2015, only 23 of 162 refer explicitly to EbA, although 109 included indicated ecosystem-orientated visions for adaptation. However, concerns have been raised over slow progress in translating such commitments into tangible targets.

Nature-based Solutions encompasses a range of ecosystem-related approaches, all of which address societal challenges. According to the IUCN Commission on Ecosystem Management, these approaches can be placed into five main categories, as shown below. Most of these approaches predate the emergence of NbS, but they generally fulfil the NbS criteria.

Table 9 NbS as an umbrella concept for ecosystem-related approaches

Nature-based Solutions as an umbrella concept for ecosystem-related approaches[19]	
Ecosystem restoration approaches	• Ecological restoration • Ecological Engineering • Forest landscape restoration
Issue-specific ecosystem-related approaches	• Ecosystem-based adaptation • Ecosystem-based mitigation • Climate adaptation services • Ecosystem-based disaster risk reduction
Infrastructure-related approaches	• Natural infrastructure • Green infrastructure
Ecosystem-based management approaches	• Integrated coastal zone management • Integrated water resources management
Ecosystem protection approaches	• Area-based conservation approaches, including protected area management

8. Examples of Nature based Solutions

A. Community based Rangeland Restoration in Egypt and Jordan

The Healthy Ecosystems for Rangeland Development initiative (HERD) is a global IUCN initiative implemented in 10 countries, including a GEF-funded project in Egypt and Jordan. The initiative focuses on natural regeneration of degraded and desertified rangelands by re-enabling effective livestock herd management arrangements. The approach recognises that rangelands are dependent on herbivore activity, for example to promote nutrient cycling and herd dispersal, and enables herders to use their environmental knowledge to promote grazing patterns that accelerate the restoration process.

Societal challenge: the project responds to land degradation that contributes to reduced food production, reduced adaptive capacity and increased exposure to risk, including drought risk.

Intervention: rangeland rehabilitation, primarily through assisted natural regeneration based on improved landscape planning and livestock herding practices, supported with strategic water interventions.

[18] Seddon, N., Jones, XH., Pye, T., Reid, H., Roe, D., Mountain, D. and Rizvi, AR. 2016. Ecosystem-based adaptation: a win–win formula for sustainability in a warming world? https://pubs.iied.org/17364iied?k=Ecosystem-based%20Adaptation%20EbA&p=3

[19] https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions

Approach: strengthening governance of rangelands through improved coordination between public institutions, securing land management rights of livestock keeping communities, and enabling coordinated herd management through community resource management groups. The primary approach focuses on reviving traditions of rest and recovery for pasture zones, based on local knowledge supported with scientific knowledge.

Outcome: based on a modelling exercise in Jordan, it has been estimated that restoration through community-based rangeland management can generate a cost to benefit ratio of approximately 1:10 over a 25-year time span[20]. The highest value in the Jordan case study was the increase water supply due to reduced surface runoff and increased infiltration. This service is enjoyed by downstream users, including industries, and can help develop investment innovations and other incentives.

The HERD project in Jordan and Egypt is implemented on a significant scale and will influence further scale up through partnership with ministries of environment and with the League of Arab States to promote rangeland restoration throughout the region.

B. Adaptation in Egypt through Integrated Coastal Zone Management[21]

The objective of this project, Adaptation to climate change in the Nile Delta through Integrated Coastal Zone Management in Egypt, is to integrate the management of risks associated with sea level rise into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta. This coastal zone is a low-lying delta of the River Nile, supporting large population centres, industry, agriculture and tourism. Due to the concentration of much of Egypt's infrastructure and development along the low coastal lands and the reliance on the Nile delta for prime agricultural land, coastal inundation or saline intrusion caused by anthropogenic climate change induced sea-level rise will have a direct and critical impact on Egypt's entire economy.

Egypt's Mediterranean coast and the Nile Delta have been identified as highly vulnerable to climate change induced Sea Level Rise (SLR). The proposed project aims to integrate the management of SLR risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta by strengthening the regulatory framework and institutional capacity to improve resilience of coastal settlements and development infrastructure, implement innovative and environmentally friendly measures that facilitate/promote adaptation in the Nile Delta, and establish a monitoring and assessment framework and knowledge management systems on adaptation.

The project has three main outcomes:

1. The regulatory framework and institutional capacity to improve resilience of coastal settlements and infrastructure will be strengthened.
2. Strategies and measures that facilitate adaptation to climate change impacts, with sea level rise in particular, will be implemented in vulnerable coastal areas in the Nile Delta
3. Monitoring/assessment frameworks and knowledge management systems will be established to facilitate adaptive management in the face of unfolding climate change impacts.

[20] Myint, M.M., & Westerberg, V. (2014). An economic valuation of a large-scale rangeland restoration project in Jordan. Report for the ELD Initiative by International Union for Conservation of Nature, Nairobi, Kenya. Available from: www.eld-initiative.org

[21] https://www.adaptation-undp.org/projects/sccf-czm-egypt

The second outcome supports implementation of proactive adaptation measures to enhance the resilience and adaptive capacity of coastal lagoons in the Nile Delta. Both areas are highly productive and particularly vulnerable to future sea level rise and have been identified through stakeholder processes as environmental hotspots and priority areas for adaptation. Hard infrastructure designed outside the context of an ICZM Plan led to the failure of accounting for natural sedimentation and flow processes. This led to significant problems with erosion, salinization and coastal flooding. This led to so-called 'soft' approaches being implemented such as living shorelines, beach nourishment, vegetative buffers, and dune rebuilding measures with native palm and Posidonia grasses in the Idku, Burullus, and Manzala coastal lagoons.

C. Nature-based water storage in arid to semi-arid lands[22]

Societal challenge: water scarcity as a limiting factor for socio-economic development

Intervention: implementation of sub-surface dams (sand dams) in seasonal river beds to enhance the storage of water, maintaining low evaporative losses, managed by local community institutions, and utilised for water consumption and small-scale agriculture. The intervention used low-cost, low-lift solar powered pumps to draw water from the river beds for irrigation purposes, as is done in the Sashane irrigation gardens in southern Zimbabwe. The technology allows farmers to access water for supplementary irrigation, and mitigate the risk of sub-optimal rainfall during the rainy season, which is highly and increasingly unpredictable as a result of climate change. It enables farmers to extend the cropping season into the dry period and harvest a second (cash or staple) crop.

Current practice is either low abstraction of this subsurface water, or over-extraction using conventional motor pumps, which leads to wells being pumped dry. The costs of these pumps – fuel and maintenance – has been prohibitive while contributing to greenhouse gas emissions and other negative environmental impacts. Manual irrigation pumps on the other hand do not provide sufficient water for irrigation at scale.

The sand dam is a sub-surface wall across the river that gradually increases the thickness of the sediment layer in the river (through heightening the dam in stages). This increases the volume of water stored and makes more water available for use over time. The sustainable use of this storage facility is managed through community monitoring mechanism and governed by water user committees.

Improving access to the shallow groundwater of sand rivers, while ensuring adequate operation and management, is described as a 'no-regret' intervention. It requires limited financial investment and has no environmental cost. It boosts production and helps to climate-proof food supply chains in arid and semi-arid Africa.

D. Restoring soil and vegetation in Algerian rangelands

The Algerian steppes extend over 20 million hectares and are home to a population or approximately 7.2 million people, many of whom are shepherds. Approximately 15 million sheep are reared on the steppe, making it a leading economic activity, but also a leading cause of land degradation: both vegetation loss and soil erosion. The steppe includes arid and semi-arid zones, which means that vegetation is scarce and unpredictable, due to naturally high

[22] Duker, A., Hago, EY., Hussey, H., Hulshof,M., Lasage, R., Mwangi, M. and Zaag, P. http://www.naturebasedsolutions4water.com/nature-based-water-storage-in-arid-to-semi-arid-lands-in-africa/

climate variability. Growing demographic pressure combined with technologies such as stock transport have changed herding practices and contribute to degradation processes.

Societal challenge: land degradation, contributing to reduced economic returns from rangelands and increased exposure to climate risks, including drought.

Intervention: government-led interventions include grazing exclosure (livestock removed from the land) and exclosure with plantation (implemented in the most degraded areas).

Approach: although reports refer to a bottom up approach, this mainly refers to how community were informed of the exclosure of their land. Local community members are employed as guards to monitor plots and enforce exclosures, since the areas are not fenced. After 4 years of protection, the grazing plots are rented to shepherds, with strict limit on the number of animals allowed to graze. Some areas are not returned to grazing as they are considered to provide important ecosystem services.

Outcome: Plant diversity, composition, vegetation cover and pastoral value were significantly higher in protected areas. Exclosure led to improved soil properties, such as organic matter and soil nitrogen content. However, the two techniques differ in their outcomes. The plantation technique on heavily degraded soil resulted in a higher pastoral value of plant communities whereas grazing exclosure technique on lesser degraded soil favored plant diversity. This is to be expected since the plantation technique used only selected species.

Social acceptance of this approach is variable and shepherds have not respected the exclosures in the driest years. Furthermore, demand for renting the recovered land is lower than supply, possibly indicating a prohibitive cost or the punitive measures associated with failing to respect the imposed rules (seizure of the livestock, legal proceedings and heavy fines). The social outcome indicates that this approach is weaker on NbS Criterion 4 (economically viability) and Criterion 5 (inclusive, transparent and empowering governance processes).

IV. Potential nature-based solutions in Egypt

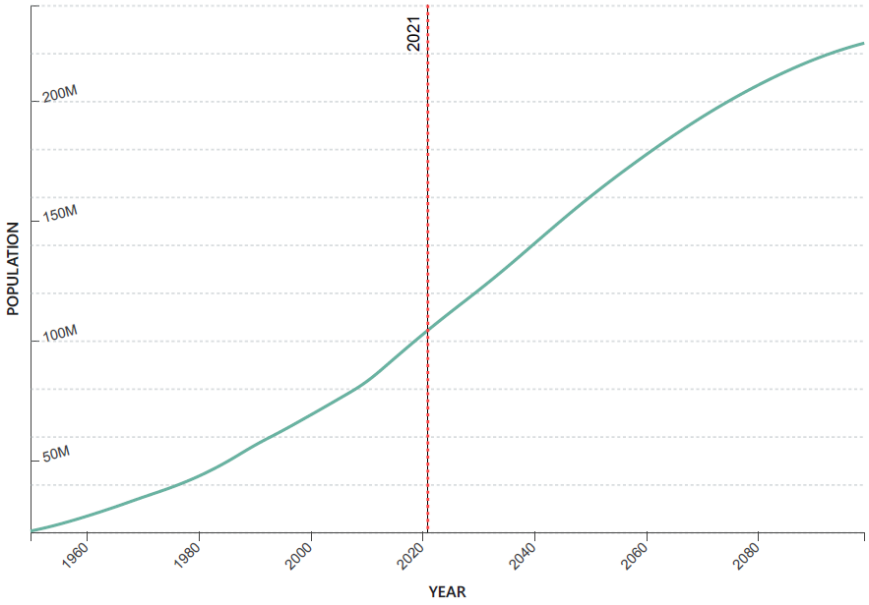
1. Egyptian Nationally Determined Contribution (NDCs)

1.1. National circumstances

1.1.1. Population

Egypt has a population of about 104 million people (June 2021) which ranks Egypt the 14th in term of population size globally[23]. According to current projections, Egypt's population is expected to double by 2078. The population is currently growing at a rate of 1.94%, a rate that adds about 2 million people to the population every year. Egypt's fertility rate is about 3.3 births per woman, well above the population replacement rate of 2.1 births per woman. Egypt has a relatively young population, where about 60% of the population is under 30 years old. The rapidly increasing population poses a threat to the Egyptian economy, where one-third of people live below the poverty line and the unemployment rate is around 10%.

Figure 3: Egypt population 2021 with its projection until 2080



Source: World Population Review: Egypt Population 2021 (accessed July, 2021)

1.1.2. Economic context

Egypt's economic growth has been strong and resilient since the economic reforms initiated in 2016. It is one of the few African countries expected to record a positive growth in 2020, at 3.6%, despite the adverse impact of the COVID–19 pandemic. The economy grew at a slower rate than in 2019 (5.6%) but did not enter a recession, thanks to high domestic consumption. The tourism sector—which accounts for about 5.5% of GDP and 9.5% of employment—was shut down from mid-March to 1st of July 2020. Despite pandemic-related expenditures and revenue shortfalls, the fiscal balance excluding the cost of government debt is expected to remain positive, at 0.5% of GDP. This fiscal buffer, a consequence of the fiscal consolidation reforms, helped keep the overall deficit broadly unchanged at 8% of GDP in 2020—compared with a 7.9% deficit in 2019 that benefited from a primary surplus of 2%. Public

[23] World-meter: Countries in the world by population (2021). https://www.worldometers.info/world-population/population-by-country/

debt was estimated to increase to 90.6% of GDP in 2020 from 86.6% in 2019, reversing three years of continuous decline. During the first half of 2020, exports dropped by 6%, while imports fell 21%, which helped narrow the current account deficit to 3.1% of GDP in 2020 from 3.6% the year before. The smaller current account deficit also reflected the strength of remittances, estimated at 8% of GDP in 2020. Following the move to a flexible exchange rate regime in 2016, Egypt experienced a period of double-digit inflation, but inflationary pressures have been trending downward since the summer of 2017. In 2020, price pressures were muted, especially on food products, and inflation declined to 5.7%, from 13.9% in 2019, which allowed monetary policy to be accommodative. To stimulate economic activity, the bank of Egypt cut the overnight lending rate by 300 basis points on 16 March 2020, another 50 basis points on 24 September, and to 9.25% on 12 November (ADB, 2021).

Real GDP growth is expected to slow to 3% in 2021 because of continued weakness in net exports, mainly tourism receipts. Tourism earnings, which totaled 25% of exports in 2019, are likely to have declined in 2020 due to the closure of international airports and restrictions on local travel. The outlook for tourism in the short term remains weak. Overall, exports, which decreased in 2020, should remain subdued in 2021 due to the weak external environment, especially in Europe, which accounts for 35.5% of Egypt's exports and is the main source of tourists. Similarly, private investment could remain subdued in 2021 but benefit from the improved investment climate over the medium term. Private consumption will remain the main growth driver. Egypt must maintain its reform momentum to dynamize the private sector and enhance inclusive growth. Monetary policy should remain accommodative in 2021, as inflation is expected to increase only moderately (ADB, 2021).

Liberalization of the capital account in 2016 attracted foreign investors to the domestic debt market. But the pandemic caused a significant reversal of capital flows, which put pressure on reserves and the current account. The pandemic also exacerbated Egypt's already large refinancing needs, with 60% of the country's public debt at a maturity of one year or less. To bridge the financing gap, Egypt accessed funding from COVID–19-related facilities. It received $8 billion from the International Monetary Fund ($2.8 billion from the coronavirus rapid financing initiative and $5.2 billion in a one-year stand-by arrangement). The African Development Bank provided $300 million, and the World Bank $450 million. On 21st May 2020, the country also tapped the international capital market, issuing a $5 billion bond, its largest issuance to date, that was largely oversubscribed. Credit facilities from international financial institutions and bond issuances boosted foreign exchange reserves to $40.06 billion at the end of 2020. External debt rose to 36% of GDP, but the new borrowing helped lengthen the average debt maturity. Total public debt is projected to increase to 90.6% of GDP in 2021 before steadily declining to 77.2% by 2025. Egypt must further lengthen the maturity of its debt and diversify its investor base to manage its refinancing risk and mitigate its rollover risk. Moreover, the country needs to continue implementing structural reforms to catalyze private sector development and enhance domestic resource mobilization (ADB, 2021).

1.1.3. Social context

"*Over the past year, Egypt has embarked on one of the most ambitious economic transformations in the modern history. These structural reforms are critical to the Egyptian economy and the reforms will consolidate the country's transition to a dynamic and more attractive economy, driving national and regional growth. The reforms will help attract foreign investment, generate economic opportunities for the country's citizens, create employment for the youth, and build the diversified economic foundation that Egypt needs for*

its long-term growth". This statement by Egypt's Minister of Finance, Amr El-Garhy, acknowledges the historical scale of Egypt's recent reforms and underlines Egypt's longer-term ambitions to become a "…new Egypt… that will possess a competitive, balanced and diversified economy, dependent on innovation and knowledge, based on justice, social integrity and participation, characterized by a balanced and diversified ecological collaboration system, investing the ingenuity of place and humans to achieve sustainable development and to improve Egyptians' quality of life" (Breisinger *et al*., 2018).

International experience shows that the type of macroeconomic reforms that Egypt has implemented since 2014 – gradual reductions in energy subsidies, imposition of a value added tax, and liberalization of the exchange rate leading to a 50 percent devaluation of the Egyptian pound – are critical to addressing the severe economic imbalances in Egypt's macroeconomy. These reforms have the potential to initiate a process of longer-term economic growth and diversification (IMF, 2015). Indeed, there are signs that the reforms are working in Egypt. By the end of 2017, the balance of payments and the fiscal balances have improved. There are also early positive signs that economic growth is picking up, inflation is easing and unemployment is starting to fall (Breisinger *et al*., 2018).

International experience also shows that functioning social safety nets[4] play an important role in protecting the poor from the negative impacts that often result from such ambitious reform packages during the first few years of adjustment. In addition, evidence from Mexico, Brazil, and Ethiopia (among others) shows that targeted social safety nets play an important role in economic development, bolstering incomes and food security for the poor and, in some cases, improving investments by poor households in education and productive assets (Hidrobo *et al*., 2017). As a result, social safety nets can play an important role for medium- to long-term economic and social development (Alderman 2017) as envisaged in Egypt's Vision 2030.

Thus, along with the macroeconomic reforms, the Government of Egypt began to reform and expand its social protection schemes in 2014. Egypt has a long history of providing social support, notably the long-standing subsidization of food and social solidarity pension system, but the redistributive benefits of these programs have been mixed. The food subsidy system goes back to the 1940s and currently covers about 70 percent of the Egyptian population and makes up about 1.6 percent of the gross domestic product with an average annual allocation of EBP 610 per capita (Ministry of Finance, 2017). Since 2014, the system has been transformed from a generalized subsidy to a voucher-based system (Moselhy, 2017; Ecker et al. 2016). During the macroeconomic reforms, the government increased the size of voucher payments, which is likely to have played an important role in protecting people from the short-term negative impacts of reform (Breisinger *et al*., 2018).

In addition, Egypt launched the Takaful and Karama Program, a pair of targeted cash transfer schemes in March 2015. Takaful and Karama is a conditional[5] cash transfer program that seeks to provide income support to the poor and most vulnerable; namely poor families with children (under 18 years of age), poor elderly (aged 65 years and above) and persons with severe disability. The introduction of the program represents a significant step on behalf of the Egyptian government to increase the share of social spending reaching poor households. It is implemented by the Ministry of Social Solidarity (MoSS), and co-financed by the Government of Egypt and the World Bank, with plans to increase government funds to reach 100 percent of the cost by fiscal year 2017 (Breisinger *et al*., 2018).

The program is divided into two subprograms: "Takaful" and "Karama". "Takaful" (Solidarity) is a family income support scheme, conditioned on school attendance and health outcomes. Cash transfers are conditioned on attendance of at least 80 percent of the school days by children aged 6 to 18 years, and on conducting two visits per year to the health clinics by mothers and children below 6 years; in addition to maintaining child growth monitoring records, and attending nutrition awareness sessions. Takaful transfers start from a basic amount of EBP 325 per household, per month, which increases depending on the number of children in the households and their educational level. At the beginning of the program, the household received EBP 60 for each child in primary education, EBP 80 for each child in preparatory education and EBP 100 in secondary education. Yet, starting July 2017, households receive EBP 60 for each child under 6 years old, EBP 80 for each child n primary education, EBP 100 for children in preparatory education, and EBP 140 for secondary education. Households can receive benefits for up to three children only, who are usually the oldest three children in the households (Breisinger *et al*., 2018).

"Karama" (Dignity) is an unconditional income support scheme targeted at the poor elderly and persons with severe disability, and orphans. Orphans have been added as Karama beneficiaries in 2017 and receive EBP 350 per beneficiary. Meanwhile, Karama monthly transfers for poor elderly and person with disability started at EBP 350 per beneficiary, but was then increased in July 2017 to EBP 450 per beneficiary. Karama also has a maximum of three beneficiaries per household (World Bank, 2015). Families can be entitled to both "Takaful" and "Karama" benefits. As of June 2017, 90 percent of Takaful and Karama Program (TKP) beneficiaries were women (Breisinger *et al*., 2018).

The Takaful and Karama Program was rapidly rolled out in three phases starting in March 2015 and now reaches more people than originally planned. The program has expanded more than originally planned both geographically, and in terms of number of beneficiaries. By December 2017, 1.9 million beneficiaries have been benefiting from Takaful, and nearly 317,990 have been benefiting from Karama, exceeding the original target of reaching 1.5 million households in 2017. The programs currently cover 8.6 million individuals in beneficiary households (Aide Memoire, December 2017). Although a major step forward in redistributing government resources toward the poor, limited funding means that many poor households are not included. Currently, the Takaful and Karama Program aims to reach 20 percent of all poor households in Egypt, and to have 60 percent of its target beneficiaries as households under the poverty line (Breisinger *et al*., 2018).

In conjunction with the Ministry of Social Solidarity and with funding from the United Kingdom Foreign and Commonwealth Office (UK FCO), the World Bank contracted the International Food Policy Research Institute (IFPRI) to conduct an impact evaluation of the Takaful and Karama Program in Egypt. The main results of the impact evaluation of the two programs can be summarized as follows:

- Takaful has helped the poor to significantly increase their household consumption. The Takaful program increased the value of household consumption for beneficiaries between 7.3 and 8.4 percent compared to non-beneficiaries, which is roughly equivalent to one third of the value of the average Takaful transfer. Adjusting for the fact that the household survey likely underestimates the value of consumption, this suggests that roughly one third to one half of Takaful transfers show up directly in the form of higher consumption.
- Impact are at a scale comparable to successful cash transfer programs in other countries. This positive impact on household consumption is comparable to the

impact of other well-known social protection programs. A review of seven conditional cash transfer programs in Latin America (Fizbein *et al*., 2009) found that impacts on household expenditure ranged from 7 to 10 percent among four programs in Brazil, Mexico, Colombia, and Honduras. Thus, the Takaful program has performed well compared to other well-known conditional cash transfer (CCT) programs, which were very successful. In the impact evaluation sample, average Takaful transfers represented 23 percent of monthly household expenditure, which is similar to other conditional cash transfer (CCT) programs with this level of impact.

- Takaful has significantly reduced the prevalence of poverty among beneficiaries. The evaluation assessed the impact of the Takaful program on the probability of a household being poor, relative to three poverty lines: USD 1.90 per person per day and USD 1.25 per person per day (the World Bank definitions of poverty and extreme poverty), and the Egyptian regional poverty lines. The Takaful program reduced the probability of a beneficiary household living in poverty (below USD 1.90 per day) by about 11 percent and this effect is statistically significant. The Takaful program reduced the probability of a beneficiary household living under the regional poverty line by 8 percent. The impact of the Takaful program on the national poverty rate is substantially smaller because the program, while substantial, covers only a fraction of poor households.
- Takaful beneficiaries increased their food consumption and improved the quality of their diets. The Takaful program caused a statistically significant increase in the value of monthly food consumption per adult equivalent unit (AEU) by 8.3 to 8.9 percent. This is a substantial effect and somewhat lower than the average impact of several social protection programs on food consumption of 13 percent as reported in a recent review by IFPRI (Hidrobo *et al*., 2017). Disaggregating the effects on household food consumption, there is some evidence that households use the transfers to improve the quality of their diet as the programs caused a significant increase in the value of fruit consumption and a weakly significant increase in the value of meat consumption. Despite this evidence of changing food expenditure patterns, there is no significant impact of the Takaful program on any measure of dietary diversity including household dietary diversity or the diversity of diets for women and children. The lack of impact on dietary diversity derives in part from the fact that households near the Takaful eligibility thresholds already have substantially diverse diets. Most households report consuming foods in 7-8 out of 14 food groups. This is consistent with households consuming greater quantities or higher quality of higher valued foods such as fruit and meat even if they are not diversifying their diets into new food categories.
- There is some evidence of positive impact of Takaful on child nutritional status. Estimates show that the Takaful program has increased weight-for-height z-scores, an indicator of short-term nutritional status, for children under age 2 years. This is a meaningful effect, although the data collected show no evidence of substantial acute child malnutrition. Therefore, it is not surprising that this increase in average weight-for-height z-scores does not correspond to a significant change in the already very low rate of wasting. Given that the population is relatively healthy, there could be a potential concern about too much weight gain, although we see no evidence of this in the collected data. Finally, Takaful program led to a reduction of 3.7 percentage points in the probability that a child under age 5 years was ever treated for malnourishment, which may imply less need for treatment due to better health status. There was no impact on child stunting prevalence (a measure of chronic malnutrition) for children under 2 years of age or between 2 and 5 years of age.

- Takaful may not have the intended effect on women's control over decision making. Ninety percent of Takaful beneficiaries were female as of June 2017. Estimates show a negative and significant impact of the program on women's control over decision making, which is driven primarily by households in Lower Egypt and by women with less than primary education. Women's control over decision making is based on the reported ability of a woman to influence a variety of types of household decisions. This pattern is the opposite of effects found in several other countries (e.g., Ecuador, Mali) and opposite to the intended impact of the program.
- There is no impact so far of the Takaful program on the probability that children or girls specifically are enrolled in school or conditional on attending school, whether they were absent for one week or more during the past year. There was also no significant impact on private tuition or tutoring, but we do find significant increased spending on school supplies and transportation of L.E. 211 per household per year in households with at least one secondary school age student and L.E. 123 per household per year in households with at least one primary school age student. There were no impacts on health service utilization including on whether women received antenatal care during pregnancy, the number of antenatal care visits, or postnatal health facility utilization.
- The efficiency and speed of the program in enrolling these newly eligible households was impressive and unexpected.

1.2. National commitments and priorities

1.2.1. Biodiversity

Table 10 National commitments and priorities for biodiversity conservation

Egyptian National Biodiversity Targets (NBSAP 2030)	National Priorities
NATIONAL TARGET 1: By 2030, PAs network secured and expanded to cover 17% of total terrestrial and inland water and at least 5% of coastal and marine representative areas, especially priority sites of particular importance for biodiversity and key ecological processes, and Effective management of PAs.	• Establish a new self-financed for conservation of biodiversity based on the current initiative by the Sustainable Finance of Protected Areas Project. • Establish coherent and resilient ecological network of PAs with especial attention to marine PAs. • Set programmes for the capacity building of staff members • Set up GIS-based national planning and evaluation system in accordance with the international standards. • Define and implement proper criteria for proper management of key biodiversity hotspots. • Establish standardized national monitoring systems within PAs based on the current monitoring efforts. • Increase close cooperation with international organizations at both technical and financial levels • Develop and implement CEPA strategy for PAs in accordance with the Global CEPA for NBSAPs. • Develop five years' action plans that include required staff, equipment and infrastructure based on the actual financial gaps. • Implement green economy instruments in PAs.
NATIONAL TARGET 2: By 2020, develop and implement unified Egyptian methodology for the identification and monitoring of	• Develop national interactive centralized biodiversity information system. • Assess status of species and habitats. • Ensure the conservation of 20% of threatened species and

Egyptian National Biodiversity Targets (NBSAP 2030)	National Priorities
priority of all components of biodiversity according to the international standards to ensure the maintenance or rehabilitation of 50% of our most threatened species focusing on mammals and reptiles to a favorable conservation status.	reintroduce critically endangered species as appropriate and feasible. • Ensure conservation and management of biodiversity hot spots located outside protected areas. • Promote more ex-situ conservation efforts
NATIONAL TARGET 3: By 2030, National conservation and rehabilitation programmes of threatened and endemic species at risk are developed and implemented with measures to evaluate its implementation.	• Practice and adopt a national policy on ex-situ conservation. • Inspire ex situ conservation through the establishment of natural history museum, gene banks, seed banks captive breeding centers, zoos and public gardens. • Develop guidelines and mechanism for collection, maintenance, reproduction and reintroduction of plants and animal species in ex-situ programmes
NATIONAL TARGET 4: By 2030, all IAS and pathways are identified and prioritized with measures in place to update and verify these pathways, with national programmes for 30% of identified pathways to control and manage IAS.	• Update and verify a list of alien invasive species and identify the most dangerous ones. • Monitor and control the expansion of key AIS with relevant authorities. • Reinforce quarantine measures to control intentional and unintentional introduction of AIS. • Launch and strengthen database of alien species • Institute a specialized unit to be concerned with AIS.
NATIONAL TARGET 5: By 2020, Conservation of natural resources through the adoption of ecologically sustainable agricultural management practices.	• Develop a national agrobiodiversity conservation program with relevant authorities in association with public organizations. • Improve capacity for the recovery and preservation of agrobiodiversity. • To create an agrobiodiversity and fisheries inventory. • To conduct research and conservation relating to the wild relatives of native domestic species and varieties. • Strengthen the capacity of relevant governmental agencies through (among other mechanisms) provision of specialized training
NATIONAL TARGET 6: By 2018, apply CBD tools to monitor and control the impact of tourism on biodiversity, in particular in protected areas and vulnerable ecosystems.	• Sustainable management of ecosystems, its heritage and cultural resources based on best conservation and tourism models for the socio-economic wellbeing of the communities and other stakeholders. • Promote environmentally sound, sustainable tourism through “wise use”, ecotourism practices and technologies, in particular at South Sinai, Red Sea, and Western Desert. • Promote marine conservations and ecotourism in the business community and general public. • Promote desert safari to be ecologically reliable avoiding destruction and degradation of natural habitats, landscapes, cultural heritage sites and other resources. • Carry out surveys of areas suitable for eco-tourism, taking into account habitat vulnerability. • Reduce the impact of tourism activities on biodiversity and natural habitats. • Assess impacts of recreational activities in coastal areas. • Encourage eco-tourism in established and managed national parks. • Launch projects to establish infrastructure and management programs for marine tourism at key sites to mitigate negative environmental impacts • Set up guidelines and licensing procedures for the desert tourism industry.

Egyptian National Biodiversity Targets (NBSAP 2030)	National Priorities
	• Develop environmental education and awareness campaigns to generate awareness about desert conservation, ecotourism and encourage support for management program • Enhance the infrastructure and natural resource base of all protected areas to make them attractive destinations for tourists and tourism investors and to improve the working environment.
NATIONAL TARGET 7: By 2020, measures, including waste management plans and law enforcement, are in place to prevent and reduce the impact of pollution and waste on ecosystems, especially on wetlands and coastal and marine areas**.**	• Set up periodical national assessment of pollution within different ecosystems taking into account habitat vulnerability. • Establish criteria for monitoring of pollution inside protected areas and associated buffer zones. • Set Capacity building for research and development regarding combating pollution. • Undertake measures to minimize the impacts from local pollution instances such as oil spills, harmful algal blooms and hydrogen sulphide events at the coast • Update greenhouse gas inventory and take action to reduce Greenhouse Gas emissions. • Develop and implement Environmental Management Plans (EMPs) for all urban areas. • Develop and implement National Implementation Plans (NIPs) for the Stockholm and Basel Conventions. • Promote increased adoption of the "reduce, re-use and recycle" principle by residents, as well as the public and private sector. Bill on waste management and pollution control enacted and implemented. • Investigate and install alternative systems to make use of solid waste as an economic resource. • Develop, monitor and enforce minimum national standards on soil, water and air quality as well as occupational health.
NATIONAL TARGET 8: By 2025, negative effects of different sectoral policies (land-use planning, transport, energy, uncontrolled urbanization, etc.) on priority elements of biodiversity are minimized, and measures to correct these effects are applied through developing and implementing land use plans**.**	• Uphold environmentally friendly land use practices. • Enhance the implementation of land regulation, pricing and registration. • Minimize the uncontrolled urbanization and enhance land-zoning and land use management plans. • Develop mapping of soil degradation and desertification • Expand desertification control programs focusing on conservation of plant cover, reduction of soil erosion and watershed management. • Develop guidelines for strategic EIA for projects.
NATIONAL TARGET 9: By 2021 rate of wetland loss reduced by 25% and water efficiency in irrigation improved by 50%.	• Develop and communicate a science-based strategic process that identifies and prioritize wetlands important for biodiversity. • Capacity building for integrated management of wetlands.
NATIONAL TARGET 10: By 2027, promote the implementation of good fishing practices in both Mediterranean Sea and Red Sea, favorable to fish protection and their habitats.	• Develop habitat mapping, and sensitivity analysis of the entire coastline. • Develop data base management systems of fishery resources based on stock assessment. • Prepare and implement pilot Integrated Coastal Zone Management Plans • Conserve key threatened coastal, coral relief, mangrove and marine species, habitats and ecosystems. • Re-plant/re-forest mangroves wherever feasible.
NATIONAL TARGET 11: By 2020, Effective operational biosafety and ABS mechanism (measures and	• Systematic update of existing biotechnologies applications and uses. • Building the capacity of NCS as the entity responsible for the

Egyptian National Biodiversity Targets (NBSAP 2030)	National Priorities
legislation) in place, in accordance with national laws and relevant international obligations and serving as national priorities relating to biodiversity.	management and control of biosafety issues. • Build up National Biosafety Database and operational BCH based on the requirements of the CBD. • Normalize, manage or control the risks associated with the use and release of LMOs. • Develop operational guidelines for issues related to biosafety within PAs. • Institute "polluter pays" legislation to recover rehabilitation costs of damaged resources affected by applications of GMOs. • Establishment of a national gene bank for all Egyptian species (economic and wild species). • Establishment of national framework for trading Egyptian's native genetic resources and for pharmaceutical and biotechnological uses.
NATIONAL TARGET 12: By 2020, to promote sustainable hunting and harvesting through adequate planning, restoration and protection of key biological resources.	• Conserve and management of wild species under the pressures of illegal hunting. • Develop effective tools for combating illegal hunting of wild animals (e.g. illegal birds hunting). • Improve the licensing procedure for hunting of migratory birds. • Define hunting quotas for migratory birds and conduct studies on hunting. • Understand and implement the concept of sustainable legal hunting.
NATIONAL TARGET 13: By 2030, Research and implement measures and strategies to strengthen local-level biodiversity resilience to desertification.	• Enhance synergies in efforts to address desertification/land degradation and drought. • Promote sustainable land management and contribute to land degradation neutrality • Share and implement measures for sustainable land management and the combating of desertification/land degradation • Establish policies and enabling environments for promoting and implementing solutions to combat desertification/land degradation and mitigate the effects of drought, including prevention, relief and recovery;
NATIONAL TARGET 14: By 2025, investigate and monitor all the effects of climate change on biodiversity and ecosystem services.	• Assess the impact of climate change on biodiversity in vulnerable areas and protected areas. • Conduct a feasibility assessment of the application of international mechanisms, suggested by UNFCCC (e.g. international carbon market), in Egypt. • Implement Climate Change Capacity Building Phase II. • Continue the implementation of Integrated Solar Thermal/Natural Gas Power Plant (e.g. Kuraymat). • Continue the implementation of the Energy Efficiency Improvement and Greenhouse (GHG) Reduction Projects. • Promotion of wind energy for electricity generation.
NATIONAL TARGET 15: By 2020, the knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared, transferred, and applied.	• Strengthen the role of NCS in the field of biodiversity research & monitoring. • Improve & maintain a regularly up-dated biodiversity data base. • Provide oriented systematic reports for the general public about the status of biodiversity • Designate an entity (center) responsible for biodiversity data analysis and for the development of recommendations from monitoring within the NCS.
NATIONAL TARGET 16: By 2020, enhancing environmental awareness of Egyptians of the	• Develop national guidelines (topics and sources of information, teaching methodologies, a list of typical errors/misconceptions concerning biodiversity issues in the natural and social science

Egyptian National Biodiversity Targets (NBSAP 2030)	National Priorities
importance of biodiversity and ecosystem services through integrating environmental themes into university and school curricula, promoting green media, and supporting youth clubs and eco-industry.	textbooks) for teaching of biodiversity and prepare recommendations for the National Teaching Plan. • Dissemination of biodiversity information in rural areas. • Increase the national capacity for ensuring the production and use of high-quality textbooks; prepare education materials suitable for use at preschool institutions and schools. • Support the establishment and functioning of eco-clubs in schools to promote teaching of biodiversity-related topics. • Increase the role of the media in ecological education and strengthen conservation information dissemination. • Encourage the development of local NGOs focusing on conservation and environmental education.
NATIONAL TARGET 17: By2018, biodiversity values are promoted and integrated into national planning process and mechanisms to support their incorporation into national accounting and reporting systems to be developed.	• Conduct an economic valuation of the country's biodiversity and ecosystems services according to the international standards. • Develop an integral value of biodiversity and its links with livelihoods and key ecosystem services to human well-being and human development • Develop the right tools and mechanism to incorporate the value of biodiversity and ecosystem services into the national plans • Formulate an indicative economic plan for biodiversity conservation, based on international experience, • Create sustainable economic mechanisms for the conservation of biodiversity.
NATIONAL TARGET 18: By 2018, ensure that the national strategy is supported by effective legislation and institutional frameworks to improve its enforcement.	• Develop a legal framework for the establishment of the Nature Conservation Agency. • Set legal mechanisms for economic incentives for sustainable use of biodiversity. • Develop law for conservation of biodiversity. • Adopt and implement legislation regulating biosafety & ABS issues and provide all necessary institutional support for its implementation.
NATIONAL TARGET 19: By 2017, proper NBSAP and associated resource mobilization are in place, in addition to establishment of the national biodiversity committee to ensure periodic evaluation of NBSAP.	• Establish National Biodiversity Committee (NBC) in order to conduct periodic assessments, evaluation and update of the NBSAP. • Enhance the implementation of guidelines and scenarios for mainstreaming of biodiversity into the national development plans. • Upgrade the national system for biodiversity indicators to be more effective.
NATIONAL TARGET 20: By 2020, Adequate financial resources for the effective implementation of the Strategic Plan for Biodiversity 2011-2020 has been mobilized of from all sources and increased substantially from the current levels.	• Develop resource mobilization strategy and mechanisms for the NBSAP implementation. • Create additional financial mechanisms to promote biodiversity conservation and protected areas (after creation of the new NCA). • Formulate an indicative economic plan for biodiversity conservation, based on international experience. • Reflection of coast of biodiversity conservation on national budget.

Source: Egyptian Biodiversity Strategy and Action Plan (2015 – 2030), (EEAA, 2015)

1.2.2. Climate change

A. Egypt's Intended Actions to Promote Resilience

Table 11 National commitments and priorities for climate change resilience

Sector	Key Proposed Actions
Water	• Maintaining water level in Lake Nasser • Increasing water storage capacity • Improving irrigation and draining systems • Changing cropping patterns and farm irrigation systems • Reducing surface water evaporation by redesigning canal cross sections • Developing new water resources through upper Nile projects • Rain water harvesting • Desalination • Treated wastewater recycling • Increased use of deep groundwater reservoirs • Circulation Models to predict the impact of climate change on local and regional water resources.
Agriculture	• Changing dates and good management practices • Changing cultivars to those more tolerant to heat, salinity and pests • Changing crop patterns • Using different multi-level combinations of improved surface irrigation systems • Increasing surface irrigation system capacity in traditional lands to overcome the negative impacts of climate change • Livestock: improving low productivity of cattle and improving feeding programs
Coastal zones	• Changes in land use • Integrated coastal zone management • Proactive planning for protecting coastal zones • Providing job opportunities in safe areas (in locations that are not impacted by climate change)
Adaptation Policies and Measures	• Building institutional capacities of comprehensive collection and analysis of monitoring and observations and geographic data • Identifying indicators and conducting full assessment of vulnerable sectors and stakeholders • Enforcing environmental regulations • Identifying and applying protection measures of vulnerable touristic and archaeological sites and roads against extreme natural phenomena such as floods, dust storms and extreme weather conditions • Proactive planning and integrated coastal zone management • Risk reduction • Building capacities for using regional water circulation models • Increasing awareness of stakeholders for energy and water utilization

Source: MoE (2016): Egyptian Intended Nationally Determined Contributions (MoE, 2016)

B. Egypt's Intended Actions to Promote Adaptation

Table 12 National commitments and priorities for climate change adaptation

Sector	Key Proposed Actions
Water	• Increase investments in modern irrigation systems. • Cooperate with Nile Basin countries to reduce water evaporation and increase river capacity. • Develop national policies to encourage citizens on water use rationalization.
Agriculture	• Build an effective institutional system to manage climate change associated crises and disasters at the national level. • Activate genetic diversity of plant species with maximum productivity. • Achieve biological diversity of all livestock, fishery, and poultry elements to protect them and ensure food security. • Develop agro-economic systems and new structures to manage crops, fisheries and animal production, which are resilient to climate changes. • Increase the efficiency of irrigation water use, while maintaining crop productivity and protecting land from degradation. • Review of new and existing land use policies and agricultural expansion programs to take into account possibilities of land degradation in Delta and other affected areas resulting from Mediterranean Sea level rise. • Develop systems, programs and policies to protect rural community and support its adaptive capacity to the expected trend in land use change, plant and animal production, and internal migration due to climate change.
Coastal zones	• Reduce climate change associated risks and disasters. • Capacity building of the Egyptian society to adapt to climate change and associated risks and disasters. • Enhance national and regional partnership in managing crises and disasters related to climate change and the reduction of associated risk.
Health	• Identify potential health risks as a result of climate change. • Raise community awareness about climate change risks and means of adaptation. • Increase the efficiency of healthcare sector and improve the quality of health services in dealing with climate change. • Support Ministry of Health efforts to improve the social and economic status and population characteristics.
Tourism	• Reduce climate change risks in touristic areas. • Engage users in supporting the proposed strategy. • Support periodical monitoring and observations systems and follow-up bodies. • Raise environmental awareness. • Cooperate with international bodies. • Incorporate disaster risks within the plans to promote sustainable tourism in Egypt. • Capacity building of local communities in touristic areas.
Energy	• Conduct comprehensive studies to assess the impact of climate change on the energy sector, propose appropriate adaptation measures, and estimate the economic cost of the proposed adaptation measures. In addition, these studies should determine the safe locations for the construction of power generation projects. • Build institutional and technical capacities of different units in the energy sector in climate change issues. • Support research and technological development to enable the electricity sector to deal properly with climate change.
Rural Areas, Population, and Roads	• Draw a baseline scenario for the optimal regional distribution of population and economic activities within the geographical boundaries of Egypt up to the year 2100, taking climate change into consideration.

Source: MoE (2016): Egyptian Intended Nationally Determined Contributions (MoE, 2016)

1.2.3. Desertification

The Land Degradation Neutrality Target Setting Programme (LDN TSP) provided a significant opportunity to create a leverage plan for all stakeholders in Egypt. LDN target setting is a country-led process, led by the government, and spearheaded by the UNCCD National Focal Point, the Ministry of Agriculture and Land Reclamation. For Egypt, Land Degradation Neutrality targets have been identified at different levels:

Table 13 National commitments and priorities for land degradation neutrality (LDN)

Scale	Land Degradation Neutrality (LDN) targets
LDN at the national scale	• LDN is achieved (no net loss) by 2030 as compared to 2015 and an additional 10% of the national territory has improved by 2030 (net gain).
LDN at the sub-national scale	• LDN is achieved in the land degradation hotspots: Kafr El Sheikh Governorate, Demiata Gov., Rasheed area, El Minia Gov., Sohag Gov., Al Fayoum, Mersa Matrouh Gov. (Fuka – El Sallum), El Khattara area, El Tina Plain area, El Farafra oasis and North Sinai by 2030 as compared to 2015 (no net loss) and an additional 10% of the degraded hotspot areas has improved (net gain).
Specific targets to avoid, minimize and reverse land degradation	• Improve productivity and carbon stocks of 3,342 km^2 (802,080 feddan) of cultivated areas by 2030. • Restore and increase the productivity of 11,666 km^2 (2,800,000 feddan) of cropland using modern agricultural techniques and Sustainable Land Management (SLM) practices in the northern areas, western and eastern fringes of reclaimed lands of the Nile Delta and El Tina Plains areas by 2030. • Rehabilitate and increase the productivity of 8,000 km^2 (1,920,000 feddan) of rangeland and rain-fed areas using SLM practices in the north coastal areas (rangelands and rain-fed farming areas) by 2030. • Rehabilitate and increase the productivity of 7,500 km^2 (1,800,000 feddan) of cropland using SLM practices in the reclaimed areas in western desert fringes of middle and upper Egypt Governorates by 2030. • Reclamation and cultivation of 6,300 km^2 (1.5 million feddan) of virgin land in reclaimed desert soils at different locations in the western desert of Egypt by 2030. • Gain in land productivity and civil society organizations (SOC) stocks in about 8,333 km^2 of cropland in reclaimed desert lands at different locations (cultivated areas) by 2030 as compared to 2015. • Halt the conversion of cropland to other land cover classes by 2030. • Increase by 25% forest cover/tree cover through agroforestry and SLM in existing forests by 2030 as compared to 2015. • Halt the occurrence of soil erosion by rain water, creating dams for water harvesting to be utilized for agricultural purposes for an area of 2,500 km^2 in dry valleys of elevated areas of the inland Sinai and Eastern Desert by 2030. • Rationalize water consumption by growing crops of low water requirements and adopting modern irrigation systems for around 1,000 km^2 in some oases in the western desert of Egypt by 2030.

Source: DRC (2018): Egypt Country Report of the Land Degradation Neutrality Target Setting Programme (DRC, 2018)

2. National efforts to implement the SDGs

Out of the government's commitment to ensure a quality life for the Egyptian people, Egypt launched its first-ever Sustainable Development Strategy: Egypt Vision 2030 (SDS) in February 2016, believing that sustainable development is the guarantee for growth, development, and prosperity for future generations. The SDS is aligned with the 17 SDGs, as well as the African Agenda 2063, and acts as the governing framework for all development programs and projects that will be implemented until 2030. It was also formulated following a participatory approach involving all stakeholders including the government, the private sector, the civil society, and academia (MPED, 2021).

Believing that strategies are living documents that ought to adapt to changes in national and international circumstances, Egypt embarked on a process of updating the SDS in 2018. The driving forces behind this update process are (1) ensuring a better and more rigorous alignment of the national goals with the SDGs, as well as (2) emphasizing complementarity of the three pillars of sustainable development across sectors. (3) The Economic Reform Program initiated by the Government of Egypt (GoE) in 2016 was also an important factor for the update process, to ensure reflecting the changes resulting from these reforms in the SDS. Furthermore, (4) the update comes to address critical challenges facing the nation, among which are water scarcity and high population growth (MPED, 2021).

The following tables presents the progress of the national SDGs implementation in each of the 17 goals. It presents a progress update on both the numerical indicators and the continuous efforts of the Egyptian government towards sustainable development, while addressing the challenges when applicable.

SDG 1: No poverty

Table 14 Descriptive narrative about Egyptian progress toward SDG 1

Progress towards the goal	• For almost 20 years, there was a disentanglement between poverty and growth where episodes of high growth (for example 2007 to 2009) were not associated with a reduction in poverty. However, this trend was reverted in 2020 where poverty declined for the first time in almost two decades. • The percentage of the Egyptian population below the national poverty line declined from 32.5% in FY2017/2018 to 29.7% in FY2019/2020, with the proportion of population in extreme poverty (USD 1.9 per day) also dropping from 6.2% to 4.5% during the same years.
Government efforts	**a. <u>Continued Increase in Spending on Access to Basic Services</u>** Since 2015, the GoE has attempted to ensure the significant mobilization of public resources towards ending poverty in all its forms, ramping up spending on access to basic services as well as on health and education. Public spending on access to basic services grew from 13.6% as a percentage of total government spending in 2018 to 29.8% in 2020. Similarly, public spending on health and education grew from 4.9% to 6.1% and from 8.8% to 10.1% respectively during the same period as a percent of total government spending. **b. <u>Social Safety Nets: The Takaful & Karama Program</u>** In addition to spending on access to basic services, Egypt massively scaled up its social protection programs and safety nets, to achieve substantial coverage of the most vulnerable and prevent the most in need from sliding into poverty. The Takaful & Karama cash transfer program was therefore inaugurated in 2015. The Takaful (Solidarity) is a conditional family income support program, while Karama (Dignity) is an unconditional cash transfer for the most vulnerable. Beneficiaries of the program rose from 60 thousand families in 2015 to 3.7 million by May 2021, with predominantly female beneficiaries, with the budget dedicated for the program nearly tripling from 2015 till 2021. An initial impact evaluation of Takaful showed that the value of household consumption for beneficiaries increased by 7.3% to 8.4% compared to households who did not receive the program. A further impact evaluation study by the International Food Policy Research Institute (IFPRI) published in October 2018 concluded that "*the Takaful transfers are regarded as having contributed positively to beneficiaries' consumption and coping abilities at both the ultra-poor and threshold levels*". **c. <u>Accelerators: The Hayah Karima Initiative</u>** Additionally, the initiative "Haya Karima" (Decent Life), originally launched in 2019, had an initial budget of EGP **675 million** (~USD **43 million**) to accelerate poverty eradication on a local level. Haya Karima partners with 18 civil society organizations targeting rural villages with poverty rates over 70% as its first phase. The initiative focuses on the effective eradication of poverty, through providing health, educational,

	and housing support, in addition to supporting microenterprises and economic empowerment. Haya Karima was endorsed as a presidential initiative in 2021 with a much bigger budget of EGP **500 billion** (~USD **31.8 billion**) for its second phase. Haya Karima also has a strong focus on local infrastructure, developing the quality of housing through ensuring access to electricity, water, sanitation, and gas. Beneficiaries of the initiatives have so far reached 186 thousand individuals. This is a dimension onto which the GoE has strong emphasis to guarantee equal rights to basic infrastructural services.
COVID-19 impact	The COVID-19 pandemic is expected to slow down the progress in reducing poverty rates over the short term, although thankfully not causing a reversal. Extreme poverty rates are estimated to have dropped from 4.5% in 2019 to **4.4%** in 2020 rather than a potential **4.1%** without COVID. With the early stages of the pandemic, the GoE took rapid response policies to protect the most vulnerable from sliding into poverty due to the pandemic's effects such as: • The Presidential initiative "**Ahalina**" constituting a monthly grant of EGP 500 for irregular laborers whose livelihood was severely affected due to the pandemic, with about **1.4 million** beneficiaries. • The Ministry of Social Solidarity's disbursement of 4-month exceptional cash grant to over **9,000** tour guides as the tourism sector came to a near complete halt during the pandemic. • Increasing the beneficiaries of the Takaful & Karama program by **411 thousand** families.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 2: Zero hunger

Table 15 Descriptive narrative about Egyptian progress toward SDG 2

Progress towards the goal	• Food security remains a national priority for the government of Egypt as is evident in the Egypt Vision 2030. • Egypt's score in composite food security indices such as the Economist Intelligence Unit's Global Food Security Index shows Egypt's score steadily increasing since 2017 with an overall score of 60.1/100 reaching a high of 65.4/100 in 2019 before dropping to **61.1/100** in 2020. There are also good strides in reducing malnutrition especially among children. Among children under 5 years of age, prevalence of stunting dropped from 22.7% to **15.5%**, wasting from 8% to **3%**, and anemia from 27% to **22.3%** all from 2015 to 2018.
Government efforts	**a. <u>Increasing Agricultural Productivity and Supply of Strategic Crops</u>** GoE continues to work on ensuring food security through improving agricultural productivity and prioritizing the production and reserves of strategic crops. The volume of agricultural production has increased from 158.6 tons per hectare in 2016 to around 163.3 in 2018. The Ministry of Agriculture and Land Reclamation sets production targets for key strategic crops with regular annual increases. For example, wheat production is planned to rise from 3.4 million feddans in 2018/2019 to 3.6 million feddans in 2020/2021, and Maize from 2.8 million feddans to 3.2 million feddans for the same years. Egypt is at or near self-sufficiency rates in the production of Diary, Poultry, and Fish. **b. <u>Food Subsidies: The "Tamween" Program</u>** In addition to improving agricultural productivity, budget allocation for food subsidies increased by around 5% from 2017/2018 to 2020/2021. The GoE continuously works towards improving the efficiency and effectiveness of its "Tamween" food subsidy system, a cornerstone of Egypt's social safety nets. The EIU's Global Food Security Index have constantly showed that one of Egypt's greatest strengths in food security is the presence, funding, coverage, and operation of food safety net programs. The system is managed by the Ministry of Supply and Internal Trade, which along with other partners constantly strives towards improving. Some of the most recent reforms included: - <u>Raising the efficiency of the system</u>: with the improved targeting of food subsidies, subsidies witnessed an overall drop from 88.6% of population in

	2015 to 84% in 2020. Consequently, families in the least spending category (1st decile) receive the highest food support both in absolute EGP terms and as a percentage of their total spending on food and beverages (11.9% in 2019/2020) with this percentage dropping steadily as the family spending category goes up. - Replacing commodity quotas with a monthly cash-based system: so that card holders have more choice as the food basket has been expanded to include more food items with the aim of improving nutritional value & dietary diversity. - Shifting to an output-based subsidy system: so rather than supplying subsidized flour to bakeries, the government now subsidizes the production cost of the bread itself which reduces resource leakage. During May 2020, **Misr El-Kheir Foundation** in partnership with the Ministry of Social Solidarity launched "**Al-Kheir Convoys**" to deliver foodstuff to families most in need during the pandemic. Three different convoys were launched during May, reaching families in every governorate, each carrying as many as 1,250 tons of foodstuff (over 2 million meals). Similarly, from April till December 2020, the **Tahya Misr Fund** launched the campaign "**Together, We Overcome the Crisis**" along two axes: supporting the healthcare sector and supporting the families most in need. The second axis involved distributing over 6,600 tons of food to those most in need in poor villages, in cooperation with over 22 civil society organizations. One of the convoys received the Guinness record title in November 2020 for largest truck convoy with 480 trucks carrying humanitarian aid.
COVID-19 impact	The short-term impact of the COVID-19 pandemic on hunger related indicators is thankfully negligible in Egypt. The percentage of malnourished people dropped from 4.4% in 2019 to **4.1%** in 2020 despite the pandemic. A similar case can be seen in child stunting, with the prevalence increasing marginally from 17.5% in 2019 to **17.6%** in 2020 with no particular effect due to COVID-19 per se. As the pandemic hit Egypt in March 2020, policies were swiftly implemented to ensure food security during global lockdowns such as: - Stopping the exports of strategic items such as legumes and sugar for a few months due to the disrupted trade and supply chains. - Facilitating the import of strategic foodstuff with the Central Bank of Egypt allowing banks to exclude imports of rice, beans and lentils from the 100% cash cover. - Granting companies in the agriculture sector loans at a diminished interest rate that to support their operations during the pandemic. - Deferring loans payments for farmers and breeders for six months under a program by the Egyptian Agricultural Bank. That is in addition to the policies targeting poverty, as well as the several emergency convoys distributing food support.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 3: Good health & wellbeing

Table 16 Descriptive narrative about Egyptian progress toward SDG 3

Progress towards the goal	Egypt affirms the universal right to high quality healthcare, and the GoE has, in turn, worked towards building and maintaining an inclusive and effective healthcare system that guarantees high quality healthcare services and promotes overall wellbeing. Since then, key national health indicators have either: a. <u>improved, such as</u>: • Maternal mortality rate (from 45.9 in 2016 to 42.8 in 2019), • Death rates due to road traffic injuries (from 8.9 in 2015 to 6.8 in 2019), • Healthcare coverage (number of insured people grew from 51.1 million in 2015 to 56.9 million in 2019). b. <u>maintained the progress or remained largely the same:</u> • Under-5 mortality rates (at 20.4 in 2019 which is already below the 2030 target of 25), • Neonatal mortality rates (increased to 7.5 in 2019 but still below the 2030 target of 12), • Suicide rates (remaining at 0.1 per 100,000 inhabitants). As for epidemics and disease-specific indicators, Egypt had noteworthy progress by 2020 (per 100,000 inhabitants) such as Malaria incidence rate dropped to Zero, Tuberculosis incidence rate reached 12, Hepatitis B incidence rate was at 1.78, and HIV incidence rate at 2.77.
Government efforts	**a. <u>Government Initiatives Towards Disease Control</u>** In 2015, Egypt ranked amongst the highest countries in the world in Hepatitis C virus infections. Recognizing the enormous health, social, and economic burden of the disease, the "**100 Million Health Initiative**" was launched in 2018 with the sole target of eliminating the Hepatitis C epidemic. The initiative proved successful with 2019 having over a **50%** decrease in newly reported Hepatitis C cases from before the initiative in 2017 after screening almost **60%** of the population and more than 4 million patients received the required treatment free of charge. Since then, the "**100 Million Health**" initiative has expanded to encompass other chronic diseases such as diabetes, hypertension, stunting, and obesity. Sub-initiatives were launched under the same umbrella focusing on other pressing health issues such as: - The "**Supporting Egyptian Women Health**" initiative aiming at performing checkups for 28 million women across Egypt to screen for breast cancer, general reproductive health, and chronic diseases. - The "**Newborns Health**" initiative with around 95.8% of newborns receiving the required medical care in 2020. **b. <u>The Family Development Strategy</u>** Population growth rates have been marginally slowing down dropping from 2.62% in 2017 to 1.79% in 2019, with fertility rates dropping from 3.4 in 2017 to 2.9 in 2020. However, population growth remains a challenge for well-being. Consequently, the "**Family Development Strategy**" was set with five pillars targeting women from 15 to 45 years. Emphasis was laid on enabling access to safe family planning and reproductive health services which led to an increase in the use of safe family planning methods from 58.8% in 2014 to 62.5% in 2020. **c. <u>An Inclusive Healthcare System for All</u>** In addition to initiatives and strategies, the GoE seeks to institutionally develop the healthcare system and increasing accessibility. In 2019, 56.9 million Egyptians had medical insurance coverage up from 51.1 million in 2015. Egypt started tackling the issues of health coverage by launching the new **Comprehensive Health Insurance Program** to be implemented on six phases from 2018 to 2032 aiming to provide medical insurance to the entire population by then.

	d. <u>Improving Efficiencies</u> The "**Ending the Waiting Lists" initiative**, launched in 2018, is concerned with ending long waiting lists of surgeries for patients in critical conditions, nearly 700 thousand surgeries on the waiting list were performed since its initiation.
COVID-19 impact	Egypt has already achieved the target for under-5 mortality rates (U5MR) of below 25 per 1,000 live births reaching 19.2 in 2019. Egypt's U5MR dropped to 19.0 in 2020 due to the pandemic as opposed to 18.8 under a No-Covid scenario. Similarly, Egypt achieved the target for neonatal mortality rates (NMR) of below 12 per 1,000 live births, reaching 7.5 in 2019 with the pandemic causing a slowdown in progress (reaching 7.4 rather than 7.3 in 2020). The GoE also issued a ban on exports of medical and protective equipment, as well as all medicines without a strategic reserve of six-month supplies. Further rapid response policies aimed to avoid the critical overwhelming of the healthcare sector such as: - A **100%** budget increase for the Ministry of Health and Population was allocated for 2020/2021 than the previous fiscal year. - More than **USD 319 million** additional allocations were set for providing basic supplies and medical equipment. - **USD 1 billion** was set aside as emergency funding in support of the different initiatives by the Ministry of Health. - A **75%** increase in the infection compensation for doctors and nursing staff with a budget of **USD 144 million**.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 4: Quality of education

Table 17 Descriptive narrative about Egyptian progress toward SDG 4

Progress towards the goal	In the academic year 2020/2021, Egypt had over 24.4 million K-12 students in over 57.7 thousand schools across the country, making it the largest education system in the Middle East and North Africa region. Successful strides were taken to ensure the Egyptian pretertiary education system is inclusive and capable of accommodating all children towards their right for a quality education. Between the years 2015 and 2020, youth illiteracy rate declined from 28% to 19.8%. Total school dropout rates for 18-year-olds or younger also declined from 6% to 2% over the same period, with both male and female dropout rates decreasing in the primary and preparatory stages (pre-secondary). Primary Education completion rate in Egypt is already universal surpassing 100% in 2019, with lower secondary completion rates somewhat lower (82.5%), and upper secondary completion at 57.2%.
Government efforts	**a. <u>Continued Commitment to Mobilizing Resources and Inclusivity</u>** GoE continues to mobilize public resources towards education and inclusivity. Public spending on education grew by an average rate of 9.6% from 2016 to 2020, with a noteworthy increase of 18.1% for spending in 2020 from 2019 (nominally), bringing education spending up to 10.1% as a proportion of total government spending. Public investments in education also increased from 7% of total public investments in 2018/2019 to 8% in 2020/2021, comprising a near 65% nominal growth. Furthermore, committing to "leaving no one behind" is evident in the growth in the number of schools for children with disabilities which increased by over 16.8% from 2017/2018 (955 schools) to 2020/2021 (1,116 schools) according to the Ministry of Education. **b. <u>A Comprehensive Transformation Plan : Egypt's Education 2.0</u>** The GoE also targets the continuous improvement of the quality of education. In 2018, with the Ministry of Education in the lead, the government embarked on a full education reform and transformation program, internationally dubbed "**Education 2.0**". The program is planned to be completed by 2030, aligned with Egypt's Vision 2030, and aims to restructure pre-tertiary education. Reforms being implemented in Education 2.0 include: - Continuous professional and capacity development for teachers and introducing new teaching techniques. - Changing the method of examinations and assessments, and reforming school curricula to be more skill-based.

	- Developing the schools' digital infrastructure to introduce substantial use of technology in classrooms. - Expanding access to quality pre-primary education, and special education for differently abled children. The GoE was keen on fostering **successful global partnerships** for Education 2.0. To name a few, the World Bank contributed with USD 500 million in support of the education reform project. The UNICEF has also been a key partner in training curriculum experts, and along with the British Government supported in developing guidelines for the adaptation of learning material for children with hearing and visual impairments. Both the civil society and the private sector continue to be key partners in supporting efforts towards quality education in Egypt. One initiative is **Qalaa Holding's long-standing scholarships** with an EGP 60 million (~ USD 4 million) endowment which has provided 198 scholarships since its inception in 2007. Another program provided by the Egyptian Refining Company is the "**Mostakbaly**" (My Future) program providing schools with tools, equipment, and supplies, and supporting students by offering scholarships. In 2019, the Mostakbaly program added a vocational training program for recipients to receive much needed vocational and technical training, bringing the total fund for the Mostakbaly program to EGP 40 million (~ USD 2.5 million).
COVID-19 impact	While COVID-19 is not expected to have a great effect on the already universal primary school completion in Egypt, it is expected to somewhat slow down the progress of lower and upper secondary completion rates in the near term. The pandemic still came with more than its fair share of challenges as school closures began in March 2020 interrupting the roll out of Education 2.0 to a great extent. The digitization that had already begun in schools helped during pandemic times. The GoE sought to intensify and accelerate the utilization of various platforms to facilitate online and blended learning such as: - The use of the **Egyptian Knowledge Bank** library, already a major part of Education 2.0, to host all primary and preparatory learning and teaching material. - Utilizing innovative methods of ensuring access to remote learning even in the absence of internet connection, such as the launching of the **Madrasatona** (Our School) television channels airing lessons for primary and preparatory stages.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 5: Gender equality

Table 18 Descriptive narrative about Egyptian progress toward SDG 5

Progress towards the goal	Egypt has made a significant leap in women empowerment and gender equality over the past decade, supported by the political leadership and the civil society. Women received 8 ministerial portfolios within the Council of Ministers in 2020/2021, **24%** of ministerial positions, compared to 11.8% in 2018. Egypt is also ranked 16th globally in the percentages of women's representation in Parliament, as women won 162 seats in the 2021 Parliament, accounting for **27%** in the House of Representatives and 13.3% in the Senate. In 2020, Egyptian women held **45%** of all government jobs, which is high compared to the global average of 32%. On another front, the representation of women on the boards of directors of banks increased to **12%** in 2019 compared to 10% in 2018. In addition, in 2018, the percentage of women's representation in diplomatic posts was also relatively strong, standing at **24.8%**. Female unemployment also dropped from 21.4% on 2018 to **17.7%** in 2020 despite the pandemic, although still worse than that of men at 6%.
Government efforts	**a. <u>Institutional Steps Towards Increasing Women's Participation in the Labor Force</u>** There is a need for continuous institutional reform to promote gender equity in the workforce. One of the most recent and most significant steps was the announcement on the 2021 International Women's Day, that Egypt's State Council (one of its high courts) approved for first time the appointment of several female members to the council. Another institutional incentive is Egypt's Gender Equity Seal, established as far back as

	2008, positioning Egypt as the first Arab country and the second globally to develop a certification program based on the success of the gender equality efforts. The Seal, revived in 2020, provides Egyptian companies with guidance on how to address challenges for women, such as access to work, wage inequities, and sexual harassment. **b. <u>Promoting Financial Inclusion for Women</u>** Another axis through which the GoE is tackling gender equality is economic empowerment through financial inclusion. The percentage of women who had bank accounts nearly doubled reaching **27%** in 2019, up from only 14% in 2014. In 2020, Egyptian women also received **51%** of the total loans directed to micro-businesses, with a default percentage not exceeding **1%**. Moreover, in 2020, microfinance balances directed at women increased to account for **62%** of the total number of the beneficiaries of the microfinance schemes. The Central Bank of Egypt (CBE) introduced several initiatives to integrate financially strained households and female micro, small and medium enterprise owners to be part of the formal financial system. Additionally, the CBE introduced a number of regulatory reforms to complement the government's initiatives towards promoting women's financial inclusion: (1) issuing guidelines to banks to collect and report gender-disaggregated data with the aim of tracking the progress of women's financial inclusion (2) unifying the definition of women-owned business, and issuing new mobile banking regulations, (3) launching a microfinance initiative that serves the unbanked and underbanked in Egypt, especially women.
COVID-19 impact	Female labor participation stood at 13.8% in 2019, with Egypt scoring **0.449** on the UNDP's Gender Inequalities Index (GII) during the same year. While the COVID-19 pandemic is expected to have impacted men and women differently, it did not result noticeable differences with regards to these indicators across the different scenarios. Egypt estimates an improvement in the female labor force to reach **23%** and the GII to reach **0.367** by 2030, given its commitment to equality.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 6: Clean water & sanitation

Table 19 Descriptive narrative about Egyptian progress toward SDG 6

Progress towards the goal	Egypt has been exerting efforts to address water demands through the efficient management of its limited water resources. This comes at a critical time of an increasing need driven by the growing population, intensive agricultural activity, and various pressing challenges. About **90%** of Egypt's water supply is dependent on the Nile river, with an annual share of around **55 m^3 billion**, not changed since 1954. The rest of the supply, about 0.5 m^3 billion, comes from non-renewable subterranean water. This leaves the country at a water deficit as it annually needs at least **90 m^3 billion** to satisfy national needs. Egypt's annual per capita share of water declined to **570 m^3** in 2018 which is below the international standards at 1000 m^3. Thus, Egypt is vulnerable to changes in upstream conditions, the most pressing of which is currently Ethiopia's plans to fill the basin of the **Grand Ethiopian Renaissance Dam** which largely threatens Egypt's already strained water supply. On the infrastructural front, noticeable progress has been made in access to drinking water (from 90% in 2015 to **97%** in 2019), access to sanitation (from 50% in 2015 to an estimated **70.6%** in 2019), and the proportion of treated wastewater (from 50% in 2015 to **68.7%** in 2019). Still, Egypt is aware of the imperative call for action necessary to ensure water security. The government devised a national plan to rationalize water and optimize the use of available resources through 2037 at **USD 50 billion** to provide alternative water sources, through desalination in coastal governorates, the establishment of groundwater extraction stations and the re-use of treated water. The plan also introduces efficient and technological irrigation systems as agriculture consumes the vast majority of Egypt's water supply.
Government efforts	**a. <u>Enabling Access to Drinking Water and Sanitation</u>** Access to drinking water is already near universal levels. In FY 2020/2021, the GoE directed 25.9% of the total public investments in the urban development sector to water and wastewater projects. Moreover, in 2020, the Ministry of Housing announced the

	completion of 295 projects for drinking water at a cost of ~USD 2.4 billion. The government also delivered sanitation services to 703 villages at a cost of ~USD 350 million. Egypt had embarked on a 10-year plan to spend ~USD 19 billion in extending and replacing outdated water pipelines. The proportion of the population benefiting from proper management of sanitation services, including handwashing facilities with soap and water rose from 50% in 2015 to 66.2% in 2018. **b. <u>Decreasing Water Loss and Encouraging Water Saving</u>** Parallel to improving access to water services and sanitation, enhancing water conservation has become critically essential. The treatment of wastewater and the reduction of the seepage loss of irrigation water is a key enabler to help meet the needs of the agriculture sector. In this regard the GoE worked on two parallel projects: - 52 wastewater treatment plants are under construction in Upper Egypt, with a capacity of 418 million m^3 per year. The percentage of treated wastewater to total wastewater witnessed a relative increase throughout the years to reach 68.7% in 2019. The largest wastewater treatment plant in the world was announced in 2020, the Bahr al-Baqar water station, with a capacity of 5 million m^3 per day. Treated water from the plant will be used to cultivate and farm around 342 thousand acres as part of the Sinai Peninsula Development Plan. - In 2020, Egypt initiated the lining of irrigation canals project. The project will save 5 billion m^3 of water per year with a plan to pave 20,000 km of irrigation canals. **c. <u>Utilizing New Water Resources</u>** Egypt has also been expanding the utilization of new water sources. A top priority in recent years for Egypt is the expansion of desalination projects to combat water poverty. The urban development plan integrates total dependence on the desalination of seawater in the new coastal cities. In 2020, Egypt operated **58 desalination plants**, with a combined capacity of **440,000 m^3** per day, and a further 39 desalination plants are under construction.
COVID-19 impact	As mentioned previously, access to improved water is effectively universal in Egypt, with more than **99%** of the population having access to improved water sources in 2019. However, access to improved sanitation lags behind at roughly **70%** in 2019. Little effects are noticed on these two indicators as a result of the pandemic.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 7: Affordable & clean energy

Table 20 Descriptive narrative about Egyptian progress toward SDG 7

Progress towards the goal	In 2014, Egypt was suffering from a deficit in terms of electricity. A daily shortage of **6,000 MW** put pressure on electricity companies to conduct scheduled cutouts between different areas. Aware of the criticality of the situation, the Government of Egypt stepped up to address this critical challenge. In 2015 the total capacity of power stations in Egypt was at **23,000 MW** and since then, Egypt has more than doubled its capacity adding **28,000 MW**. Today, Egypt has a surplus in energy allowing it to become a regional exporter of power with around **19,000 MW** in daily reserves, and access to electricity, already at near universal levels, increased from 99.2% of the population in 2015 to **99.7%** in 2019. In 2015, the "I**ntegrated Sustainable Energy Strategy 2035**" was launched aiming at increasing the total electricity production and boosting Egypt's renewable energy output. As per the New and Renewable Energy Authority (NREA) in 2019 the target is to reach **20%** of the total energy produced by 2022 and an ambitious **42%** by 2035, with the introduction by then of the first nuclear power plant which will contribute by around 3%.
Government efforts	**a. <u>Increasing Electrical Capacity and Production</u>** This notable progress mentioned above is a result of significant efforts in constructing 26 new electricity stations with a total capacity of 26,000 MW which represents 12 times more than the generated electricity from the High Dam. Three stations were built in partnership with Siemens AG providing a massive total capacity of 14,500 MW. This increased the total generated electricity from 185.6 billion KW in 2015/2016 to 198.8 billion KW in 2018/2019. In 2014, Egypt had only 18 power transmitting stations for the entire grid and since then 29 new stations have been constructed. Similar work is also ongoing to strengthen the transmission network by adding, replacing, and renewing overhead lines and transformer stations. **b. <u>Increasing Reliance on Renewable Sources</u>** In addition to increasing the overall capacity of electricity generation, the GoE is also prioritizing clean energy, for which Egypt has significant potential. Between 2018 and 2019, the total electricity produced through ***solar energy*** increased from 0.529 billion KW to 1.465 billion KW (by 177%), and capitalizing on Egypt's high solar energy potential, in 2019, the Benban Solar Park was inaugurated. It is one of the world's largest solar energy production projects, constructed in cooperation with the private sector and is "expected to avoid 2 million tons of greenhouse gas emissions a year" according to the IFC World Bank Group. As for ***wind energy***, Egypt is working on the construction of the largest wind power plant in the MENA region in Jabal El-Zeit area in the Red Sea Governorate (east). Jabal El-Zeit project is expected to increase Egypt's wind energy capacity by 18%. Regarding the leaps that have been taken in ***nuclear power***, the GoE, in partnership with the Russian Company Rosatom, is working on the construction of a nuclear power plant in Al-Dabaa in Matrouh Governorate (northwest). The first unit of this project is planned to enter force in 2026. **c. <u>Turning Egypt into a Regional Energy Hub</u>** As Egypt develops its electricity capacity and increases the share of renewables, the next step looking outwards and commercially capitalizing on this realized potential through transforming to an **energy hub**. Now with an energy surplus, the GoE initiated electrical interconnection projects to export electricity and assist in meeting neighboring countries' electricity demand. In 2020, the linkage line with **Sudan** project was initiated. This comes in addition to the electrical interconnection projects with the Kingdom of **Saudi Arabia**, **Cyprus**, and **Greece** which are already planned and set to start implementation in 2021. This will turn Egypt into a regional energy hub in the Middle East along with the new Natural Gas discoveries in the Mediterranean.
COVID-19 impact	Thankfully, as the COVID-19 lockdowns hit the world economy, the challenges of availability and accessibility of electricity in Egypt had already been addressed over the

	past few years. Therefore, the GoE focused on the affordability of energy to help mitigate the economic repercussions of the pandemic on businesses. A decision was reached to reduce the prices of electricity for industry and high and medium ultra-voltage. That is in addition to consolidating and reducing the price of natural gas for industrial use. Moreover, since 2015, Egypt has been gradually reducing energy subsidies for domestic use and the plan was to complete the final phase by FY 2021/2022. However, the Government extended the timeframe till the end of 2024/2025 in order to support in alleviating economic and budgetary difficulties on households during the pandemic.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 8: Decent work & economic growth

Table 21 Descriptive narrative about Egyptian progress toward SDG 8

Progress towards the goal	Egypt has demonstrated sound economic progress over the past three years, garnering the fruits of the reform program launched in 2016. The program constituted bold and critical macroeconomic measures to stabilize the economy and boost growth. Egypt's progress appears in many performance indicators such as GDP growth from 2017 to 2019, which reached a high of **5.6%** in 2018/2019. GDP per capita reached **USD 2,448** in 2019/2020. Egypt has also managed to curb inflation to reach **5.3%** in 2019/2020 down from 13.3% in 2018/2019. Additionally, foreign exchange reserves recovered to cover more than **8.1 months** of imports in January 2021 compared to 5.5 months in January 2017. Despite the macroeconomic stability and high growth, the COVID-19 pandemic caused a setback in Egypt's GDP growth trajectory reaching **3.5%** 2019/2020 compared to an initially projected growth rate of 5.8% in 2019/2020, and 6% in 2020/2021. In particular, the tourism sector went down to **2.7%** of total GDP especially with the high level of uncertainty compared to 4.2% in the previous year. However, Egypt remained one of very few countries worldwide and the only country in the MENA region to register positive growth rates in 2020 despite repercussions of the pandemic.
Government efforts	**a. <u>Reducing Unemployment</u>** Unemployment decreased from 11.8% in 2017 to reach 7.9% in the year 2019. Despite the COVID-19 pandemic, the single-digit unemployment was maintained during 2020, increasing in Q2 to 9.6% but returning to its downward trajectory to reach 7.2% in Q4. **b. <u>Empowering Egyptian Micro, Small and Medium Enterprises (MSME)</u>** In Egypt, MSMEs are large in numbers, diverse in type of business, and are spread nationwide. Egypt has been giving special attention to MSMEs, given its critical role in different sectors and as main source of employment in the country. According to the economic census of 2017/2018, the number of MSMEs is estimated at **3.6 million** establishments, with 9.7 million people working in this sector (**37%** of total employed persons) and production of ~USD 108 billion. With financing being the biggest challenge to MSMEs worldwide, the GoE has taken several serious measures supporting their funding by launching initiatives to provide them with opportunities and credit facilities: - On 21 February 2021, the CBE directed banks to increase financing directed to SMEs from 20% to **25%** of banks' credit facilities portfolio. This is expected to lead to an additional **USD 7.4 billion** injection into this vital sector by the end of December 2022. Funding will be made available to more than **120,000** companies and establishments, which would create and maintain about one million jobs. - The Ministry of Social Solidarity launched the "***Forsa***" (Opportunity) program which aims at empowering the beneficiaries of the **Takaful and Karama** cash transfer program and additional vulnerable groups through establishing their own MSMEs and include them in value-chains that ensure sustainable income for them. The Nile Pioneers Initiative was launched in 2019, sponsored by the **Central Bank of**

	Egypt and in partnership with Nile University. The initiative aims to enable youth to act as a catalyst to carry out and develop projects on a nationwide scale. Enablers Platform for Technical Support was launched in cooperation with the **German Development Agency (GIZ) and the Egyptian Banking Institute**. The digital platform aims at providing non-financial and consulting services required by startups and small businesses in 6 areas: legal advice, accounting and taxation, human resources, marketing, qualification for export, government procurement. Through the **UNDP-MSMEDA** (Micro, Small, and Medium Enterprises Development Agency) partnership, MSMEDA's loans for financing MSMEs reached 526,858 micro and small-sized enterprises and created around 802,434 job opportunities. 48% of the beneficiaries of the project were women while benefits were also directed to youth as 45% of beneficiaries were in the age group 20 to 35 years old. The collaboration extended to building people's capacities to run their own projects as between 2017 and 2019, MSMEDA held 510 training workshops on entrepreneurships which benefited at least 11,947 participants.
COVID-19 impact	COVID-19 impacted the global economy triggering the deepest economic recession in nearly a century. In line with the global economy, the pandemic has reduced economic growth in Egypt, although not significantly. Egypt's GDP per capita growth for 2020 has dropped to **0.4%**, as opposed to 2.1% without COVID. In addition to, decisions on the fiscal front included waiving late fees on income tax, VAT, customs tax, real estate tax, and other state dues. A temporary COVID-19 tax of 1% was levied on salaries and 0.5% on state pensions, as the proceeds of which are earmarked for sectors and SMEs most affected by the pandemic.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 9: Industry, innovation, & infrastructure

Table 22 Descriptive narrative about Egyptian progress toward SDG 9

Progress towards the goal	With regards to infrastructure, Egypt has made notable progress over the past few years in upgrading its transport, utility, and communications/digital infrastructure. This progress is reflected in Egypt's ranking in global indices such as its ranking in the Global Competitiveness Index's "Transport Infrastructure" climbing from 55th in 2017 to **44th** in 2019, and "Utility Infrastructure" climbing from 70th to **64th** over the same years. As for the communications infrastructure, Egypt advanced 55 places in one year on Oxford Insights' 2020 Government Artificial Intelligence Readiness Index, ranking **56th**. As for industry, the value added of non-oil manufacturing as percentage of GDP witnessed a decline over the past few years reaching **11.7%** in 2020 from a high of 12.7% in 2018. On the other hand, high technology exports' share of manufactured exports witnessed a noticeable increase in 2019 reaching **3%** although still below aspirations. Small and medium enterprises are leading the way in high technology industries and services with numerous ICT startups. Their share in manufacturing exports also witnessed an increase from 6% in 2015 to **10%** in 2020. On the innovation front, Egypt's rank in the Global Innovation Index jumped ten ranks from 2017 and three ranks from 2018, reaching the 92nd place in 2019. In 2020, however, its ranking dropped 4 places to **96th** although still with notable achievements in several sub indicators such as "Trade and Competition" reaching **62nd** in 2020 from 124th in 2015, "Business Environment" reaching **84th** from 105th, and the "Investment" indicator increased from 138th to **85th** over the same years. Egypt's Innovation, Digitization & Entrepreneurship international portfolio stands at USD 1 billion through 34 projects.
Government efforts	**a. <u>A Focus on Resilient Infrastructure</u>** Infrastructure has long been recognized by the GoE as an important driver for economic growth in Egypt. Almost USD 106.25 million were spent on infrastructure over the past six years. Public investments dedicated to the transportation & logistics sector alone grew by 101% in 2020/2021 from just the previous, and similarly those dedicated to

construction grew by 95%. Egypt has significantly improved the quality of its trade and transport infrastructure with projects aiming to massively upgrade the highways connecting Cairo to different cities and reducing chronic congestion. It is currently undertaking a major program of transport infrastructure development works which will see a total of 7,000 km of roads being constructed at an estimated cost of roughly USD 9.8 billion.

Megaprojects are another way through which the GoE is accelerating the upgrade of the national infrastructure. Currently, 25 megaprojects are underway with a total budget of EGP 162 billion (~USD 10.34 billion) tackling mainly 7 sectors and taking place in all 27 governorates. The megaprojects include: the New Administrative Capital, the national project for social housing, expanding the establishment and development of industrial complexes, railway network, and development of the Suez Canal axis. It also includes establishing 9 new cities (4th generation cities) to accommodate for the growing population.

b. Industry

After a successful first phase, which was primarily focused on a macro-fiscal dimension, the GoE launched the Second Phase of the National Structural Reform Program in 2021. The second phase focuses on boosting Egyptian industrialization in three main sectors: **Manufacturing**, **Information and Communication Technology** (ICT), and **Agriculture**, which combined account for a contribution to GDP of 26% in 2019/2020. The target is to raise this contribution to 30% - 35% by 2023/2024. Efforts are focused on many aspects such as: increasing competitiveness of local products, improving their integration in global value chains, and improving the digital infrastructure.

The GoE also sought to support the industrialization infrastructure through Industrial Complexes and Cities, which would increase productivity, efficiency, and economies of scale. During the past 6 years, 17 industrial complexes were established in 15 governorates nationwide providing **43,000** new direct job opportunities for young people. Additionally, in the past 2 years, Egypt has established 3 of the most important industrial cities. The largest city for the furniture industry in **Damietta** was inaugurated in 2019, serving a key economic sector in Egypt to meet the needs of the local market and direct its production for export. Egypt also completed the first and second stage of **Rubiky Leather Project** which aims to bring all leather tanneries in one place to become an integrated city for leather manufacturing. Moreover, a textile city is under construction in **Sadat City** in partnership with China to become the biggest city for textile manufacturing.

c. Innovation

- The social enterprise "**Chito-Shrimp**" (originally by Al-Azhar University students, now sponsored by Orascom Development), benefited over 250,000 Egyptians and directly benefited 8,500 through repurposing of shrimp shells. The project established 100 spice production units to produce organic spices from shrimp, making organic fertilizers from shrimp waste, and recycling a whole 53 tons. The project also established 8 educational hubs to teach fishermen how to cultivate shrimp, created 20 shrimp farms. The team invented a mask with the shells' chitosan nanoparticles to protect around 5,000 doctors & nurses from COVID-19.
- The Central Bank of Egypt (CBE) is hosting COVD-19 innovation sprint in collaboration with FSD Africa, a specialist development agency, aiming to refine already-existing FinTech solutions that directly address pandemic-related problem in the banking and the financial sectors. The CBE has also launched the **FinTech academy** for startups training in collaboration with German Development Agency (GIZ).
- **Assiut Cement Company (CEMEX)** came out with a novel idea to help minimize the spread of COVID-19. The team developed an engineered disinfection solution that caters for widespread areas through modifying a stationary industrial fog canon and fixing it on mobile equipment. In coordination

	with Assiut Governorate, CEMEX disinfected the roads and alleys of Assiut. Activities were performed in presence of representatives from CEMEX's Operations, Safety & Security departments to ensure the process is safely carried out.
COVID-19 impact	The pandemic's impact on various Industry, Innovation, & Infrastructure indicators for Egypt is considerably minor. Growth in total manufacturing value added is slowed slightly due to COVID-19 reaching **16.18%** in 2020 instead of 16.26% in case of a No COVID scenario. Fixed broadband subscriptions remain unaffected by in the short-term increasing from 6 per 100 people in 2019 to **6.5** in 2020. However, this is not to say that industry in Egypt was not affected by COVID-19. The GoE took several major decisions to support the industries most affected by the pandemic-induced closures, drop in aggregate demand, and disruptions in supply chains. Energy costs were lowered for the entire manufacturing sector, real estate tax relief was provided for the industrial and tourism sectors, subsidy pay-out for exporters was stepped up, and discounts on fuel price were introduced for the aviation sector. Support was also extended to Special Economic Zones, exempting their exports from value-added tax.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 10: Reduced inequalities

Table 23 Descriptive narrative about Egyptian progress toward SDG 10

Progress towards the goal	Social justice and reducing all forms of inequality are embedded by design in all of Egypt's developmental efforts. In fact, a key pillar of Egypt's 2030 is Social Justice and Equality, emphasizing equal opportunity for all regardless of gender, religion, race, age, disability, income-level, or geographic location. Over the past few years, noticeable progress was reached in promoting poverty reduction, gender equality, and equal access to essential services. There is also progress over the past three years in reducing the urban/rural economic divide. Poverty rates in rural areas dropped faster than in urban areas from 38.4% in 2017/2018 to **34.78%** in 2019/2020, a 3.6 percentage points decrease compared to a **1.6** percentage point decrease in urban areas. This meant shrinking the difference between poverty in rural vs urban areas from 13.8 percentage points to **11.8** points. However, regional inequalities still persist, as household income during the period 2017/2018 to 2019/2020 grew by **16%** in urban areas compared to **13%** in rural areas. Household expenditure as well grew more in urban areas by **19%** than in rural areas **12%**. Policies undertaken by the GoE reflect Egypt's commitment to empower all its citizens and remove all forms of discrimination through reducing the various forms of inequalities.
Government efforts	**a. <u>Reducing Income Inequality</u>** - <u>Subsidies</u>: Efforts towards poverty reduction are not limited to social safety nets but also include food, electricity, and gas subsidies, all of which contribute to reducing income inequalities as it estimated that poverty rates (currently at 29.7%) would increase by over 10 percentage points to 40% without these subsidies. - <u>Minimum Wage</u>: Other than subsidies, Egypt raised the monthly minimum wage for public sector employees by 100% since 2014. The first increase was by 66.7% in April 2019, and the second was in March 2021 by a further 20%. This raise has increased the monthly minimum wage to an equivalent of USD 153 in 2021 from USD 77 in 2014. - <u>Progressive Taxation</u>: In addition to raising the minimum wage, in May 2020, a new progressive tax rate for income tax (Law no. 26 of 2020) was issued to improve progressive taxation for individual income tax. The rates depend on the taxpayer's level of annual income, with the new law raising the exemption threshold to reduce the tax burden on the lower income brackets. **b. <u>Removing All Forms of Discrimination within Government</u>** In 2021, the GoE worked on the establishment of "**Equal Opportunities Units**" in 34

	ministries and government entities. The Equal Opportunities Units are entrusted with: (1) preparing databases of each entity's employees, (2) enumerating & studying problems that any employee is exposed to as a result of qualitative discrimination, (3) proposing solutions to these problems. **c. <u>Localizing Development to Reduce Geographical Inequalities</u>** In 2021, an EGP 500 billion (**~USD 32 billion**) fund was allocated for developing 4,500 villages across the country over the span of 3 years in synergy with *Haya Karima*'s (Decent Life) second phase targets. The initiative attempts to support local areas most in need, in addition to capitalizing on local competitiveness thereby reducing internal migration to large cities in search for opportunity & better life and further closing the urban/rural gap. **d. <u>Supporting Persons with Disabilities (PWD)</u>** - <u>Institutional Support</u>: The GoE established **The National Council for Persons with Disabilities**, tasked with the overall promotion, development, and protection of the rights of PWD. Law No. 200 of 2020 established the **Support Fund for Persons with Disabilities**. The Fund aims at providing protection and social development for PWD and to supporting them in economic, health, educational endeavors such as through scholarships as well as covering the costs of prosthetic devices and related surgeries. - <u>Social Protection</u>: Of the total number of enrolled direct beneficiaries of the "Karama" social safety net program, **68%** were people with disabilities as of May 2021, which incorporated providing unconditional cash transfers to **1.2 million** PWD, at an annual cost of EGP 5 billion (~USD 319 million). The Ministry of Social Solidarity has several other programs in which PWDs are direct beneficiaries supporting their education and employment. 5,196 PWDs have been employed in the private sector under various MoSS programs, with training and opportunities to be provided for 7,000 more in collaboration with the civil society.
COVID-19 impact	In 2019, Egypt's Gini Coefficient reached 0.29 which ranked Egypt in 2nd place MENA countries and 5th place among LMICs. COVID-19 has had negligible effect on the Gini coefficient under the assumption that a pandemic-induced reduction in economic activity overall actually results in lowering inequality just slightly. Still the GoE responded rapidly with policies that would stop various forms of inequalities from worsening as follows: - **Supporting Egyptians with disabilities**, by launching an automatic testing of COVID-19 symptoms using chatbots in sign language through "Wasel" application for the deaf and people with difficulties in hearing alongside the "Tamkeen" website. - **Supporting Egyptian expatriates**, with a committee headed by Ministry of State for Immigration and Expatriates Affairs to coordinate with authorities pertaining to Egyptians stranded abroad, and work on facilitating their return with them receiving due care and precautionary measures.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 11: Sustainable cities & communities

Table 24 Descriptive narrative about Egyptian progress toward SDG 11

Progress towards the goal	In 2020, the Government of Egypt (GoE) launched the first National Housing Strategy in the region in collaboration with UN Habitat. The strategy effectively guides the housing sector to fulfill the aspirations of access decent housing to everyone. It is set to unify the efforts of the different stakeholders working on the housing sector in Egypt. In the same year, the National Center for Spatial Data Infrastructure (NCSDI) was founded aiming at establishing an integrated national planning system and directing government investments and developmental work to the areas with the most urgent needs. The NCSDI is the outcome of integrating spatial information infrastructure into the Egyptian planning system which enables the government to prevent land encroachments and new informal settlements. Construction violation is an issue from which Egypt has suffered for some years, varying from possession and building on arable lands to design and construction violations. In 2019, a new Construction Violations Reconciliation Law came to force aiming at legalizing certain violations through reconciliation.
Government efforts	**a. <u>Eradication of Slums</u>** Slums in Egypt are mainly located around urban cities and occupy around 38% of the total built area in urban communities in 2019. Slums are divided into two main types; unsafe settlements constitute around 1% and unplanned settlements constituting around 37%. Between 2015 and 2020, the GoE spent USD 2.3 billion in the development of unsafe settlements, with USD 20.3 billion more expected to be spent in projects to develop unplanned settlements. This is in accordance with a three-phase plan that target eradicating all unsafe and unplanned settlements either by developing the targeted areas and enabling the inhabitants by providing clean water, sanitation, and electricity or by moving the inhabitants to another planned housing project. The project also aims at preventing the possibility of the emergence of any unplanned settlements which Egypt has already achieved as in the last three years, no new unplanned or unsafe settlements have been established. In 2019, the proportion of the urban population living in slums decreased from 10.6% in 2015 to reach only 5.2%. **b. <u>Building 4th Generation Cities</u>** The current total inhabited land of Egypt represents only 7% of the total land area. Since 2018, Egypt has begun constructing 22 fourth-generation cities. The focus on fourth-generation cities comes as part of a vision to satisfy the growing population's need for sustainable cities, and offer housing, investment and job opportunities. The total land utilized for the new cities is 7.5% of the total land area which will raise the total inhabited area to 14.5% once the cities are established. **c. <u>Preserving Cultural Heritage</u>** In addition to building cities for the future, the GoE has been working on preserving its national heritage. Egypt directed 3.2% of its total public expenditure in FY 2019/2020 to cultural and religious spending, a tally of more than 20 museums have been established or restored and more than a 100 archeological sites have been restored or developed in the past few years. **d. <u>Upgrading the Roads Infrastructure</u>** Being aware that infrastructure is a key enabler for development, Egypt increased its investments on roads and bridges by more than 90% over the past three years to reach USD 1.79 billion in 2020 from USD 0.89 billion in 2018. The National Roads Project was initiated in 2015, it targets creating 7000 km of new roads in 6 years with a budget of USD 11 billion. Supplementary work is also been done on enhancing the current road network by providing the required maintenance for 5000 km of existing roads. This work was reflected as Egypt's scores in the various transportation infrastructure-related indices such as "Road Connectivity" and "Quality of Road Infrastructure" under the Global Competitiveness Index, which witnessed a strong improvement in 2019. **e. <u>Modern Railway Transportation</u>** The GoE has also been working on improving the current railway network by adding more trains and renewing the old coaches. Two rail megaprojects are currently

	underway that will significantly decrease commute time and helps curb Egypt's carbon footprint: - The High-Speed Train, a USD 23 billion project that establishes a new network with high-speed trains for passengers and cargo. - The Cairo Monorail, a USD 3.5 billion project that aims at constructing two fully automated and driverless Monorail lines, linking the suburbs of Greater Cairo & Giza as well as the Administrative Capital to the heart of Cairo.
COVID-19 impact	Since the beginning of the pandemic, Egypt has been keen on following best practices in combatting the spread of COVID-19. Starting with public sanitization measures in government entities, schools, universities, main roads, and subway stations on daily basis before opening hours to ensure a minimum level of virus spread. The GoE also enforced fines on not wearing a face mask in public transportation and government entities which helped a lot in mitigating the virus spread.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 12: Responsible consumption & production

Table 25 Descriptive narrative about Egyptian progress toward SDG 12

Progress towards the goal	The need for responsible consumption and productions is particularly critical for Egypt as the country faces scarcity in water and challenged in food supply to meet local demand. This scarcity is triggered by increased demand due to population increase and changing consumption patterns; therefore, it has been a top priority to address responsible consumption and production for water, energy, and food security. The cross-cutting nature of responsible consumption and production also makes it a transformative catalyst for attaining a circular economy and the formation of integrated sustainable communities. In 2016, Egypt devised its National Sustainable Consumption and Production Action Plan prepared in collaboration with the United Nations Environment Program (UNEP) and the Centre for Environment and Development for the Arab Region and Europe (CEDARE). Since then, Egypt has taken solid steps in terms of policies and initiatives in order to promote responsible consumption and production.
Government efforts	**a. Energy Resource Management** In efforts to rationalize energy consumption, the Ministry of Electricity and Renewable Energy and the Ministry of Petroleum and Mineral Resources designed policies for the efficient consumption of electricity, as well as maximizing the use of new and renewable energy. Efforts in promoting energy-saving lamps through community awareness led to Egyptian consumers showing positive behavior in electricity conservation and choosing the available friendly alternatives such as LED lamps. On an industrial level, economic sectors are becoming more energy efficient. Overall consumption of petroleum products dropped **9%** from 37.8 million tons in 2017 to 34.4 million tons in 2018. Taking into account other factors affecting the consumption of petroleum products, there is a noteworthy decrease in the industrial sector's consumption (**-10.7%**), and the electricity sector consumption (**-25%**) of petroleum products over the same years. Sectors are partly migrating to natural gas but more importantly becoming more energy efficient, with total petroleum products plus natural gas consumption dropping for several sectors such as Transportation (**-2.7%**) and even Housing/Commercial consumption (**-1.7%**). **b. Water & Food Resource Management** Egypt devised a four-pronged National Water Resources Plan (NWRP 2017-2037) led by the Ministry of Irrigation and Water Resources. Its projects cover the plan's four pillars: (1) rationalizing water use especially in agriculture, (2) improving water quality and expanding the treatment of wastewater, (3) developing water resources, and (4) creating an enabling environment. Under the NWRP, various projects are being implemented to increase the capacity of the water management system with an estimated cost of EGP 900 billion (~**USD 57.5 billion**) across the 20 years. These projects include wastewater treatment, seawater desalination, rehabilitation and lining of canals, and switching from surface to modern irrigation systems in agriculture. The GoE's work on improving the efficiency of water management is also clear in the programs of the National Structural Reforms Program. Prioritizing agriculture as one of

	its three main sectors, the program includes efficiency targets such as "maximizing the monetary value per cubic meter of water" as the agricultural sector uses over 85% of Egypt's water. This will be done through prioritizing the farming of high-yield, low-water-consuming crops especially strategic ones such as wheat and maize, while at the same time activating the regulatory frameworks of high-water-consuming crops. **c. Solid Waste and Recycling** Solid waste management is a sector in which there is significant potential for improvement. In 2017, it is estimated that about 1.2 kg of solid waste per person per day is generated in Egypt, with collection coverage rate estimated at 40%. Only about 2.5% of solid waste is recycled with dramatically high disparities between governorates as the three top performers have between 98% and 72% of their solid waste recycled while the fourth performer's rate drops to a mere 0.5%. Similar disparities can be found in agricultural waste with Alexandria recording 100% recycling rate in 2018 while governorates on the other end are close to zero. The National Solid Waste Management Program (NSWMP 2012-2022) was launched under the Ministry of Environment, aiming to restructure the waste sector on the national and local levels. The program is a model of partnerships with funding of about USD 88 million co-financed by national (30%) and international (70%) institutions including the European Union, the German Ministry for Economic Cooperation & Development, and the Swiss State Secretariat for Economic Affairs. The NSWMP focuses on four governorates (Kafr El Sheikh, Gharbia, Quena, and Assiut) implementing waste management projects and awareness campaigns capitalizing on partnerships with civil society organizations such as the Nahdet Misr Foundation for Development.
COVID-19 impact	Across the food chain (including in production, transport, and consumption), roughly **22%** of agricultural production is lost or wasted. This is slightly lower than that of MENA (around 23%) but slightly higher than LMICs at 21% in the same year of 2019. The COVID-19 pandemic and its resultant economic effects have had an impact on agricultural loss, both in raising the total amount lost and reducing production. COVID-19 necessitated measures to ensure the safe and continuous supply of food and energy; paramount for the sustainability of livelihoods and businesses. Notwithstanding the fact that the food sector was exempted from the movement restrictions and night-time curfew, food manufacturers' production capacity has reportedly dropped by 30-40%, together with contractions in sales and revenues.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 13: Climate action

Table 26 Descriptive narrative about Egyptian progress toward SDG 13

Progress towards the goal	Over the past few years, Egypt has showed progress in efforts to combat climate change and its impact. Estimates of per capita CO_2 emissions show a decrease from 2.59 per capita metric tons in 2017 to 2.46 per capita metric tons in 2019, a near **5%** drop. Many recent projects are dedicated to address air pollution management and adaptation to climate change. This is evident in the portfolio of official development assistance Egypt received for environmental projects in 2019/2020 which reached **USD 56.5 million**, compared to USD 23 million in the previous year, with an increase of **68%**. Several significant projects are thus underway towards the goal led by the Ministry of Environment and its partners.
Government efforts	**a. Climate-Related Strategies and National Policy Frameworks** In 2015, Egypt established the **National Council for Climate Change** (NCCC), which aims to establish clear legislation and form an institutional entity to deal with climate change and its effect. The Council has recently been restructured to be chaired by the Prime Minister. In the past two years, special focus was directed to developing a general framework for the national strategy for climate change to incorporate it into the sectoral labor training plans of other ministries. Currently, Egypt is updating its strategy for low-emission development and is working on developing its long-term strategy on climate change until 2050. Meanwhile, a parallel focus is being directed towards Disaster Risk Reduction through

a three-phase project to develop an interactive map for Egypt's vulnerability to the effects of climate change. This project assists in guiding development projects through identifying areas vulnerable to climate change, taking measures necessary to deal with this risk, and facilitating access to climate change adaptation funds offered.

On the Adaptation & Mitigation front, Egypt has reaffirmed its commitment by preparing its Fourth National Communication to the UNFCCC (NC4Egypt) from March 2019 to February 2023. The NC4Egypt shall incorporate the following sections: National Circumstance, Green House Gas Inventory, Mitigation Measures & Policies (PaMs), Vulnerability & Adaptation, Achievement of the Objectives of the Convention, Capacity Building, and Institutional and Technical Needs.

b. Mobilized Funding for Green & Climate-Related Projects

In addition to strengthening its policy and institutional frameworks, public funding is being directed towards climate-related projects. In the 2020/2021 investment plan, green projects amounted to 691 projects with an overall cost of EGP 447 billion (~USD 28.5 billion), about USD 2.3 billion of which is budgeted for 2020/2021 representing about 14% of total public investments of the year. The transportation sector constitutes about 50% of such projects followed by the Housing and Utilities sector with about 29%. The plan is to increase public green investments as a proportion of public investments to 30% in the fiscal year 2021/2022 prioritizing green projects and gradually opting out of unsustainable projects. Several other projects are being implemented in cooperation with development partners supporting with financing and technical expertise, such as:

- In 2018, the Ministry of Environment implemented a project in cooperation with the Ministry of Irrigation and Water Resources funded by the Green Climate Fund to "Enhance Climate Change Adaptation in the North Coast and Nile Delta Regions". This is a capacity-building project in cooperation with the UNDP, in the field of monitoring, reporting and verification of GHG emissions and adaptation & mitigation measures.
- In September 2020, the GoE and the World Bank signed a USD 200 million project to support Egypt's initiatives to reduce air and climate pollution from critical sectors and increase resilience to air pollution in Greater Cairo. The challenge of air pollution remains ones of the city's most significant environmental issues with an estimated annual economic cost of air pollution on health in the Greater Cairo of about 1.4% of Egypt's GDP as per a 2019 World Bank study.
- In December 2020, the Ministry of International Cooperation announced the start of the implementation phase of a Converting Climate Finance Systems with the French Development Agency (AFD). The project aims to provide long-term loans and technical support to small and medium enterprises, at the cost of USD 182 million. Specific focus will be on four sectors: sustainable tourism, waste management, water and sanitation, and transportation. This loan will be managed by national banks, with the AFD providing a grant of USD 1.8 million to support the Egyptian banking sector in keeping pace with international best practices regarding not financing projects that directly contribute to the severity of climate change.

The civil society and private sector in Egypt have launched initiatives spanning multiple directions such as:

- Awareness and Social Action: Several Egyptian startups and forums operating with environmental mandates have appeared in recent years affiliated with green tech promoters like icecairo and icealex, as well as the **Cairo Climate Talks**, a monthly Egyptian-German forum that hosts environmental discussions with policymakers around the world. Additionally, **YouthThinkGreen** is a non-profit dedicated to raising youth awareness about the environment and climate change, through educational offerings in and out of schools.
- The Private Sector's Role: **SEKEM Holding** is applying an approach to farming in reclaimed desert land that emphasizes zero use of synthetic fertilizers, known as "biodynamic agriculture." BD agriculture emits fewer greenhouse gases and

	have been found to be more resilient to climate change and more energy efficient to grow than their non-organic counterparts. **Qalaa Holdings** is also working on enabling Environment for private sector activities in order to achieve sustainable development. They launched a Business Ambition for 1.5°C" Campaign for Climate Action in December 2019 among the communities surrounding Qalaa Holdings and its subsidiaries across Egypt.
COVID-19 impact	Carbon emissions in Egypt are estimated to have increased from 55 million tons in 2019 to **60 million tons** in 2020, with no noticeable effect caused by the pandemic. Still the Egyptian government is committed to taking a firm approach to ensure the achievement of the sustainable development goals with climate action in its focus. Along with the Green Climate Fund (GCF), the European Bank for Reconstruction and Development (EBRD) and the European Union (EU) are responding to the impact of the coronavirus pandemic on the Egyptian economy by boosting green finance and the development of value chains for the private sector. This partnership with local banks resulted in launching two programmes cumulatively worth €220 million: - Green Value Chain programme, with a volume of up to €70 million, will allow small and medium-sized enterprises (SMEs) to invest in advanced technologies and climate mitigation and adaptation solutions that improve competitiveness and enhance the development of green value chains. - The second programme, an extension of the Green Economy Financing Facility (GEFF), aims to provide up to €150 million of green finance to SMEs across the agricultural, construction, commercial and manufacturing sectors.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 14: Life below water

Table 27 Descriptive narrative about Egyptian progress toward SDG 14

Progress towards the goal	Egypt's marine environment is characterized by a uniquely rich and diverse marine life that extends over more than 3200 km across the Mediterranean and Red Sea. Such natural resources are defined as key tourist attraction sites, with 80% of all tourism activity in Egypt associated with marine life in the Red Sea area. According to The Ocean Health Index (OHI) assessment conducted by the US-based National Center for Ecological Analysis and Synthesis (NCEAS) and global non-profit Conservation International, Egypt is ranked 88 out of 221 EEZs (exclusive economic zone of each coastal country) with a constant improvement in the overall score since 2016.
Government efforts	Egypt is determined to preserve life below water and protect marine and coastal ecosystems from pollution through: **a. <u>Go Green Initiative</u>** In 2020, the Ministry of Environment, announced the launch of an expanded underwater cleaning campaign for the Red Sea through the Red Sea Protected Areas, in cooperation with the Red Sea Governorate, the Chamber for Diving and Marine Activities, in addition to the Hurghada Environmental Protection and Conservation Association (HEPCA) which is a marine and land conservation NGO. The campaign is considered the first activity of the Urban Green initiative in the field of protecting biological diversity and preserving natural resources for future generations. Go Green targeted cleaning the seabed of waste to protect marine life and biological diversity. By integrating civil society and workers in the tourism sector, progress was achieved in programs to preserve and protect natural resources and their biological diversity and maintain their sustainability. Most importantly, it opened channels of communication with the community to support environmental work. **b. <u>Bar Aman Initiative</u>** The interest in fishermen's livelihood and the sustainability of their work is part of the recently launched Presidential initiative "**Bar Aman**" (Safe Shore). With the participation of the Minister of Environment and the Governor of Fayoum, the Ministry of Social Solidarity and the **Tahya Misr Fund** launched in 2021 the first phase of the "Bar Aman" initiative in cooperation with the Public Authority for Fish Resources Development. Through its programs, the initiative will provide 42 thousand fishermen nationwide with proper environmentally-friendly tools to support their work, in addition to bringing them under social security and health insurance as well as extending low-interest micro loans to support their livelihood during times of low

	fishing. The initiative has an allocated budget of about EGP 50 million (**USD 3.19 million**). Attending to Egyptian fishermen is critical in supporting marine and coastal ecosystems as well as Egypt's nine inland lakes and the Nile river. Egypt›s annual total fish production reaches to about **2 million tons** in 2021, and the target is to increase fish production to **3 million tons** by 2030. The total fish production from natural fisheries is 397 thousand tons, and the total fish production from fish farms reaches about 1.6 million tons, while the number of fishing licenses and fishing cards nationwide is 80.6 thousand licenses. **c. <u>Banning Plastic in the Red Sea</u>** In addition to nationwide initiatives, governorates where life below water is an integral part of their daily life take many local initiatives towards preserving their ecosystems. For example, the touristic nature of the Red Sea cities contributes significantly to plastic pollution, which threatens the region's marine life. Plastic waste also damages coral reefs, as the bacteria that causes white band disease. Therefore, Egypt's Red Sea governorate banned in 2019 the use of single-use plastic bags and other items in a move to clean up the environment.
COVID-19 impact	In Egypt, fish production which includes both fish catch and aquaculture accounted for 1.8 million metric tons in 2019. This is projected to grow to 1.94 million metric tons by 2021. The COVID-19 pandemic is not expected to have a noticeable effect on Egypt's annual fish production. Egypt accounts for 30% of fish production in the MENA region and 3.5% of total fish production in LMICs. Per capita, Egypt's fish production (0.018 metric tons per capita, post-loss) is just above those in LMICs (0.017 metric tons) and above that in the MENA region (0.013 metric tons).

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 15: Life on land

Table 28 Descriptive narrative about Egyptian progress toward SDG 15

Progress towards the goal	Since 2016, Egypt has maintained its efforts towards the protection of life on land. The country has recently worked on increasing its protected areas network adding 13 more protected areas (PAs) to the existing 30 PAs in Egypt. Such efforts are coupled with the progress made in combating: biodiversity losses, urban encroachment of agricultural lands, afforestation, all while expanding Egypt's agricultural lands to achieve self-sufficiency in various crops as well as purifying the lakes. According to the Red list index of species survival, an indicator of the changing state of global biodiversity used to monitor the risk of species extinction, Egypt maintained a constant score of around 0.9 in the past four years (worst 0-1 best).
Government efforts	**a. <u>Contribution to Global Forums</u>** Egypt has been committed to preserving life on land which has been demonstrated in Egypt's the presidency of the 14th Conference of the Parties to the Convention on Biological Diversity (COP14) in 2018. Egypt presented an initiative to link the three Rio environmental conventions "**Biodiversity, Climate Change and Desertification**" with USD 500 million mobilized to implement projects linking climate change and biodiversity from the Global Environment Facility. In order to fulfill the initiative, a biodiversity road map was announced during the conference. **b. <u>National Efforts to Preserve and Restore Terrestrial Ecosystems</u>** On the national level, Egypt directed efforts in environmental preservation and adopted a project that aims to transform Sharm El Sheikh into a green city, to be the first Egyptian, Arab, African and Middle Eastern city to bear this characteristic according to international standards. This comes in addition to tailoring new key projects such as El Alamein City, the New Administrative Capital, the Grand Museum, and others, to become an environmental model pertaining to life on land. Other efforts include: - In 2020, Egypt implemented an initiative to monitor and control major activities to protect the existing wildlife. The program includes a plan for periodic inspections of farms, zoos, etc., in cooperation with the Environment and Water Surfaces Police. In addition, Egypt launched "The Migratory Soaring Bird Conservation Project" in 2018. This project identifies and documents sites of global importance for birds around the world (called Important Bird Areas or IBAs). In 2020, Egypt's Migratory Soaring Bird Conservation Project won the

	World Energy Prize as an example for pioneering and sustainable projects that achieve concrete goals to protect migratory birds as a natural resource and integrate its goals with renewable energy. - Among those efforts in afforestation and increasing greenery is Egypt's participation in 2019 in reviving the "**green wall**" project with African nations. The project aims to green the entire width of Africa to confront desertification. Egypt is also set to host the African continent's first vertical forest, with about three buildings covered with pollution-absorbing trees and plants in Egypt's New Administrative Capital. The buildings will have planted terraces containing 350 trees and 14,000 shrubs of more than 100 different species. - In 2020, "**Eco Egypt**" was launched as the first campaign to promote ecotourism and raise environmental awareness on the importance of protected areas and their services and benefits, as part of the activities of the "**Go Green**" Initiative. The campaign includes the promotion of 13 PAs by presenting a true model for sustainable development that considers the environmental, economic, social and health dimensions of tourism. The year 2020 also witnessed the re-habilitation of visitor centers in the Ras Muhammad National Park (RMNP), Wadi El-Rayan PA (WRPA) and Qaroun PA (QPA), in addition to the integration of the local community in the PAs management and their operation, which contributed to raising the average income of the residents of the WRPA, QPA and Wadi El-Gemal National Park (WGNP), ranging between 126% - 460% in one year. - The Ministry of Environment issued a decision, with the support of the Prime Minister, to collect "permit fees" for activities within PAs, to ensure their financial sustainability for future generations. The Ministry also developed a new method for financial estimating the value of environmental damage resulting from violations of destroying terrestrial resources within PAs. - In addition to terrestrial life, there is also a focus on preserving and restoring Egypt's inland lakes. The year 2019 witnessed the launch of a plan to restore its lakes after they had suffered years of neglect, pollution and encroachments. This neglect affected the lakes' production of fish and changed their biological nature. The project, therefore, aims to develop and restore the lakes and improve penalty enforcement on factories that dump their waste in these lakes.
COVID-19 impact	During the exceptional circumstances that the world has been suffering from due to the pandemic's spread, Egypt succeeded in assessing the progress made in the global goals for biodiversity 2020 and prepare the post-2020 framework that guarantees the preservation of the world›s natural resources especially in Africa. The framework offers methods of financial support for projects related to biodiversity through developed countries and other environmental work partners and local communities.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 16: Peace, justice, & strong institutions

Table 29 Descriptive narrative about Egyptian progress toward SDG 16

Progress towards the goal	Having strong institutions is a key driver for inclusive development and Egypt aims at becoming more transparent and efficient. In 2019, Egypt achieved higher ranks in several governance indicators in comparison to 2015. Egypt progressed to reach **37.98%** rank in 2019 in the Rule of Law indicator from 31.25 in 2015. Also, in the Government Effectiveness indicator, Egypt reached **36.54%** rank in 2019 from 22.12 in 2015. A similar progress is in Political Stability & Absence of Violence/Terrorism as it reached **12.86** in 2019 from 8.57 in 2015. Moreover, Egypt jumped 20 ranks in the "Institutions" component of the Global Competitiveness Index as it reached rank **82nd** in 2019 from 102nd in 2018. With a long road still ahead, the Government of Egypt is working diligently on enhancing excellence in governance and combatting corruption at its roots.
Government efforts	**a. <u>Good Governance and Strong Institutions</u>** - <u>Citizen Participation</u>: GoE launched the "**Sharek 2030**" (Participate) app in 2019, that acts as a channel for informing the public about recent governmental initiatives, laws and policies, and receive citizens' views, proposals and suggestions for the improvement of public services. This qualitative development in government-citizen communication will undoubtedly encourage a more participatory attitude among the public.

	- Good Governance: In its efforts to consolidate the principles and values of excellence in government and sustain institutional competitiveness, Egypt awarded the first round of 'Government Excellence Award' in 2019. The practice used to be implemented several years ago and in 2018 H.E President Abdel-Fatah El-Sisi announced that the awards will be resumed in line with the objectives of Egypt Vision 2030. In parallel, the National Institute for Governance and Sustainable Development (NIGSD) was established in September 2020, tasked with developing and enhancing human resources in the Egyptian government particularly in the fields of good governance and sustainability. - Anti-Corruption: To reduce corruption and enhance efficiency, Egypt launched the second phase of the "**Egyptian National Anti-Corruption Strategy**" 2019-2022. The strategy was prepared after studying the challenges of the previous 2014-2018 strategy, and many international experiences and best practices, determining the most appropriate methods that apply to the Egyptian case. The UN has praised the Egyptian effort in this regard as it has incorporated the first national strategy as one of Egypt's successful practices in preventing and combating corruption. Another milestone is the cooperation protocol signed by the Egyptian Human Rights Council and the Administrative Control Authority in December 2020. The cooperation conceptualizes corruption control as part and parcel of advancing human rights, and how advancing human rights will ultimately have a positive effect on corruption control. **b. Promoting Peace, Security, and Protection from Violence** - Fighting Human Trafficking: The National Coordinating Committee for Combating and Preventing Illegal Migration and Human Trafficking launched the second part of the national campaign «**Together Against Human Trafficking**» in 2020. The campaigns urge citizens to report the crime through the hotlines of the National Council for Childhood and Motherhood, the National Council for Women, the National Council for Human Rights, or by informing authorities. Furthermore, in October 2020, Egypt, with full international support, succeeded in passing its draft resolution 10/7 titled «**Combating Transnational Organized Crime Against Cultural Property**», during the 10th Conference of the Parties to the UN Convention against Transnational Organized Crime in Vienna. - Eliminating Violence Against Women: Egypt provides services to protect women who were exposed to violence and is committed to protecting women from all forms of violence, whether psychological or physical. The Ministry of Social Solidarity supervises 8 centers to host women at risk and who are exposed to violence. The center provides them with health, psychological and legal care, and seeks to provide them with livelihood opportunities. The number of women who have access to services is 2,958 women and 183 children. This year, the Ministry attaches special importance to protecting girls from harmful practices such as early marriage, female genital mutilation and human trafficking. The Ministry is also working to expand the establishment of centers to host women in the governorates of Sohag, Qena, and Port Said.
COVID-19 impact	Egypt has been working to reduce corruption and achieve better global ranks every year. However, the COVID-19 pandemic is believed to have slowed down the gradual progress. In 2020, Egypt's score in Transparency International's Corruption Perception Index fell to **3.3** from a 3.5 in the previous year, reflecting the effect the pandemic had on institutions. The pandemic is believed to also have slowed the improvement of the World Bank's Government Effectiveness, as in 2020 Egypt scored **1.87** during COVID-19, an improvement on the 1.84 in 2019 but slightly less than the 1.88 under the NO COVID scenario.

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

SDG 17: Partnerships for the goals

Table 30 Descriptive narrative about Egyptian progress toward SDG 17

Progress towards the goal	Strengthening the means of implementation of the sustainable development agenda is the main key to reaching Egypt's various goals and targets. Towards this end, Egypt has worked on strengthening regional and international relations. Since 2017, Egypt has been organizing the World Youth Forum on an annual basis, engaging with youth globally in an enriching setting, allowing them to exchange views and recommend initiatives to decision-makers and influential figures. The forum has been classified by the United Nations Commission for Social Development as a platform for addressing youth-related issues at the regional and international levels highlighting the outcomes of the three previous rounds. Under the values of unified destiny and mutual development, in 2019, Egypt utilized its role as chair of the African Union to strengthen the means of cooperation between African nations in priority areas such as (1) economic and regional integration, (2) building bridges among Africa's peoples, and (3) institutional and financial reform of the AU. While in charge, Egypt announced that the African Continental Free Trade Area (AfCFTA) had come into force after being ratified by 22 countries. Egypt also launched an initiative to train African youth under the African Presidential Leadership Program. Egypt has similarly directed efforts towards building regional alliances with the Arab States. With a focus on preserving peace and security, Egypt supported the Libyan people through a decade long conflict and backed the Lebanese government in the wake of the devastating explosion in Beirut's harbor. Egypt also led the efforts towards institutionalizing security and intelligence cooperation by paving the way for the Arab Intelligence Forum and hosting its headquarters in Cairo.
Government efforts	**a. Mobilizing Domestic Resources** Total government revenues as a proportion of GDP decreased to reach 19.2% of the GDP in 2019/2020 due to COVID-19 pandemic as well as Egypt's low tax to GDP ratio in comparison to other developing countries. However, the percentage is still close to the previous years as the existence of more sustainable financial activities has increased. Egypt has also worked on reforming the taxation system and tax collection through: - Implementing reforms that lead to broadening the tax base, laying foundations for fiscal justice, and integrating the informal economy into the formal economy. Within 4 years' tax revenues increased by 111% in 2020. The proportion of domestic budget funded by domestic taxes reached 54.4% in 2019/2020. - Directing efforts towards implementing an integrated digital system to raise the efficiency of tax administration. **b. Capitalizing on International Resources** - Official Development Assistance (ODA): ODA to Egypt increased to USD 9.8 billion in 2020 from USD 8.6 billion in 2018 (a **14%** increase). In 2020, Egypt launched an interactive map showing the distribution of ODA per SDG with specific project details and geographical location. 34 projects are allocated for SDG 7 (Affordable and Clean Energy) which is the biggest percentage of total ODA worth **23.2%** (USD 5.9 billion). SDG 9 (Industry, Innovation, and Infrastructure) was in 2nd place with 36 projects and a percentage of the total ODA of **22.3%** (USD 5.7 billion). - Remittances: Total remittances inflows increased by 4.9% from ~USD 26.4 billion in the fiscal year 2017/2018 to ~USD 27.7 billion in 2019/2020. However, the volume of remittances as a proportion of GDP decreased from 10.8% in 2017/2018 to 8% in 2019/2020. - Foreign Direct Investments (FDI): In addition to mobilizing ODA, encouraging FDIs is also a priority for the Egyptian government. Net FDI increased by **7.2%** from USD 6.9 billion in 2015/2016 to USD 7.4 billion in 2019/2020. In the past few years, Egypt has implemented various structural reforms to improve the business and investment climate such as:

COVID-19 impact	○ Establishing the Micro, Small, and Medium Enterprise Development Agency in 2018 to promote MSMEs growth. ○ Strengthening and empowering the Egyptian Competition Authority. ○ Putting in place investment promotion instruments, such as the Investment Map which works as an innovative and interactive software to present investment opportunities by sector and location. The COVID-19 pandemic affected the economy and caused a decrease in government revenues in 2020 compared to previous years. As a percent of GDP, there was little effect on government revenues due to the pandemic. As for the country's share of global exports, Egypt accounted for roughly **0.18%** of global exports in 2019. The value of exports in 2020 decreased about **1%**, from 2019 which reflects the resilience of the Egyptian export sector in the face of the stagnation of global economic activity and international trade movement. The GoE's response to the pandemic was primarily based on partnerships and collaborations and can be divided into: - Prioritizing shifting the government services to be provided through digital portals. With emphasis on investing in the telecommunication infrastructure and capitalizing on its utilization. - Egypt joined hands with multiple development stakeholders to direct more funds towards projects serving the SDGs: 36 projects worth USD 1.4 billion have been directed to SDG3 (Good Health & Wellbeing), and USD 1.32 billion (5.17%) in 20 projects to SDG1 (No Poverty).

Source: MPED (2021): Egypt's 2021 Voluntary National Review for SDGs (MPED, 2021)

3. NBS case studies in Egypt

A series of case studies have been developed to examine examples of Nature based Solutions in Egypt. The majority of these examples were implemented before the NbS Standard was published in 2020 and therefore were not designed using the NbS criteria. The examples have been evaluated against the NbS criteria to illustrate how each case conforms, and to identify areas for strengthening. The following 8 case studies are described as follows:

3.1 Community Based Rangeland Restoration in Egypt[24]

Rangelands are the largest area of productive land in Egypt, covering an estimated 4 to 10 million hectares, and they are affected by land degradation and desertification. Restoring degraded rangelands requires action on a large scale, considering high variability in precipitation, diversity of ecology, communal and customary resource rights, and the cross sectoral nature of rangeland resources.

Community based approaches are recommended to ensure that restoration actions build on local knowledge, respect local resource rights, and are embedded in the long-term management strategies of herding communities. Community based rangelands restoration addresses land degradation by reviving local governance and promoting effective management of livestock herd to assist rehabilitation of rangelands. The approach is applied in the Matrouh Governorate of Egypt, building on lessons from implementation in Jordan and other countries.

NbS Criterion 1: Addressing societal challenges

Community based rangelands restoration (CBRR) address land degradation and biodiversity, which contribute to reduced food production, reduced adaptive capacity, and increased exposure to risk, including drought risk. CBRR therefore contributes to food and water security and increased resilience. Although CBRR is at an early stage of implementation in Egypt, evidence from a similar context in Jordan has shown that rangeland restoration can make a significant contribution to improving water supplies and to mitigating climate change.

Table 31 NbS indicators Criterion 1: Addressing societal challenges

NBS indicators	Clarification
Indicator 1.1: The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritized.	Community Based Rangeland Restoration contributes to food security, risk reduction and adaptive capacity. (**Indicator positive)**
Indicator 1.2: The societal challenge(s) addressed are clearly understood and documented.	Food security and climate risk are among the most clearly documented challenges in Egypt. (**Indicator positive)**
Indicator 1.3: Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed.	Work is in its preliminary stages and the impact on societal challenges is not yet evaluated. (**Indicator neutral)**

[24] https://www.iucn.org/regions/west-asia/projects/current-projects/healthy-ecosystems-rangeland-development-herd - https://www.iucn.org/theme/ecosystem-management/our-work/global-drylands-initiative/gdi-projects/healthy-ecosystems-rangeland-development

NbS Criterion 2: Design at scale

Community Based Rangeland Restoration is practiced in Egypt on a significant scale in two landscapes of the Matrouh Governorate: Abou-Mazhoud – El Zewaid with 208,426 ha and Gaioin with 124,516 ha. The sparse nature of rangeland landscapes demands particularly large scale intervention.

Table 32 NbS indicators Criterion 2: Design at scale

NBS indicators	Clarification
Indicator 2.1: The design of the NbS recognises and responds to interactions between the economy, society and ecosystems	CBRR restores sustainable grazing as the foundation of the pastoral economy and as the mainstay of pastoral (primarily Bedouin) herding communities. (**Indicator positive)**
Indicator 2.2: The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors.	CBRR is typically implemented as a combination of actions that address natural resource rights and governance, rangeland management planning, and value chain development, with focus on primary (i.e. livestock) and secondary values. Effective CBRR is embedded in mechanisms for increased public institution coordination over rangeland landscape investments. (**Indicator positive)**
Indicator 2.3: The design of the NbS incorporates risk identification and risk management beyond the intervention site.	CBRR takes place at a landscape scale, recognising the scale of pastoral management systems. However, interactions between distinct landscapes are anticipated and may require development of additional mechanisms for cross-landscape coordination. (**Indicator positive)**

NbS Criterion 3: Biodiversity net-gain

CBRR focuses on natural regeneration of degraded and desertified rangelands by re-enabling effective livestock herd management arrangements. The approach recognizes that rangelands are dependent on herbivore activity, for example to promote nutrient cycling and herd dispersal, and enables herders to use their environmental knowledge to promote grazing patterns that accelerate the restoration process. Indicators of success include reversal of land degradation, restoration of indigenous rangeland vegetation, and recovery of soil organic carbon, which indicates a rehabilitation of soil biodiversity.

Table 33 NbS indicators Criterion 3: Biodiversity net-gain

NBS indicators	Clarification
Indicator 3.1: The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss.	Evidence based assessment is a component of CBRR and combines evidence from both scientific and local knowledge. (**Indicator positive)**
Indicator 3.2: Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed.	CBRR interventions are built around land health assessment and monitoring of indicators of land degradation, including land productivity (e.g. vegetation cover) and soil organic carbon. (**Indicator positive)**
Indicator 3.3: Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS.	Monitoring typically goes beyond the basic land degradation indicators mandated by the UNCCD to include other indicators of biodiversity, such as floral assessment and identification of palatable species. Herders favour certain palatable and other high-value species and their management practices can discourage species of lower value, which needs to be tracked in ongoing monitoring. (**Indicator positive)**
Indicator 3.4: Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy.	Opportunities to enhance ecosystem integrity depend on implementing action at the landscape scale, which is the purpose of CBRR. **(Indicator positive)**

NbS Criterion 4: Economic feasibility

Progress in Egypt is at an early stage and does not yet support economic feasibility analysis. Analysis of the same approach in a similar context in Jordan has indicated that restoration through community-based rangeland management can generate a cost to benefit ratio of approximately 1:10 over a 25-year time span[25]. The analysis showed that the benefits to herders through increased livestock production on rangelands outweighs the cost of implementation. However, increased livestock production was only one among many benefits.

The highest value in the Jordan case study was the increase water supply due to reduced surface runoff and increased infiltration. This service is enjoyed by downstream users, including industries, and can help develop investment innovations and other incentives. Other values included carbon capture and storage, regeneration of native species with economic value (e.g. medicinal herbs), and reduction in drought risk. The reduction in drought risk may be of particularly high value but has proven challenging to measure.

Table 34 NbS indicators Criterion 4: Economic feasibility

NBS indicators	Clarification
Indicator 4.1: The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented.	CBRR projects typically monitor the direct and indirect benefits. A principle of CBRR is to recognise the non-livestock benefits of restoring rangelands and to link land managers to incentives for these values. **(Indicator positive)**
Indicator 4.2: A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies.	Early interventions in Egypt did not include detailed cost-benefit analysis due to the absence of applicable cases on which to build the analysis. Emerging CBRR projects include stronger cost-benefit analysis. **(Indicator neutral)**
Indicator 4.3: The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities.	Explicit comparison of approaches has not been widely carried out, although all the alternatives to CBRR involve localised, high-cost interventions, often using machinery to modify soil. (**Indicator positive)**
Indicator 4.4: NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance.	CBRR projects have demonstrated proof of concept and new projects for scale up are being designed that include innovative resourcing options, including the sue of blended finance to crowd in private investments. (**Indicator positive)**

Recommendation for this criterion:

- Ensure community-based rangeland restoration interventions include, and are develop based on, a thorough cost-benefit analysis.

NbS Criterion 5: Inclusive governance

Community-based rangeland restoration is implemented by reviving local and inclusive governance systems as the basis for improved coordination of livestock herding. This can include reviving the ancient institution of *al Hima*, which is a mechanism through which communities can assert management over an area of land and implement restoration actions. Other approaches besides *al Hima* may also be effective. The management approach focuses

[25] Myint, M.M., & Westerberg, V. (2014). An economic valuation of a large-scale rangeland restoration project in Jordan. Report for the ELD Initiative by International Union for Conservation of Nature, Nairobi, Kenya. Available from: www.eld-initiative.org

on reviving traditional herding strategies of rest and recovery for pasture zones, based on local knowledge supported with scientific knowledge and monitoring.

Important components in community-based rangeland restoration are improved coordination between public institutions, securing land management rights of livestock keeping communities, and enabling coordinated herd management through community resource management groups. This implies strengthening governance at multiple levels in a coordinated and transparent way. Egypt has developed a draft strategy for community based rangelands management, which can enhance inclusive governance if successfully adopted and implemented.

Table 35 NbS indicators Criterion 5: Inclusive governance

NBS indicators	Clarification
Indicator 5.1: A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated.	Grievance resolution mechanisms have not yet been developed in CBRR projects. (**Indicator negative)**
Indicator 5.2: Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC).	CBRR is primarily a participatory approach that relies on detailed and comprehensive stakeholder analysis and representation of all stakeholder groups. Formal recognition of FPIC principles have not been included to date. (**Indicator positive)**
Indicator 5.3: Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention.	Stakeholder analysis and engagement is an essential component of CBRR and has been implemented in all projects. (**Indicator positive)**
Indicator 5.4: Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders.	CBRR depends on institutionalising decision-making processes in landscape level institutions, including Governorate level planning. (**Indicator positive)**
Indicator 5.5: Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions.	Mechanisms for coordination of CBRR between Governorates have not yet been established in Egypt. (**Indicator negative)**

Recommendation for this criterion:

- Although CBRR is fundamentally about strengthening inclusive governance, these outcomes should not be assumed to be automatic. It is recommended to include a process of securing FPIC from participating communities to strengthen the credibility of the approach.

NbS Criterion 6: Balance trade offs

Community-based rangeland restoration is low cost and primarily depends on investment of time and knowledge from community members, combined with significant investment in building the social capital that underpins local governance. Some trade-off may be anticipated in access to pastures during key seasons when pastures need recovery time, but the advantage of implementation at scale is that livestock movements can be synchronized to accommodate these periods. In some cases, strategically placed water infrastructure is

considered a prerequisite for coordination of grazing. This can create new governance challenges and new natural resource pressures, which need to be managed through the re-invigorated governance framework of al Hima.

Table 36 NbS indicators Criterion 6: Balance trade offs

NBS indicators	Clarification
Indicator 6.1: The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions.	Trade-offs have not been evaluated and currently do not strongly inform CBRR activities. (**Indicator negative)**
Indicator 6.2: The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected.	CBRR focuses on strengthening resource rights and responsibilities of local communities, particularly management rights. (**Indicator positive)**
Indicator 6.3: The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS.	Specific safeguards for CBRR have not been developed, but standard safeguards are followed, such as the principles outlined in the Conceptual Scientific Framework for Land Degradation Neutrality under the UNCCD. Period review against these safeguards has not widely been used. (**Indicator negative)**

Recommendations for this criterion:

- Ensure an effective landscape-scale assessment for rangeland landscapes to identify potential trade-offs (for example between overlapping resource rights-holders).
- Monitor CBRR interventions against established principles of landscape restoration, including those in the Conceptual Scientific Framework for Land Degradation Neutrality, to avoid potential trade-offs.

NbS Criterion 7: Adaptive management

Rangeland restoration depends entirely on the adaptive management of livestock herds, based on the knowledge of herders and dictated by the highly variable climate of rangeland regions. Challenges may be faced in implementing grazing plans during particularly dry years and incentives may be needed to off-set any short-term costs associated with transitioning to improved rangeland management. The greatest challenge may lie in enforcing resource use agreements across a large and widely dispersed community. The role of local institutions, such as grazing committees and producer associations, is critical for this aspect of resource management.

Table 37 NbS indicators Criterion 7: Adaptive management

NBS indicators	Clarification
Indicator 7.1: A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention.	CBRR projects incorporate participatory monitoring and evaluation for adaptive management, including monitoring of progress in implementation as well as monitoring against impact indicators. (**Indicator positive)**
Indicator 7.2: A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle.	CBRR includes monitoring and evaluation plans during establishment, but continuation of monitoring depends on the capacity of community institutions and supporting public institutions. This is an area for future strengthening. (**Indicator positive)**
Indicator 7.3: A framework for iteractive learning that enables adaptive management is applied throughout the intervention lifecycle.	CBRR includes a cyclical – usually annual – process of evaluation and review, through which communities will adjust their priorities and their delivery arrangements (e.g. revise herding strategies, re-examined responsibilities etc.). (**Indicator positive)**

Recommendation for this criterion:

- Monitoring of CBRR initiatives, including participatory monitoring with local communities, can be strengthened to improve the long-term viability of interventions and to track outcomes in the long term.

NbS Criterion 8: Mainstreaming and sustainability

To be considered fully successful, the rangeland restoration experience should be expanded beyond these two landscapes (in Matrouh) and replicated in other governorates of Egypt. The work is currently carried out in two countries in the League of Arab States region and is part of a region-wide effort to promote rangeland restoration. This high-level support will help to build momentum on the ground and help to generate communities of practice and opportunities for learning and experience sharing that will further contribute to momentum. Mainstreaming in Egypt will depend on successful implementation and validation of experiences in Matrouh, followed by replication to other governorates, and supported by national policies and mechanisms to enable all rangelands to eventually be managed effectively through community institutions.

Table 38 NbS indicators Criterion 8: Mainstreaming and sustainability

NBS indicators	Clarification
Indicator 8.1: The NbS design, implementation and lessons learnt are shared to trigger transformative change.	CBRR practices are evaluated and lessons are shared as part of an emerging rangeland restoration initiative. (**Indicator positive)**
Indicator 8.2: The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming.	CBRR is implemented in partnership with government in order to influence public policy. Specific actions are dedicated to evaluating policy opportunities and developing public support for scaling up. (**Indicator positive)**
Indicator 8.3: Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).	CBRR are implemented under the framework of the Sustainable Development Goals, and particularly aligned with SDG15.3 (Land Degradation Neutrality). They are evaluated against indicators of land degradation, biodiversity loss, food and water security and other indicators of sustainable development. (**Indicator positive)**

Conclusion about this case study:

Community Based Rangeland Restoration is a proven Nature-based Solution in Egypt that has significant potential for scaling up. Further efforts are needed to consolidate existing experiences, and to scale up, which will require investment in capacity of extension agents. Capacity development should focus on delivering effective participation and ensure free, prior and informed consent of participating communities. Monitoring and evaluation can be strengthened to also consider potential tradeoffs with other land uses and cost-benefit analysis.

3.2 Sustainable land management to restore desertified land[26]

Land degradation is a significant threat in large areas of Egypt's arid land. Land degradation includes soil erosion by wind and water, often as the result of reduced vegetation cover and unsustainable land management practices. Land degradation is reflected in the loss of land productivity, including reduced fertility and moisture, which lead to lower yields and increased exposure to risks.

Sustainable land management (SLM) practices are technologies and approaches that integrate the management of land, water, and other environmental resources to meet human needs while ensuring long-term sustainability, ecosystem services, biodiversity, and livelihoods. SLM is central to achieving Land Degradation Neutrality (LDN), as defined under the UN Convention to Combat Desertification. Land reclamation efforts in Egypt include a wide range of SLM measures to stabilise soil and prevent erosion, enrich soil fertility and improve crop yields, capture run-off, and increase infiltration of water. This includes building stone bunds and semi-circles, creating dams and cisterns to store water, and promoting sustainable natural resources management, such as improved agronomic practices.

NbS Criterion 1: Addressing societal challenges

Sustainable land management in Egypt has been demonstrated to increase crop and livestock yields as well as provide secondary benefits to land users. Increased soil moisture and productivity leads to greater resilience to the ever-present risk of drought. Restored vegetation provides secondary products with domestic and commercial value, including medicinal plants and fuel. SLM has been used to boost food and water security, boost local incomes, and improve the livelihoods and socio-economic conditions of rural Bedouin people.

Table 39 NbS indicators Criterion 1: Addressing societal challenges

NBS indicators	Clarification
Indicator 1.1: The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritized.	Food and water insecurity and drought risk are among the most pressing societal challenges in rural Egypt. **(Indicator positive)**
Indicator 1.2: The societal challenge(s) addressed are clearly understood and documented.	The societal challenges being addressed are clearly prioritised in Egypt's national plans, including UNCCD NAP. (**Indicator positive)**
Indicator 1.3: Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed.	Although approaches are scattered, there are examples of systematic evaluation of the impact on societal challenges. **(Indicator positive)**

[26] Report from CIHEAM on Water and Agroforestry to Rural Resilience in Mediterranean Agriculture. See also http://www.secheresse.info/spip.php?article63688

NbS Criterion 2: Design at scale

SLM has been practiced in many locations in Egypt and consists of a number of technologies and interventions that can be applied at scale. Interventions are championed by the Desert Research Centre and other agencies that have country-wide mandates.

Table 40 NbS indicators Criterion 2: Design at scale

NBS indicators	Clarification
Indicator 2.1: The design of the NbS recognises and responds to interactions between the economy, society and ecosystems	SLM practices are guided by knowledge on the links between land degradation, biodiversity loss (e.g. ecosystem destabilisation), and poverty and vulnerability. **(Indicator positive)**
Indicator 2.2: The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors.	Cross-sectoral approaches are followed, particularly to connect the sectors responsible for agriculture and water. SLM is typically a package of actions combining land and water interventions with livelihood activities and market development. (**Indicator positive)**
Indicator 2.3: The design of the NbS incorporates risk identification and risk management beyond the intervention site.	SLM is implemented under Egypt's Land Degradation Neutrality targets, which are based on country-wide assessment of land degradation and associated risk factors. (**Indicator positive)**

NbS Criterion 3: Biodiversity net-gain

SLM restores soil fertility and increases land productivity. This leads to regeneration of vegetation on pasture lands and recovery of land health on crop lands.

Table 41 NbS indicators Criterion 3: Biodiversity net-gain

NBS indicators	Clarification
Indicator 3.1: The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss.	SLM is guided by land degradation assessments at site level and national planning. (**Indicator positive)**
Indicator 3.2: Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed.	Some land degradation indicators are relevant to monitoring biodiversity at a macro scale – such as land productivity, land cover change and soil organic carbon. (**Indicator weakly positive)**
Indicator 3.3: Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS.	It is unclear if monitoring includes this level of assessment, but off-site impacts, including potential aridification due to localisation of water resources is not typically considered. (**Indicator negative)**
Indicator 3.4: Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy.	It is unclear if this level of monitoring is included in typical SLM projects in Egypt. As an approach that is aligned to LDN principles, SLM practices should be informed about landscape-scale impacts and impacts across landscapes. (**Indicator neutral)**

Recommendations for this criterion:

- Develop more detailed indicators to qualify the recovery of specific taxonomic groups.
- Strengthen national capacities for managing analysis of ecosystem integrity and connectivity.

NbS Criterion 4: Economic feasibility

SLM activities tackle a number of economic goals, including agricultural production and resilience and strengthening rural economies and livelihoods. SLM activities are frequently accompanied by investments in value chains and in producer associations.

Table 42 NbS indicators Criterion 4: Economic feasibility

NBS indicators	Clarification
Indicator 4.1: The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented.	Thorough valuation of costs and benefits have not been identified in SLM projects in Egypt. In other countries, economic valuations have generally been positive for the most suitable SLM practices. (**Indicator Neutral)**
Indicator 4.2: A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies.	Cost-effectiveness studies not observed in Egypt, but in the absence of viable alternatives to land reclamation, SLM practices are anticipated to be cost effective. **(Indicator Neutral)**
Indicator 4.3: The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities.	Alternative solutions for land reclamation have not been identified. More detailed analysis is required to select between SLM options that will have different cost-benefit ratios in different locations. (**Indicator Neutral)**
Indicator 4.4: NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance.	Some investments in value chain development and market access in some SLM projects. Most SLM work is currently financed using public funds and grants and further innovation is needed to identify suitable blended finance options for scaling up. (**Indicator negative)**

Recommendations for this criterion:

- Improve valuation of costs and benefits of SLM practices.
- Include cost-effectiveness studies to evaluate the SLM actions.
- Evaluate SLM approaches against viable alternative solutions where possible.
- Develop innovative resourcing solutions for SLM, including blended finance and other investment incentives.

NbS Criterion 5: Inclusive governance

SLM approaches often include gender-responsive actions and aim to enhance the role of women, improving technology transfer, research and innovation results and dissemination. SLM is guided by LDN principles, which include upholding and strengthening land and other resource rights of rural communities and strengthening local governance. SLM projects in Egypt have also included support for local agricultural producer associations.

Table 43 NbS indicators Criterion 5: Inclusive governance

NBS indicators	Clarification
Indicator 5.1: A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated.	Grievance resolution mechanisms have not been observed, although a number of SLM projects are implemented by major international partners that include social safeguards. **Indicator negative**
Indicator 5.2: Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC).	Most SLM projects have used participatory approaches and work closely with local communities, aiming to include balanced representation according to gender, age or social status. Explicit adherence to FPIC principles has not been observed. (**Indicator negative)**

NBS indicators	Clarification
Indicator 5.3: Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention.	Stakeholder identification is typically robust and local communities are involved in SLM planning. Some gaps may be identified in relation to resource rights of mobile livestock herding populations, but to a large extent these groups are represented in SLM consultations. (**Indicator positive)**
Indicator 5.4: Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders.	SLM planning documents address locally-identified needs and are implemented through community groups and other local partners, which pays attention to the rights and interests of stakeholders. The full extent of stakeholder identification has not been verified. (**Indicator positive)**
Indicator 5.5: Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions.	The type of SLM intervention used in Egypt tend to be localise, site-level actions that do not cross jurisdictional boundaries. Interventions may be needed in trans-boundary landscapes (e.g. between governorates) or may have implications for transboundary resource users (e.g. mobile pastoralists), which would raise the need for such mechanisms in future. (**Indicator neutral)**

Recommendations for this criterion:

- Develop grievance resolution mechanisms for SLM initiatives.
- Ensure adherence to FPIC principles.
- Clarify and respect resource rights of different stakeholder groups, including mobile livestock herding populations.
- Verify stakeholder identification in SLM projects to respect over-lapping resource rights and the rights of marginalized groups within society.
- Identify where specific mechanisms and responses are needed to enhance the management of transboundary landscapes.

NbS Criterion 6: Balance trade offs

SLM practices are typically implemented in heavily degraded lands where there are assumed to be few if any trade-offs. However, trade-offs may occur at the landscape level, for example if rain water run-off is localised in project sites, or if tenure over communal grazing lands and other communal resources changes (e.g. when new water sources change access rights to adjacent land).

Table 44 NbS indicators Criterion 6: Balance trade offs

NBS indicators	Clarification
Indicator 6.1: The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions.	There is no acknowledgement of potential trade-offs and safeguards have not been developed to manage this. (**Indicator negative)**
Indicator 6.2: The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected.	Land and other resource rights and responsibilities of local stakeholders in target sites are usually respected. Off-site access and management rights over communal resources may be at risk in some cases. (**Indicator weakly positive)**
Indicator 6.3: The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS.	It is unclear to what extent safeguards are reviewed in SLM target areas, but low awareness of trade-offs is a risk. (**Indicator negative)**

Recommendations for this criterion:

- Identify potential trade-offs related to SLM practices, such as downstream impacts, and ensure appropriate safeguards are adopted.
- Clarify overlapping and communal resource rights and ensure the rights of different users, including women and youth, are respected.
- Develop safeguards to ensure equitable and safe outcomes from SLM interventions.

NbS Criterion 7: Adaptive management

Adaptive management in SLM sites depends on the transfer of responsibilities to local community groups, which depends on the skills of the implementing agency. Most SLM interventions involved hard infrastructure that cannot easily be adapted. Adaptive management options, therefore, relate to the governance of resources, the evolution of land use options, and exploitation of economic opportunities in the SLM sites.

Table 45 NbS indicators Criterion 7: Adaptive management

NBS indicators	Clarification
Indicator 7.1: A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention.	Where a strong participatory approach is followed, and where community associations are strengthened, natural resource management strategies will be implemented. It is unclear if an effective participatory approach was used in all case. (**Indicator weakly positive)**
Indicator 7.2: A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle.	Monitoring and evaluation usually takes place through the intervention cycle, but M&E beyond project intervention depends on clarifying institutional roles and responsibilities and this can be uncertain in some locations. (**Indicator weakly positive)**
Indicator 7.3: A framework for iteractive learning that enables adaptive management is applied throughout the intervention lifecycle.	Learning usually takes place through the intervention cycle but roles and responsibilities post-intervention may need further attention. (**Indicator weakly positive)**

Recommendations for this criterion:

- Ensure SLM projects respect participatory approaches and ensure that participation is fully reported so as to strengthen the legitimacy of projects.
- Ensure systematic, periodic monitoring and evaluation of SLM initiatives after project completion.
- Ensure learning around SLM initiatives continues after project completion.

NbS Criterion 8: Mainstreaming and sustainability

SLM is mainstreamed in policy through Egypt's National Action Programme to combat desertification and its Land Degradation Neutrality targets and action plans. SLM practices have been institutionally supported by an Executive Authority for Land Improvement Projects, a General Authority for Rehabilitation Projects and Agricultural Development, the Agricultural Research Center, and the Desert Research Centre. Sustainability primarily depends on determining responsibility for long-term monitoring and maintenance of SLM infrastructure (e.g. stone bunds and semi-circles) and continued practice of sustainable agricultural activities.

Table 46 NbS indicators Criterion 8: Mainstreaming and sustainability

NBS indicators	Clarification
Indicator 8.1: The NbS design, implementation and lessons learnt are shared to trigger transformative change.	Transformative change for SLM is largely driven by the UNCCD process at global and national level. Mechanisms for systematic learning and development exist and can play a stronger role in future scaling up of good practices. **(Indicator positive)**
Indicator 8.2: The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming.	Policy, regulations and public institutions have been established to support further scale up of SLM practices. **(Indicator positive)**
Indicator 8.3: Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).	SLM practices are reported under Egypt's commitments to the UNCCD, which includes indicators of human well-being, climate change and biodiversity (https://www.unccd.int/convention/unccd-national-reporting-process). **(Indicator positive)**

Recommendation for this criterion:

- Develop effective mechanisms for systematic learning on SLM initiatives to validate good practices that merit scaling up.

Conclusions about this case study:

- Sustainable land management refers to a recognised set of effective practices for restoring desertified and degraded land. Overall adherence to the 8th criteria of Nature based Solutions is generally good, but there are gaps in monitoring, learning, validating and communicating effective SLM practices.
- Gaps are noted in cost-benefit analysis, managing possible trade-offs, and transparency with regards to upholding the rights of different stakeholders. Although SLM practices are expected to be cost-effective, safe and equitable, it should not be automatically assumed: More effective monitoring and evaluation will help to demonstrate adherence to these principles and to identify gaps that can be addressed.

3.3 Mangrove Restoration as a Nature based Solution in Egypt's Coastal Zones[27]

Mangroves are a globally important natural wetland found in the intertidal zone of tropical and subtropical regions. Mangroves in Egypt occur along the coastlines of the Red Sea and Sinai Peninsula where they have historically contributed to the livelihoods of coastal communities, for example through provision construction material and fuel.

Egypt's mangroves face a number of significant stresses that have led to rapid decline over the past 3 decades. Major threats include oil pollution, sewage and municipal waste, industrial and solid waste, construction activities, landfill and coastal reclamation, dredging, sedimentation, touristic activities, and watershed torrents. In addition to loss of associated provisioning services, degradation of mangroves has significantly affected their function as a nursery for aquatic animals, particularly in relation to shrimps.

[27] This case study is informed by the following two reports, unless otherwise stated in the text:

1. Ministry of Agriculture and Land Reclamation (MALR), Under Secretariat for Afforestation and Environment (UAE), Ministry of State of Environmental Affairs (MSEA) and Egyptian Environmental Affairs Agency (EEAA). Assessment and Management of Mangrove Forest in Egypt for Sustainable Utilization
2. and Development. April 2009.Shaltout, K., El-Bana, M.I. and Eid, E.M., 2018. Ecology of the Mangrove Forests along the Egyptian Red Sea Coast. International Book Marketing Service, Mauritius.
3. Cabahug, D.M., 2002. Community-based mangrove rehabilitation and ecotourism development and management in the Red Sea Coast, Egypt. Consultancy Report for Ministry of Agriculture & Land Reclamation and others. FAO, Cairo.

Egypt has implemented mangrove restoration with initiatives led by the Ministry of Agriculture and Land Reclamation, the Under Secretariat for Afforestation and Environment, the Ministry of Environment, and the Egyptian Environmental Affairs Agency.

NbS Criterion 1: Addressing societal challenges

Restoring mangroves can help mitigate the environmental damage associated with coastal development. It can contribute to reviving fish stocks, contributing to the livelihoods of fishing communities as well as supply of protein to the market. Mangroves provide an attractive landscape and contribute to raise revenues from tourism and increase jobs in the tourism sector, including employment at national parks. They also provide materials that are used by farmers and fishers (for cooking, construction, animal feed, and firewood. Mangroves contribute to protect against erosion and flooding as well as providing habitat for many wildlife species.

Table 47 NbS indicators Criterion 1: Addressing societal challenges

NBS indicators	Clarification
Indicator 1.1: The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritized.	Projects address a wide range of societal benefits, including employment, enhanced fishing, livestock raising, tourism, use of timber/wood fuel, erosion and flood protection, attractive landscape, and refuge for wildlife species. Mangroves preserve indigenous knowledge and culture and are resources for education, training and scientific research. (**Indicator positive)**
Indicator 1.2: The societal challenge(s) addressed are clearly understood and documented.	Baseline assessments are clear and unambiguous. **(Indicator positive)**
Indicator 1.3: Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed.	Project evaluations have not clearly demonstrated the human well-being outcomes. (**Indicator negative)**

Recommendation for this criterion:

- Mangrove restoration is expected to deliver a number of benefits to human-wellbeing, but evaluation of these outcomes has not been seen. The approach deserves a detailed evaluation and the findings need to be published to inform policy and investment decisions.

NbS Criterion 2: Design at scale

Although Egypt's mangroves have relatively limited spatial extent, more than 500 individual sites have been identified where mangrove restoration can take place. The Ministry of Agriculture and Land Reclamation began mangrove restoration in 2003, increasing the total area of mangrove in target areas from 525 ha in 2002 to 700 ha in 2006. In the process, additional sites for potential mangrove restoration were identified, offering further potential for future scale up.

Table 48 NbS indicators Criterion 2: Design at scale

NBS indicators	Clarification
Indicator 2.1: The design of the NbS recognises and responds to interactions between the economy, society and ecosystems	Mangrove restoration addresses the relationship between mangrove ecosystem health, economic and social outcomes. (**Indicator positive)**
Indicator 2.2: The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors.	Integration with other interventions has not been observed. (**Indicator negative)**
Indicator 2.3: The design of the NbS incorporates risk identification and risk management beyond the intervention site.	Risk identification beyond the intervention site has not been observed. (**Indicator negative)**

Recommendation for this criterion:

- Current mangrove restoration initiatives are relatively small-scale pilots that have proven technically successful (mangrove ecosystems have been restored) but have not examined the wider questions of off-site impacts (costs and benefits) and linkages with complementary interventions. This should be examined as part of a detailed evaluation of pilots.

NbS Criterion 3: Biodiversity net-gain

In addition to restoring native mangrove diversity (specifically *Avicennia marina* and *Rhizophora mucronate*), mangroves support a diverse flora and fauna, including 36 algal species, 40 insect species, and more than 80 crustaceans (particularly crab). Mangroves provide nursery habitats for juveniles of 21 fish species.

Mangrove restoration contributes to restoring a number of ecosystem functions, including biodiversity support, shore protection, sediment regulation and accretion, storm protection, nutrient retention, water quality maintenance, micro-climate stabilization, groundwater recharge and discharge, flood and flow control, shoreline stabilization / erosion control, and sediment retention.

Table 49 NbS indicators Criterion 3: Biodiversity net-gain

NBS indicators	Clarification
Indicator 3.1: The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss.	Detailed monitoring of biodiversity outcomes has been reported. (**Indicator positive)**
Indicator 3.2: Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed.	Biodiversity conservation outcomes have been strongly established. (**Indicator positive)**
Indicator 3.3: Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS.	Monitoring of the long-term impacts on biodiversity have not been seen. (**Indicator negative)**
Indicator 3.4: Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy.	Mangrove restoration is essentially focused on ecosystem restoration to improve ecosystem integrity. While connectivity implies a larger scale of action than has currently been achieved, overall ecosystem restoration has been achieved. (**Indicator positive)**

Recommendation for this criterion:

- Monitoring of biodiversity outcomes has demonstrated that mangrove restoration in specific sites was effective, but has not examined impacts outside the pilots. This should be included in a new evaluation of the established pilots.

NbS Criterion 4: Economic feasibility

Detailed cost benefit analysis has not been conducted, but the government restoration project was relatively low cost (less than US$500,000) for the area restored in a pilot project. The full value of mangrove restoration requires careful analysis to reflect the multiple use and non-use values. This should include the value of mangrove forests in terrestrial and oceanic carbon cycling.

Mangroves provide a wide range of ecosystem goods (fuel wood, medicine, food, and construction materials) and services (sediment trapping, coastal protection from storm surges and tsunamis, sewage phytoremediation and carbon sequestration, a breeding ground for commercial fishery species, and the elevation of the seabed through soil accretion to provide a natural defence against sea level rise). These services have local, national and global value. Ecosystem services supplied by mangroves have been estimated at US$14,000-16,000 ha−1 yr−1.

Table 50 NbS indicators Criterion 4: Economic feasibility

NBS indicators	Clarification
Indicator 4.1: The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented.	Economic benefits have been documented and the contribution to the livelihoods of different user groups has been assessed. (**Indicator positive)**
Indicator 4.2: A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies.	Cost-benefit analysis was conducted in 2002 to inform early pilots. The data is incomplete because some values were not included, but provided justification for action. (**Indicator positive)**
Indicator 4.3: The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities.	Alternative solutions have not been evaluated. (**Indicator negative)**
Indicator 4.4: NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance.	Some consideration of the role of private actors (e.g. tourism sector) in mangrove restoration. Furthermore, the benefit to the fishing trade has been examined. (**Indicator positive)**

Recommendation for this criterion:

- The pilots provide a good basis for conducting an updated analysis of costs and benefits. A revised economic analysis is recommended, with close attention to the full range of benefits generated through mangrove restoration.

NbS Criterion 5: Inclusive governance

Government reports do not pay attention to local resource governance by coastal communities. The extent to which local resource users are involved in restoration, and the mechanisms through which their resource rights are taken into consideration is therefore unclear. The government reports on the importance of improving artisanal fishing through mangrove restoration, indicating consideration for the non-use values. Further clarity over community rights to use mangrove resources is needed, including attention to the roles and resource needs of women in these communities.

Table 51 NbS indicators Criterion 5: Inclusive governance

NBS indicators	Clarification
Indicator 5.1: A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated.	No grievance mechanism has been observed. (**Indicator negative)**
Indicator 5.2: Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC).	Consultation with communities was conducted in some cases, but generally the pilots appear to have been implemented by government without community involvement. (**Indicator negative)**
Indicator 5.3: Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention.	Mangrove stakeholders have been identified, including Bedouin, fish traders and the tourism sector. Interventions are oriented to provide benefits to these groups, but their involvement in the interventions is not well-enough documented. (**Indicator weakly positive)**
Indicator 5.4: Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders.	Projects have been designed with the interests of local stakeholders in mind and respond to identified needs. Full participation is unclear and respect for local rights is ambiguous. Mangrove stakeholders have been identified, including Bedouin, fish traders and the tourism sector. Interventions are oriented to provide benefits to these groups, but their involvement in the interventions is not clearly documented. (**Indicator weakly positive)**
Indicator 5.5: Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions.	Project documents have identified gaps in law enforcement and the need to increase coordination between stakeholders. (**Indicator negative)**

Recommendation for this criterion:

- Pilots are likely to be attractive for scaling up, but future actions should place greater emphasis on inclusion of local communities in design and implementation, and pay more attention to their use rights and management rights. Public sector arrangements will also be needed to ensure coherence in development planning.

NbS Criterion 6: Balance trade offs

The current threats to mangroves including encroachment from the landward side of the ecosystem due to construction, particularly in the tourism sector, and over harvesting by local communities. Restoring and conserving mangroves inevitably means modifying these activities to some extent, implying a potential trade off. The value of restoring and sustainably using mangroves appears to be economically attractive, but the short-term costs to investors and local users is unclear. Such trade-offs need further consideration to ensure

that the cost is not disproportionately carried by local communities who may already face significant development challenges.

Table 52 NbS indicators Criterion 6: Balance trade offs

NBS indicators	Clarification
Indicator 6.1: The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions.	Trade-offs have not been formally documented and will require deeper consultation with stakeholders to find equitable solutions. (**Indicator negative)**
Indicator 6.2: The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected.	There is some documentation of the use rights of different stakeholders, but this does not appear to be strongly factored into project implementation. (**Indicator negative)**
Indicator 6.3: The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS.	Safeguards have not been documented. (**Indicator negative)**

Recommendation for this criterion:

- Scaling up mangrove restoration will require a thorough evaluation of costs and benefits, including potential trade-offs. Considering the increased risk to livelihoods and businesses associated with mangrove degradation, it is likely that economic analysis will show that the benefits outweigh the disadvantages. This needs to be more clearly documented and communicated to stakeholders.

NbS Criterion 7: Adaptive management

As mangrove restoration goes to scale, the complexities of restoration become more apparent and management approaches need to be adaptive. Adaptive management can include scenario planning based on projected socio-economic and physical changes (e.g. population growth, climate change, or land-use)[28]. For effective adaptive management to be in place, mangrove restoration in Egypt will need to give further consideration to governance, stakeholder analysis and community engagement, as already discussed above.

Table 53 NbS indicators Criterion 7: Adaptive management

NBS indicators	Clarification
Indicator 7.1: A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention.	Monitoring and evaluation has been conducted at an early stage of some pilots, but the full range of outcomes—particularly the social and economic outcomes-have been neglected. (**Indicator negative)**
Indicator 7.2: A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle.	Monitoring and evaluation plans have been implemented, with particularly robust monitoring of species recovery and soil properties. Project evaluation has reported adaptive management and flexibility as an important success factor. (**Indicator positive)**
Indicator 7.3: A framework for iteractive learning that enables adaptive management is applied throughout the intervention lifecycle.	Learning in the pilot sites has focused predominantly on biophysical changes, and has feed back into project implementation. Gaps related to social and economic indicators have been noted above. (**Indicator positive)**

[28] UNEP-Nairobi Convention/USAID/WIOMSA (2020). Guidelines on Mangrove Ecosystem Restoration for the Western Indian Ocean Region. UNEP, Nairobi, 71 pp. A digital copy of this report is available at: www.nairobiconvention.org/; www.wiomn.org; www.wiomsa.org

Recommendation for this criterion:

- Monitoring of biophysical outcomes was strong, while monitoring of social and economic outcomes was largely overlooked, which is crucial for NbS. Monitoring, evaluation and learning of social and economic outcomes is required to ensure management of mangroves continues to adapt to the needs of stakeholders. Opportunities for community-led monitoring by local user groups should be explored as a way to address a number of the gaps reported in this case study.

NbS Criterion 8: Mainstreaming and sustainability

The spatial scale of mangroves in Egypt is relatively small, but they are high value ecosystems that show high potential for scaling up. Mangrove restoration will need sustained commitment from the public sector combined with suitable legislation and other institutions to ensure sustainable use and protection in the long term. The value of mangroves to the tourism sector suggest one important investment pathway. Clarifying the roles and responsibilities of the different organizations and stakeholder groups, and improving collaboration over mangrove management, will also help to sustain efforts in the long term.

Table 54 NbS indicators Criterion 8: Mainstreaming and sustainability

NBS indicators	Clarification
Indicator 8.1: The NbS design, implementation and lessons learnt are shared to trigger transformative change.	Mangrove restoration appears to have demonstrated proof of concept, but suffers from lack of attention to capturing lessons, engaging communities, and going to scale. (**Indicator negative)**
Indicator 8.2: The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming.	A 2009 report recommends that a "proposed national action plan for the conservation of mangroves in Egypt in order to ensure the rehabilitation, conservation and sustainable utilization" is reviewed, adopted and implemented. The progress in this direction has not been observed. (**Indicator not evaluated)**
Indicator 8.3: Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).	The reported benefits of mangrove restoration can contribute to a number of sustainable development goals, but have not been adequately evaluated. (**Indicator weakly positive)**

Recommendation for this criterion:

- Mangrove restoration pilots were documented as long as 20 years ago and there is great value in evaluating the long-term outcomes, as well as social and economic benefits that were not documented at the time. These lessons are needed to make the case for scaling up mangrove restoration and strengthen the institutional arrangements to ensure mangrove ecosystems are protected and sustainably used.

Conclusions about this case study:

- Mangrove restoration meets many of the criteria for Nature based Solutions and has significant potential for scaling up along the country's coast line. A stronger economic feasibility analysis will strengthen the evidence supporting scale up, particularly if it reflects the many use and non-use values of mangrove forests. Evaluations of these pilots should gather evidence of local resource governance by coastal communities and ensure that future interventions respect and strengthen local rights, including management and use rights, with particular attention to the roles and

resource needs of women in these communities. New investments related to mangroves should be considered, including innovations in the non-consumptive values of mangroves, such as their tourism value, their value as nurseries for aquatic animals, and their contribution to risk reduction.

- Greater attention can be paid to developing community-led approaches and ensuring the under-lying governance is strong enough to maintain sustainable use. These are likely to be more sustainable, more equitable, and potentially more cost-effective approaches. For community-led approaches to succeed, sustained commitment from the public sector is needed at the national and local level to enforce rules and uphold rights.

3.4 Waste water irrigation for rehabilitation of arid areas in Egypt[29]

Egypt is primarily an arid country with 95 per cent of its territory consisting of deserts and marginal areas that cannot be cultivated. Most people live in the Nile valley and its delta and depend on the Nile River for water for both agriculture and domestic use. Water reuse in Egypt was estimated at a little over 10% in 1990 and the Ministry of Water Resources and Irrigation has projected more than tripling of this contribution by 2025.

Due to low quality, high processing costs, and environmental and health risks, sewage water is considered unsuitable for irrigating food crops. This wastewater can be used for irrigation of high-value industrial woody plantations in desert areas. Local authorities in Egypt have initiated afforestation projects irrigated with raw and primary processed wastewater in several locations in Upper Egypt governorates since the mid-1990s.

NbS Criterion 1: Addressing societal challenges

Using wastewater for irrigation to assist afforestation is motivated by a number of benefits: safe and low cost of treatment and disposal of wastewater; rehabilitation of fragile ecological zones; reduced discharge of wastewater into the sea; and use of nutrients in wastewater for productive purposes. Afforestation provides protection to farmlands and creates green belts to protect new cities from wind erosion. It also provides wood materials for industrial purposes and provides new income sources from secondary products like silk worm which produces silk and ropes from Sisal. Afforestation also contributes to climate change mitigation.

Additionally, trees can be selected for their capacity to accumulate nitrogen in foliage, and their contribution to removal of nitrogen from waste. This accumulation declines as plants mature, and removal of N and other nutrients from wastewater can be maximized by growing trees in short rotations. Bioremediation of wastewater with trees is a useful treatment process that also provides other benefits such as fibre for pulp and paper, high-quality lumber, poplar wood chips, biomass for renewable energy, shade and windbreaks.

Inclusive clarification against this criterion: **Criterion met**

[29] Hashim, M.N., Abd Razak, O., Rosdi, K. and Soliman, M.K. no date. Wastewater-Irrigated Industrial Woody Plantations for Rehabilitation of Arid Areas in Egypt. https://www.researchgate.net/profile/Hashim-Md-Noor/publication/269919946_Wastewater-irrigated_industrial_woody_plantations_for_rehabilitation_of_arid_areas_in_Egypt/links/583cda8408aeb3987e2f9c33/Wastewater-irrigated-industrial-woody-plantations-for-rehabilitation-of-arid-areas-in-Egypt.pdf

NbS Criterion 2: Design at scale
Use of wastewater for irrigated afforestation has been practiced in Egypt since the 1990s at least and has been deployed on a significant scale. Total forest plantation area in Egypt was 52 000 ha in 1990 and annual planting during the period 1991–2000 was 2000 ha per year increasing at the rate of 3.3% annually. The total area of forest plantations in the year 2000 was about 71 200 ha.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 3: Biodiversity net-gain
Biodiversity gain in afforestation projects has not been closely evaluated, possibly relying on the assumption that the benefits of afforestation are self-explanatory. However, the selection of tree species is critical and projects have variously used native and non-native trees. Native species include *Pinus pinea*, *Tamarix aphylla*, and *Cupressus sempervirens*. Non-native species include *Khaya senegalensis*, *Pinus halepensis*, *Pinus brutia*, *Cupressus arizonica*, *Cupressus macrocarpa*, and *Morus alba*.

Wastewater irrigation for afforestation cannot be assumed to generate a biodiversity net gain without more detailed analysis. Afforestation has taken place in desert and marginal areas that are not normally forested and studies have not examined the cost in terms of lost indigenous biodiversity. Where afforestation is carried out on degraded land there may be a biodiversity net gain. However, land that is naturally arid desert is not necessarily degraded and in its natural state is the home to unique biodiversity.

Inclusive clarification against this criterion: **Criterion not evaluated**

NbS Criterion 4: Economic feasibility
As a means of disposing of wastewater, this approach appears to have strong economic feasibility. Indeed, the first tree plantation using wastewater in El-Gabal El-Asfar farm was established in 1911 to dispose of the city wastewater. Processing wastewater is high cost and irrigation for afforestation provides a convenient way to use that water in a safe way. In Egypt, the cost of wastewater use also has to be compared with the cost of other water supply, including the high cost associated with accessing ground water.

Economic valuation studies have not been identified and closer examination is needed to provide a full accounting of costs and benefits. This should include benefits of ecosystem services, including provisioning of fuel and construction materials, and the role of trees in bioremediation.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 5: Inclusive governance
Afforestation projects have largely been government driven and have not paid attention to inclusive governance by communities and non-state actors. However, some communities in Egypt use sewage or drainage water after primary treatment to irrigate woodlots, presumably in an uncoordinated way. As a community-led initiative, recycling household waste water for irrigating land restoration could have untapped potential for inclusive scaling up.

Intensification and commercialisation of afforestation using wastewater has been proposed and this would require active involvement of the private sector. This has potential to supply

industrial woody raw materials for production of value-added downstream products in Egypt. If development proceeds in this direction, close attention should be paid to land rights and historical land claims to avoid the risk of appropriating private or community land. This is particularly a risk when arid land is labelled as 'wasteland', as is the case in Egypt for land that is not cultivated.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 6: Balance trade offs
Trade-off in the use of wastewater have not been identified and the emphasis is on disposing of wastewater that is otherwise costly to manage. There may be trade off over the use of land, although this seems negligible given the large extent of arid land that could be afforested. If afforestation takes place on healthy arid lands, there will be trade-offs in biodiversity that need to be understood and mitigated. This is best avoided by identifying arid land that is demonstrably degraded – something that has not clearly been shown in reports.

Inclusive clarification against this criterion: **Criterion not clearly evaluated**

NbS Criterion 7: Adaptive management
Use of wastewater to irrigated afforestation projects has been practiced for more than a century in Egypt and has introduced many adaptations over time, including adapting the species of tree, paying more attention to native species, and understanding a wider range of values from afforestation. Adaptive management will benefit from diversifying the approaches to a wider range of governance arrangements, including private and community projects.

Inclusive clarification against this criterion: **Criterion probably met**

NbS Criterion 8: Mainstreaming and sustainability
Due to the history of this practice, the number of sites in Egypt, and the overall extent of afforestation, this practice can be considered to be already mainstreamed and sustainable. There is potential for further scaling up of the practice, through private and community projects. It is unclear whether there is potential to withdraw wastewater from plantations that are established and divert the same source of wastewater to further expansion of sites, but this is an opportunity for future consideration, possibly depending on the site characteristics and the species selected.

The practice is supported by an inter-ministerial committee through the Egyptian Water Reuse Code and a Ministerial Decree issued in April 2005. This complements the government's projection of tripling the volume of wastewater used in Egypt by 2025. Furthermore, capacity for expanding the practice of afforestation using wastewater appears strong, with a considerable body of expertise in the country. Multiple ministries are engaged in afforestation using waste water, including the Ministry of State for Environmental Affairs/Egyptian Environmental Affairs Agency, Ministry of Agriculture and Land Reclamation, Desert Research Center, Ministry of housing, Utilities and Urban Communities, Ministry of Water Resources and irrigation, and Ministry of Health, indicating strong institutional support.

Conclusions about this case study:

- Waste water irrigation for rehabilitation of arid areas in Egypt may be considered a Nature based Solution, depending on how the waste water is used. Specifically, the impact on biodiversity – particularly indigenous biodiversity – needs to be included in evaluation and reporting. Irrigation for afforestation with non-native species, for example, would not meet Criterion 3 (biodiversity net gain), although that does not necessarily negate the value of such actions.
- Economic valuation of the practice is recommended, with greater attention to the multiple benefits that can be derived. Evaluation of the impact of waste water irrigation on resource rights needs further consideration, and reporting, to improve transparency. Similarly, trade-offs have not been examined and require closer attention.
- Nature based Solutions are solutions that can be taken to scale and it appears that the use of waste water to irrigate arid areas has potential for further scale up, subject to the previous conclusions. In particular, attention should be given to clearly identifying degraded lands where irrigation can help promote rehabilitation

3.5 Medicinal Plants Rehabilitation Program

The Saint Katherine Protectorate (SKP) is one of Egypt's largest protected areas and includes the country's highest mountains. This arid mountain ecosystem supports relatively high biodiversity and a high proportion of endemic plants. The Medicinal Plants Conservation Project (MPCP) implemented actions to protect and restore endangered wild medicinal species by addressing underlying threats to these species. The project focused on restoration and rehabilitation of the threatened species and the associated habitat and are considered as an effective tool for in-situ conservation

NbS Criterion 1: Addressing societal challenges

The objective of the rehabilitation program is to allow the restoration of vegetative cover and re-establish the environmental protection functions of the site. The project aims to conserve plant genetic resources and maximize their socio-economic value for the local Bedouin communities. However, project documentation does not provide information on how local communities are involved and whether they have rights to harvest medicinal plants. The focus is on protection and recovery of species and further actions will be needed to propagate these species outside protected areas where communities are free to use them. No other societal benefits are referred to in the project literature.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 2: Design at scale

Action has been implemented in the Saint Katherine Protectorate, initially in 2 selected sites (Wadi Walee and Wadi Kassba), and rolled out in a second phase in 5 additional sites. Project reports suggest all action is confined to the protected area, which would restrict options for scaling up. Further action is required to explore options for reviving medicinal plants at scale.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 3: Biodiversity net-gain

Six microhabitats have been targeted for rehabilitation in the in the SKP mountains that support the growth of the endemic plants. These include wadi beds, terraces, slopes, gorges,

and caves. Several of the species recovered are only found in a sub-set of the microhabitats protected in the target areas: these include *Primula boveana*, *Rosa Arabica, Ballota kaiseri*, *Polygala sinaica* and *Bufonia multiceps*.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 4: Economic feasibility
The cost of establishing the microhabitats in the Saint Katherine Protectorate have not been evaluated.

Inclusive clarification against this criterion: **Criterion not evaluated**

NbS Criterion 5: Inclusive governance
Documentation provides no evidence that communities were involved in re-establishing microhabitats for medicinal plants.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 6: Balance trade offs
There is insufficient information on the approach to evaluate trade-offs.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 7: Adaptive management
Adaptive management is unclear from project documentation. Given that the approach is science led, with detailed assessment and inventorying of species, it is likely that effective monitoring systems are being used to guide subsequent phases.

Inclusive clarification against this criterion: **Criterion probably met**

NbS Criterion 8: Mainstreaming and sustainability
The Medicinal Plants Rehabilitation Program appears to have only localized application in its current form. Opportunity for scale up is impeded by the absence of engagement with Bedouin communities and lack of application outside of designated protected areas.

Inclusive clarification against this criterion: **Criterion not met**

Conclusions about this case study:

- Rehabilitation of degraded ecosystems to provide economic benefits is a common Nature based Solution, and Egypt's Medicinal Plants Rehabilitation Program meets some NbS criteria. However, a fundamental requirement is to generate societal benefits, which is not adequately demonstrated from the case study. The focus on rehabilitating these ecosystems in sites that are not community-controlled raises questions over rights and benefits that need to be addressed.
- To be considered an NbS, the approach should be implemented on a larger scale in community managed landscapes, integrated into community management planning and benefiting community members. They should be accompanied with economic assessment to ensure they are cost effective, and to evaluate possible competition with other economic activities over resources or labour.

3.6 Biodynamic farming[30]

Biodynamic agriculture is a form of Organic farming that has been tested in Egypt by the organization SEKEM. The approach has been applied for reclamation of desertified land in Egypt. Biodynamic agriculture "treats soil fertility, plant growth, and livestock care as ecologically interrelated tasks". SEKEM won the UNCCD Land for Life Award in 2015 for their work in reclaiming desertified land through biodynamic agriculture.

NbS Criterion 1: Addressing societal challenges

Biodynamic agriculture has been promoted to strengthen rural livelihoods and food security, while addressing environmental and social concerns. Biodynamic agriculture increases the organic matter in the soil, improving soil fertility and soil moisture. It allows soil to store up to 40% more water and bind an average of 3 tons of CO2 equivalent per hectare and per year. It therefore contributes to food security, risk reduction, and climate change mitigation.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 2: Design at scale

Biodynamic agriculture has been implemented in Egypt on a modest scale to date, focused on a few model farms with an area of approximately 2500 hectares (6000 Feddan). Additionally, the organisation works with contracted farmers around Egypt to cultivate a further 840 hectares of land biologically.

Inclusive clarification against this criterion: **Criterion not met, but proof of concept has been achieved**

NbS Criterion 3: Biodiversity net-gain

Biodynamic farming leads to a high diversity of plants and animals on the farm, including trees and other vegetation, and a variety of animals such as birds, insects, hedgehogs, lizards and others. A fundamental principle of biodynamic farming is to increase soil fertility through composting plant residues and animal manure from the farm. This mixture is treated with compost preparations made from medicinal plants. Additionally, biodynamic field preparations are used when cultivating the fields which are claimed to enhance the bacterial, fungal and mineral processes that are found in the farming system.

Inclusive clarification against this criterion: **Criterion probably met but published evidence is weak**

NbS Criterion 4: Economic feasibility

Biodynamic farming relies on agricultural inputs that are not subsidized by the government of Egypt, but which are reported to improve soil structure, maintain water quality, increase soil organic matter, increase biodiversity and yields, and decrease the total cost of production of any crop. Production is associated with higher costs, but advocates argue that full cost accounting, taking into consideration the external costs of environmental impacts of food wastage, would reflect favorably. Although organic agriculture has a higher direct input cost of production, the environmental and health benefits may result in greater cost effectiveness and profitability in the long term for society as a whole.

[30] https://www.sekem.com/en/index/

Analysis of the economic feasibility of biodynamic farming is not found on the organization's website. However, SEKEM has established a number of companies to develop products and market outputs, indicating a degree of financial viability. Evidence of cost-benefit from SEKEM's sites has not been accessed, but the website claims up to 200% yield increases when applied on degraded soils.

Inclusive clarification against this criterion: **Criterion not adequately evaluated**

NbS Criterion 5: Inclusive governance
Biodynamic farming is currently rolled out as more than just a farming approach, with attention given to an underlying attitude change among farmers and businesses. The approach is supported by awareness raising, training, education, and economic activities. In its current state it pays strong attention to inclusive governance. Scaling up will require further attention to ensure inclusive governance at scale and may require significant investment in raising the capacity of trainers and extension workers if it is to go to scale rapidly.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 6: Balance trade offs
The main trade off in biodynamic farming is related to overall production levels and costs. Farmers incur higher cost of production, in return for increased food security and resilience (e.g. less drought-prone soils). These trade-offs do not seem to have been empirically demonstrated in the pilot areas at this point. Balancing of tradeoffs will require deeper understanding of the trade-off for farmers and farming households, and trade-offs at the national scale in terms of overall production and impacts on net food imports and exports in the scenario of large-scale adoption of this approach.

Inclusive clarification against this criterion: **Criterion not adequately evaluated**

NbS Criterion 7: Adaptive management
Biodynamic farming is designed around a deep understanding of ecological processes, and requires farmers to adapt to changing circumstances. At the farm level it rests on continuous adaptive management. On a larger scale it is unclear whether public services have the capacity to be equally adaptive, and the role of the public sector in scaling up and supporting biodynamic farming has not been described.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 8: Mainstreaming and sustainability
Biodynamic farming has not been mainstreamed in Egypt at this point. Sustainability depends on biodynamic farmers remaining competitive in mainstream markets, assuming that niche markets for their products are not established (NB: the organisation has established a number of companies, some of which may provide markets that favour biodynamic farming). A number of underlying questions may need to be resolved before mainstreaming can take place, including full accounting of the values of biodynamic farming combined with analysis of the implications for balancing biodynamic farming with the country's agriculture sector priorities. Agriculture sector priorities may change over time, in response to climate change and other factors, which may create future entry points for mainstreaming biodynamic farming.

Inclusive clarification against this criterion: **Criterion not met**

Conclusions about this case study:

- Biodynamic agriculture shows promise in Egypt and can contribute to food security and livelihood security in arid regions, but the approach suffers from insufficient validation. To go to scale, greater attention is needed to measure the full range of environmental, economic and social benefits and the overall economic feasibility. Feasibility currently depends on privileged access to markets and therefore a deeper investigation of financing options and policy incentives is needed to identify conditions for scaling up. Scaling up will also depend on greater investment in technical capacity of farmers and extension agents, which should include capacity to identify governance gaps and solutions. Public sector support is critically needed to validate and promote biodynamic farming as a mainstream option for agriculture.
- Stronger evidence is needed of the overall cost and benefit at the local and national scale, to identify possible trade-offs between productivity (i.e. returns on investment) and production (total yields). Evidence should also be generated of the impact on drought resilience, which can translate into productivity gains over longer time scales (i.e. better multi-annual average productivity). The benefit of biodynamic farming in the context of climate change—particularly for adaptation to increasing drought events—will be valuable in generating public support.

3.7 Integrated Coastal Zone Management[31]

Egypt's Nile Delta coastal zone includes valuable agricultural areas, densely populated urban areas, and important industry and infrastructure, concentrated in low-lying areas that are exposed to the risk of coastal flooding. The risk of flooding is exacerbated by coastal subsidence and erosion, which are in turn amplified the effect of climate change on sea-level rise and increasing frequency and intensity of storms. Economic and social vulnerability to climate risk is therefore extremely high.

The Integrated Coastal Zone Management demonstrated innovative and environmentally sensitive adaptation measures for coastal protection. Interventions focused on low-lying coastal lagoons that are threatened by habitat loss and water pollution as well as sea level rise. The project piloted adaptation measures to restore coastal habitats and increase resilience to coastal flood risk. It drew on lessons from the "Living Shorelines Approach" trialed in the USA as a basis for community engagement in local adaptation and spatial planning.

NbS Criterion 1: Addressing societal challenges

The ICZM approach focused on developing 'soft structures' – specifically beach nourishment and sand dunes – to mitigate erosion and flood risk. The project was primarily focused on reducing social and economic risks from sea-level rise, and the terminal evaluation was unable to strongly validate the impact of the intervention. The strong support from public institutions indicates a high level of confidence in the approach, but the lack of validation highlights the difficulty of monitoring risk reduction.

[31] Jobbins, G., 2018. Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management: Terminal Evaluation Report. UNDP Project ID: PIMS No. 3748, GEF Project ID: 3242. https://erc.undp.org/evaluation/evaluations/detail/8411

Modelling exercises indicate that soft structures would be appropriate interventions to counter risks in certain areas. Interventions were completed relatively late in the project cycle and further evaluation will be required to compare the social and economic cost of sea level rise in the intervention areas with control sites.

Inclusive clarification against this criterion: **Criterion probably met, but requires validation**

NbS Criterion 2: Design at scale
The project implemented a number of trials that were rolled out at scale in the target area. The initial trials covered 250 metres of coastline and the successful approaches were then implemented along 4.5 km pilot at Metobas (Kafr el Sheikh), using bamboo-fence sand traps above a geotube-core (consisting of dredged material).

The successful approaches are targeted for scale-up through an ambitious proposal to the Green Climate Fund. The GCF project, entitled "Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions in Egypt", builds on initial progress by scaling up along Egypt's North Coast. It will include 69 km of sand dune dikes along five vulnerability hotspots together with an integrated coastal zone management plan for the entire North Coast, to manage long-term climate change risks and provide Egypt with adaptability to impending flood risks.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 3: Biodiversity net-gain
The main intervention in this initiative focused on using dredged materials to nourish the shoreline in Damietta, dredging and rehabilitation of Lake Manzallah, and protection for the newly built fish farms in Kafr el-Sheikh. By the end of the project, construction was recently completed and the impact on biodiversity was unclear. The terminal evaluation did not consider biodiversity as an indicator (recommendation?). However, the evaluator reports that, "at the time of the evaluation mission…wind was accreting sand around the fences and contributing to dune rehabilitation, and the dike system was holding up well to winter storms. Interventions had been sited appropriately, and have the potential to contribute to dune habitat conservation as well as land reclamation and flood risk management". Habitat creation was not an explicit goal of the project and therefore no assessment was made of the potential biodiversity benefits. This remains to be evaluated, but could be an important co-benefit of the approach with additional social and economic values.

Inclusive clarification against this criterion: **Criterion probably met, but requires validation**

NbS Criterion 4: Economic feasibility
The project evaluation did not explicitly evaluate economic feasibility, and lacked critical insights into the cost of sea-level rise and the potential to mitigate these costs. The best indicator the value of the initiative lies in the strong public support and the commitment of significant public finance for scaling up. Beach nourishment in Damietta primarily consisted of redeveloping sand-dunes, built on a core that was constructed from dredged material from Damietta Port. The terminal evaluation noted that this, "represents a considerable cost saving with positive effects for financial sustainability, and the [port authorities] donated land to store the dredged materials".

Inclusive clarification against this criterion: **Criterion probably met, but requires validation**

NbS Criterion 5: Inclusive governance
The initial project design was weak on stakeholder consultation, but in practice extensive consultations were carried out during project preparation, particularly with public servants in the Ministry of Water Resources and Irrigation. The approach needed a cross-sectoral approach to be fully successful and this was hampered by uncertainty over the roles and responsibilities of other public institutions. This is not unusual in a highly innovative initiative and future actions would require more attention to defining institutional mandates. This is particularly essential to effect changes to Egypt's historical institutional priorities and orientations for shoreline protection.

Inclusion of nongovernmental stakeholders – including citizens and businesses – appears to have been weak. This is reflected in the absence of detailed evaluation of the social and economic benefits. As a result, there are remaining questions to be answered over the implications of the approach on natural resource rights, the positive or negative impacts on different sectors of society, and the overall acceptance by local communities.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 6: Balance trade offs
Bio-physical trade-offs were not reported in the evaluation and could be investigated as part of an environmental assessment. In particular, an evaluation should look at changes to habitat in the coastal zone as a result of reduced coastal flooding, since some coastal habitats will depend on such events.

The main trade-off identified was between institutional responsibilities, and the potential creation of intersectoral rivalry over shoreline protection. This can be avoided through more consultative project design, as well as through clarification of institutional mandates.

Further investigation is required to identify possible trade-offs between residents and business in the coastal zone. For example, access to the sea for fishing communities or for tourism businesses.

Inclusive clarification against this criterion: **Criterion not met, but can be remedied in future interventions**

NbS Criterion 7: Adaptive management
The initial intervention exercised adaptive management, testing different approaches before settling on a suitable option for scaling up. Further adaptation of the approach to restoring natural infrastructure will be possible as the approach is rolled out in new locations. During the pilots, additional adaptation was made to accommodate the needs of local fishermen, by creating stone tops to the dunes.

A primary challenge during the initiative was clarifying the institutional arrangements for implementation. This is where further attention is needed to ensure adaptive management as the approach is scaled up.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 8: Mainstreaming and sustainability
The approach to beach nourishment and restoring sand dunes is well supported by existing legislation and national policy priorities. It is aligned with Egypt's National Environmental Action plan and the National Action Plan for Climate Change. Existing environmental laws (4/1994; 9/2009) provide a legal framework for Integrated Coastal Zone Management. The project evaluation recommends greater efforts to raise awareness about climate change and coastal management in the coastal regions and to develop the institutional relationships for scale up. This includes the Governorates, line ministries for agriculture, tourism housing and urban development, and the military, among others.

Sustainability is expected to be high due to the scale of contribution the government is already making, including a co-financing commitment of US$73.8 million to the GCF Project. Attitudes to these 'soft' approaches have shifted based on the evidence of the pilots. As a note of caution, the evaluator recommends not 'over-selling' the benefits of the approach to the governorates until there is stronger supporting evidence, particularly of the stability of the soft structures and their effectiveness at mitigating coastal flood risks.

Inclusive clarification against this criterion: **Criterion partially met**

Conclusions about this case study:

- Integrated Coastal Zone Management can be strengthened as a Nature based Solution with stronger evaluation of the approach, including its full range of environmental, social, economic costs and benefits. Evaluation of biodiversity net gain requires particular attention and may be an under-rated benefit that could be the catalyst for scaling up. Cost-benefit analysis should consider the risks of projected sea-level rise combined with increasing storm surges under climate change scenarios.
- Integrated Coastal Zone Management requires careful analysis of the governance outcomes, including at the level of public institutions (cross-sectoral support) as well as the community and private sector level (e.g. rights of fisher communities, rights of local businesses). In addition to safeguarding against inequitable outcomes, stronger participation and consultation would help identify potential trade-offs and could be used to strengthen support for further adoption.

3.8 Agroforestry as a Nature based Solution Egypt

Agroforestry is the practice of growing trees on farmland as part of the crop or livestock production system. Agroforestry has been tested in Egypt using the trees *Balanites aegyptiaca* and *Faidherbia albida*. Agroforestry is promoted for a number of benefits, including as a means to improve soil fertility and soil moisture, to increase shade for crops, and to provide secondary economic benefits such as fodder, fuel, fruit, and gum.

NbS Criterion 1: Addressing societal challenges
Agroforestry binds carbon in vegetation and soil, contributing to mitigate climate change. It contributes to adaptation to the effects of climate change, as trees provide shade, bind soil, and increase resistance to pests, drought and floods, while providing access to firewood, a variety of nutritious food, and alternative incomes options. Trees in the agricultural landscape can also increase the soil's ability to capture and retain water in the soil and replenish groundwater. Agroforestry therefore contributes to addressing climate change, disaster risk,

water security, food security, human health and economic development: all six of the societal challenges that Nature based Solutions are designed to address.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 2: Design at scale
Agroforestry has been tested in Wadi Allaqi with promising results on a small scale. There is no documented evidence of traditional practice of agroforestry in the country, although research into the use of agroforestry in Egypt has been carried out for more than 30 years[32]. Agroforestry needs further efforts to go to scale to meet this criterion of NbS.

Inclusive clarification against this criterion: **Criterion not met but achievable**

NbS Criterion 3: Biodiversity net-gain
Agroforestry increases the tree cover in farming landscapes, although the diversity of trees is often limited to one or two species that provide specific benefits, and options for diversifying the range of species should be explored. In Egypt, agroforestry experiments have focused on two economically important indigenous desert plants, *Balanites aegyptiaca* and *Faidherbia albida*. Further research is needed to evaluate any impact that these trees have on wider species diversity, by creating habitat patches on farms and by rehabilitating soil biodiversity. Furthermore, the implications of restoring soil biodiversity on ecosystem health is among the main reasons for promoting agroforestry – i.e. to promote soil moisture and replenish groundwater – but has not been well evaluated.

Inclusive clarification against this criterion: **Criterion probably met, but not evaluated**

NbS Criterion 4: Economic feasibility
Current studies have not examined the economic feasibility of agroforestry, although evidence from other countries indicates that the practice can be economically viable. Economic valuation should consider multiple benefits, including impacts on crop yields, increases in crop resilience (i.e. yields in dry years), secondary economic and nutritional benefits from trees on crop land, and the value of carbon storage and water supply.

Current research in Egypt has relied on irrigation to establish agroforestry, which may negate part of the value of the practice, particularly in the short term. An under-exploited opportunity in Egypt could lie in using waste water to establish agroforestry systems[33]. Agroforestry systems will be considered established when they are viable in the absence of irrigation. Further research is needed to examine the relationship between agroforestry, increased green water in farm soils, replenishment of groundwater, and associated benefits in terms of risk reduction.

Inclusive clarification against this criterion: **Criterion probably met, but not evaluated**

NbS Criterion 5: Inclusive governance
Agroforestry is part of a social and economic system that has proven to be an effective tool in a number of countries to support women's right to income from the land they cultivate[34].

[32] https://www.participatorymethods.org/resource/final-report-role-women-agroforestry-egypt-jordan-and-sudan
[33] http://www.iwmi.cgiar.org/Publications/Books/PDF/resource_recovery_from_waste-556-568.pdf
[34] http://www.fao.org/3/xii/0051-b5.htm

Investments in agroforestry have enabled women to earn income from commercially valuable tree products, such as shea nuts. This has contributed to economic empowerment and improved access to education, which contribute to a number of development goals.

Inclusive clarification against this criterion: **Criterion met**

NbS Criterion 6: Balance trade offs
The main trade-offs associated with agroforestry appear to be related to the use of water to establish agroforestry on farms. Rain-fed establishment of agroforestry requires much more time and there is little literature to show whether this practice is feasible. Deeper insight into other possible trade-offs is required.

Inclusive clarification against this criterion: **Criterion probably met, but not evaluated**

NbS Criterion 7: Adaptive management
Adaptive management will be required to take agroforestry from research stations to wider adoption by farmers. This will require development of a suitable monitoring framework through which farmers can evaluate the impact of agroforestry on several criteria, including crop yields, crop resilience, and secondary benefits.

Inclusive clarification against this criterion: **Criterion not met**

NbS Criterion 8: Mainstreaming and sustainability
Agroforestry appears to be an option for mainstreaming in Egypt that can increase resilience in the agriculture sector and promote productivity on some lands. Long term sustainability will depend on resolving questions around the use of water for establishing trees on farm. Mainstreaming may ultimately depend on stronger evaluation of the benefits to resilience of farmers, particularly in the context of climate change.

Inclusive clarification against this criterion: **Criterion not met but achievable**

Conclusions about this case study:

- Agroforestry has significant potential for large-scale adoption in Egypt and meets many of the requirements to be considered as a leading Nature based Solution. Further details of the overall biodiversity net gain are required, including the impact on soil biodiversity and off-farm biodiversity, but also by widening the range of tree species that are integrated into cropping systems, for example to combine trees with economic products and nitrogen fixing or shade-producing trees. The value of trees on farm needs more detailed evaluation to explore the benefits of shade, mulching, nutrient cycling and other possible impacts.
- Greater insight to the cost of establishing agroforestry, particularly the reliance on irrigation to establish trees, will be required to understand the true potential. Options for integrating agroforestry with the recycling of waste-water should be explored. A concerted effort will be needed to take agroforestry to scale on a large number of private farmers if it can be considered an effective NbS. This requires public commitment and policy support, possible incentives to farmers to offset any costs of adoption, as well as effective systems for monitoring and evaluating outcomes – which should include impacts on resilience as well as food production.

The overall evaluation of the Nature based Solutions practices in Egypt (evaluated in this report), can be summarized in the following table:

Table 55 The overall evaluation of the NbS practices in Egypt

Practice	C1. Addressing societal challenges			C2. Design at scale			C3. Biodiversity net-gain				C4. Economic feasibility				C5. Inclusive governance					C6. Balance trade offs			C7. Adaptive management			C8. Mainstreaming and sustainability		
1. Community Based Rangeland Restoration in Egypt	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
2. Sustainable land management to restore desertified land	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
3. Mangrove Restoration as a Nature based Solution in Egypt's Coastal Zones	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3
4. Waste water irrigation for rehabilitation of arid areas in Egypt																												
5. Medicinal Plants Rehabilitation Program																												
6. Biodynamic farming																												
7. Integrated Coastal Zone Management																												
8. Agroforestry as a Nature based Solution Egypt																												

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Annexes

Annex 1: List of GEF projects for Egypt **(from GEF 1 until GEF 7)**

Table 56 Annex 1: List of GEF projects for Egypt

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
3990	MED: Integration of Climatic Variability and Change into National Strategies to Implement the ICZM Protocol in the Mediterranean	International Waters	$2,298,545 $6,176,400	United Nations Environment Programme	GEF Trust Fund	GEF-4	Completed
267	Energy Efficiency Improvements and Greenhouse Gas Reductions	Climate Change	$6,360,000 $1,784,000	United Nations Development Programme	GEF Trust Fund	GEF-1	Completed
9165	Enabling Implementation of the Regional SAP for the Rational and Equitable Management of the Nubian Sandstone Aquifer System (NSAS)	International Waters	$3,990,000 $17,730,000	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
2020	Formulation of an Action Programme for the Integrated Management of the Shared Nubian Aquifer	International Waters	$975,000 $0	United Nations Development Programme	GEF Trust Fund	GEF-3	Completed
2865	Promotion of Strategies to Reduce Unintentional Production of POPs in the PERSGA	Persistent Organic Pollutants	$950,000 $0	United Nations Industrial Development Organization	GEF Trust Fund	GEF-4	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Coastal Zone						
5143	PPP-EBRD South Eastern Mediterranean EE/ ESCO Markets Platform (PROGRAM)	Climate Change	$15,000,000 $150,000,000	European Bank for Reconstruction and Development	GEF Trust Fund	GEF-5	Project Approved
9407	Healthy Ecosystems for Rangeland Development (HERD): Sustainable Rangeland Management Strategies and Practices	Land Degradation	$3,515,982 $12,227,000	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
3398	SIP: Eastern Nile Transboundary Watershed Management in Support of ENSAP Implementation	International Waters, Land Degradation	$8,700,000 $26,700,000	The World Bank	GEF Trust Fund	GEF-4	Completed
4886	Continuing Regional Support for the POPs Global Monitoring Plan under the Stockholm Convention in the Africa Region	Persistent Organic Pollutants	$4,208,000 $10,190,200	United Nations Environment Programme	GEF Trust Fund	GEF-5	Project Approved
340	Implementation of the Strategic Action Programme(SAP) for the Red Sea and Gulf of Aden	International Waters	$19,000,000 $17,650,000	United Nations Development Programme	GEF Trust Fund	GEF-1	Completed
3809	Red Sea and	International	$3,000,000	The World	GEF Trust	GEF-4	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Gulf of Aden Strategic Ecosystem Management	Waters	$15,890,000	Bank	Fund		
2546	Demonstration of Sustainable Alternatives to DDT and Strengthening of National Vector Control Capabilities in Middle East and North Africa	Persistent Organic Pollutants	$3,960,014 $8,416,402	United Nations Environment Programme	GEF Trust Fund	GEF-4	Project Approved
9491	Mainstreaming Conservation of Migratory Soaring Birds into Key Productive Sectors along the Rift Valley / Red Sea Flyway (Tranche II of GEFID 1028)	Biodiversity	$3,500,000 $10,534,885	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
1028	Mainstreaming Conservation of Migratory Soaring Birds into Key Productive Sectors along the Rift Valley/Red Sea Flyway (Tranches 1 and 2)	Biodiversity	$6,243,243 $4,490,232	United Nations Development Programme	GEF Trust Fund	GEF-3	Cancelled
2584	Nile Transboundary Environmental Action Project (NTEAP), Phase II	International Waters	$6,700,000 $71,990,000	United Nations Development Programme	GEF Trust Fund	GEF-4	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
1094	Nile Transboundary Environmental Action Project, Tranche 1	International Waters	$16,800,000 $93,700,000	The World Bank	GEF Trust Fund	GEF-2	Completed
3321	Mainstreaming Groundwater Considerations into the Integrated Management of the Nile River Basin	International Waters	$1,000,000 $0	United Nations Development Programme	GEF Trust Fund	GEF-4	Completed
1394	Climate, Water and Agriculture: Impacts on and Adaptation of Agro-Ecological Systems in Africa		$700,000 $540,000	The World Bank	GEF Trust Fund	GEF-2	Completed
9118	Support to Preparation of the Third National Biosafety Reports to the Cartagena Protocol on Biosafety - AFRICA REGION	Biodiversity	$1,368,550 $1,225,000	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
5186	MENA: Desert Ecosystems and Livelihoods Knowledge Sharing and Coordination Project	Land Degradation	$1,000,000 $487,500	The World Bank	GEF Trust Fund	GEF-5	Completed
4620	MENA - Desert Ecosystems and Livelihoods	Land Degradation, Climate Change,	$3,025,557 $154,824,500	The World Bank	Multi Trust Fund	GEF-5	Cancelled

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Program MENA-DELP)	Biodiversity					
3628	MENARID: Cross Cutting M & E Functions and Knowledge Management for INRM within the MENARID Programme Framework	Land Degradation	$667,270 $1,600,000	International Fund for Agricultural Development	GEF Trust Fund	GEF-4	Completed
3423	MENARID Integrated Nature Resources Management in the Middle East and North Africa Region (PROGRAM)		$0 $0	International Fund for Agricultural Development	GEF Trust Fund	GEF-4	Cancelled
410	Conservation of Wetland and Coastal Ecosystems in the Mediterranean Region	Biodiversity	$13,273,200 $28,620,900	United Nations Development Programme	GEF Trust Fund	GEF-1	Completed
9691	Financing Advanced Environmental Technologies in the Mediterranean Sea Region for Water Systems and Clean Coasts (EnviTeCC)	International Waters, Chemicals and Waste	$8,750,000 $90,000,000	European Bank for Reconstruction and Development	GEF Trust Fund	GEF-6	Project Approved
9685	Mediterranean Coastal Zones: Managing the Water-Food-Energy and Ecosystems	International Waters	$3,500,000 $11,309,871	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	NEXUS						
9607	Mediterranean Sea Programme (MedProgramme): Enhancing Environmental Security	International Waters, Biodiversity, Chemicals and Waste	$42,376,147 $708,000,000	United Nations Environment Programme	GEF Trust Fund	GEF-6	Concept Proposed
3977	MED Mediterranean Environmental Sustainable Development Program "Sustainable MED"	International Waters	$0 $0	The World Bank	GEF Trust Fund	GEF-4	Cancelled
3229	World Bank-GEF Investment Fund for the Mediterranean Sea Large Marine Ecosystem Partnership, Tranche 1, 2nd Installment	International Waters	$905,000 $45,000,000	The World Bank	GEF Trust Fund	GEF-4	Project Approved
9684	Reducing Pollution from Harmful Chemicals and Wastes in Mediterranean Hot Spots and Measuring Progress to Impacts	Chemicals and Waste, International Waters	$14,250,000 $53,146,727	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
9717	Mediterranean Pollution Hot Spots Investment Project	Chemicals and Waste, International Waters	$5,000,000 $546,451,400	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
9687	Mediterranean Coastal Zones Climate	International Waters	$7,000,000 $143,270,231	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Resilience Water Security and Habitat Protection						
9686	Mediterranean Sea Basin Environment and Climate Regional Support Project	International Waters, Chemicals and Waste	$2,500,000 $6,623,920	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
461	Determination of Priority Actions for the Further Elaboration and Implementation of the Strategic Action Programme for the Mediterranean Sea	International Waters	$6,060,000 $5,925,000	United Nations Environment Programme	GEF Trust Fund	GEF-1	Completed
2600	Strategic Partnership for the Mediterranean Large Marine Ecosystem-Regional Component: Implementation of Agreed Actions for the Protection of the Environmental Resources of the Mediterranean Sea and Its Coastal Areas	Persistent Organic Pollutants, International Waters	$12,891,000 $36,548,200	United Nations Environment Programme	GEF Trust Fund	GEF-4	Completed
9047	Green Logistics Program (non-grant)	Climate Change	$15,000,000 $155,250,000	European Bank for Reconstruction and Development	GEF Trust Fund	GEF-6	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
10638	Support to Preparation of the Fourth National Biosafety Reports to the Cartagena Protocol on Biosafety - AFRICA REGION	Biodiversity	$1,287,000 $1,246,750	United Nations Environment Programme	GEF Trust Fund	GEF-7	Project Approved
5292	MENA: Morocco GEF Social and Integrated Agriculture (ASIMA)	Biodiversity, Land Degradation	$6,440,000 $35,540,000	The World Bank	GEF Trust Fund	GEF-5	Completed
23	Promoting Best Practices for Conservation and Sustainable Use of Biodiversity of Global Significance in Arid and Semi-arid Zones	Biodiversity	$750,000 $0	United Nations Environment Programme	GEF Trust Fund	GEF-2	Completed
402	Pilot Biosafety Enabling Activity	Biodiversity	$2,744,000 $0	United Nations Environment Programme	GEF Trust Fund	GEF-1	Completed
5136	Support to 20 GEF Eligible Parties for Alignment of National Action Programs and Reporting Process under UNCCD (Add-on Umbrella 2)	Land Degradation	$1,000,000 $1,000,000	United Nations Environment Programme	GEF Trust Fund	GEF-5	Project Approved
1685	FC-1: Fuel Cells Financing Initiative for Distributed Generation	Climate Change	$9,825,000 $9,000,000	The World Bank	GEF Trust Fund	GEF-3	Concept Proposed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Applications (Phase 1)						
172	Biodiversity Country Studies - Phase I	Biodiversity	$5,000,000 $0	United Nations Environment Programme	GEF Trust Fund	Pilot Phase	Project Approved
145	Biodiversity Data Management Capacitation in Developing Countries and Networking Biodiversity Information	Biodiversity	$4,000,000 $0	United Nations Environment Programme	GEF Trust Fund	Pilot Phase	Completed
4541	Fifth Operational Phase of the GEF Small Grants Program - Implementing the program using STAR resources I	Climate Change, Biodiversity, Land Degradation	$40,828,365 $40,890,000	United Nations Development Programme	GEF Trust Fund	GEF-5	Completed
3514	4th Operational Phase of the GEF Small Grants Programme (RAF1)	Climate Change, Biodiversity	$13,647,498 $0	United Nations Development Programme	GEF Trust Fund	GEF-4	Completed
9866	Support to Preparation of the Interim National Report on the Implementation of the Nagoya Protocol	Biodiversity	$1,430,000 $1,111,321	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
9981	GEF Support to UNCCD 2018 National Reporting Process - Umbrella I	Land Degradation	$1,981,737 $336,000	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
2261	Building Partnerships to Assist Developing Countries to Reduce the Transfer of Harmful Aquatic Organisms in Ships' Ballast Water (GloBallast Partnerships)	International Waters	$5,688,000 $17,701,939	United Nations Development Programme	GEF Trust Fund	GEF-4	Project Approved
4001	MED: Sustainable Governance and Knowledge Generation	International Waters	$3,000,000 $4,400,000	The World Bank	GEF Trust Fund	GEF-4	Completed
9829	Support to Eligible Parties to Produce the Sixth National Report to the CBD (6NR - Mixed regions)	Biodiversity	$1,963,500 $1,822,500	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
3871	4th Operational Phase of the GEF Small Grants Programme (RAF2)	Climate Change, Biodiversity	$45,211,963 $44,500,000	United Nations Development Programme	GEF Trust Fund	GEF-4	Project Approved
10010	Fourth National Communication to the UNFCCC	Climate Change	$500,000 $80,000	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
6936	Egypt's First Biennial Update Report	Climate Change	$352,000 $30,000	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
4965	National Biodiversity Planning to Support the implementation of the CBD	Biodiversity	$220,000 $310,000	United Nations Development Programme	GEF Trust Fund	GEF-5	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	2011-2020 Strategic Plan in Egypt						
10796	Greening Hurghada	Biodiversity, Climate Change	$3,889,996 $22,000,000	United Nations Industrial Development Organization	GEF Trust Fund	GEF-7	Concept Approved
10360	Seventh Operational Phase of the GEF Small Grants Programme in Egypt	Climate Change, Biodiversity, Land Degradation	$2,096,119 $5,437,000	United Nations Development Programme	GEF Trust Fund	GEF-7	Concept Approved
10117	Green Sharm El Sheikh	Biodiversity, Climate Change, Chemicals and Waste	$6,212,694 $57,690,000	United Nations Development Programme	GEF Trust Fund	GEF-7	Concept Approved
9928	Sustainable Management of Kharga Oasis Agro-Ecosystems in the Egyptian Western Desert	Climate Change, Biodiversity	$1,045,890 $9,000,000	Food and Agriculture Organization	GEF Trust Fund	GEF-6	Project Approved
9671	Effective Management of Wadi El-Rayan and Qarun Protected Areas	Biodiversity	$1,319,864 $8,500,000	United Nations Environment Programme	GEF Trust Fund	GEF-6	Project Approved
9423	Egyptian Programme for Promoting Industrial Motor Efficiency	Climate Change	$2,750,000 $16,800,000	United Nations Industrial Development Organization	GEF Trust Fund	GEF-6	Project Approved
9334	Enhancing National Capacities for Improved Public Participation for		$991,000 $1,084,000	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Implementing Rio Conventions						
6956	Sixth Operational Phase of the GEF Small Grants Programme in Egypt	Climate Change, Biodiversity, Land Degradation	$2,843,241 $4,073,461	United Nations Development Programme	GEF Trust Fund	GEF-6	Project Approved
6927	Integrated Management and Innovation in Rural Settlements	Climate Change	$7,812,000 $38,132,600	International Fund for Agricultural Development	Special Climate Change Fund	GEF-6	Project Approved
5073	Mainstreaming the Conservation and Sustainable Use of Biodiversity into Tourism Development and Operations in Threatened Ecosystems in Egypt	Biodiversity	$2,574,338 $49,200,000	United Nations Development Programme	GEF Trust Fund	GEF-5	Project Approved
5064	Grid-connected Small Scale Photovoltaic Systems	Climate Change	$3,536,364 $30,260,000	United Nations Development Programme	GEF Trust Fund	GEF-5	Project Approved
4790	Utilizing Solar Energy for Industrial Process Heat in Egyptian Industry	Climate Change	$6,500,000 $37,300,000	United Nations Industrial Development Organization	GEF Trust Fund	GEF-5	Project Approved
4392	Protect Human Health and the Environment from Unintentional Releases of POPs Originating	Persistent Organic Pollutants	$4,100,000 $17,568,000	United Nations Development Programme	GEF Trust Fund	GEF-5	Project Approved

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	from Incineration and Open Burning of Health Care- and Electronic-waste						
3991	MED: Enhanced Water Resources Management	International Waters	$6,682,000 $28,121,000	The World Bank	GEF Trust Fund	GEF-4	Completed
3905	Sustainable Persistent Organic Pollutants Management Project	Persistent Organic Pollutants	$8,100,000 $15,500,000	The World Bank	GEF Trust Fund	GEF-4	Project Approved
3832	Improving the Energy Efficiency of Lighting and Building Appliances	Climate Change	$4,450,000 $15,055,000	United Nations Development Programme	GEF Trust Fund	GEF-4	Project Approved
3742	Industrial Energy Efficiency (IEE)	Climate Change	$3,950,000 $24,121,000	United Nations Industrial Development Organization	GEF Trust Fund	GEF-4	Project Approved
3242	Adaptation to Climate Change in the Nile Delta Through Integrated Coastal Zone Management	Climate Change	$4,000,000 $12,838,060	United Nations Development Programme	Special Climate Change Fund	GEF-4	Project Approved
3209	Strengthening Protected Area Financing and Management Systems	Biodiversity	$3,616,000 $15,316,200	United Nations Development Programme	GEF Trust Fund	GEF-4	Project Approved
3190	Mainstreaming Global Environment in		$475,000 $812,000	United Nations Development Programme	GEF Trust Fund	GEF-4	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	National Plans and Policies by Strengthening the Monitoring and Reporting System for Multilateral Environmental Agreements						
2824	Support the Implementation of the National Biosafety Framework	Biodiversity	$908,100 $0	United Nations Environment Programme	GEF Trust Fund	GEF-3	Completed
2776	Sustainable Transport	Climate Change	$6,900,000 $37,100,000	United Nations Development Programme	GEF Trust Fund	GEF-3	Project Approved
2602	WB/GEF MED: Alexandria Coastal Zone Management Project (ACZM)	International Waters	$7,150,000 $647,003,292	The World Bank	GEF Trust Fund	GEF-4	Completed
2200	National Capacity Self-Assessment (NCSA) for Environmental Mangement		$200,000 $0	United Nations Development Programme	GEF Trust Fund	GEF-3	Completed
2157	Assessment of Capacity Building Needs in Country Specific Priorities in Biodiversity Management and Conservation in Egype	Biodiversity	$148,000 $0	United Nations Environment Programme	GEF Trust Fund	GEF-3	Completed
1497	Enabling Activities to Facilitate Early Action on the	Persistent Organic Pollutants	$496,500 $0	United Nations Industrial Development	GEF Trust Fund	GEF-3	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in Egypt			Organization			
1335	Bioenergy for Sustainable Rural Development	Climate Change	$3,000,000 $12,390,000	United Nations Development Programme	GEF Trust Fund	GEF-3	Project Approved
1213	Second Matrouh Resource Management Project		$5,170,000 $39,790,000	The World Bank	GEF Trust Fund	GEF-2	Cancelled
1040	Solar Thermal Hybrid Project	Climate Change	$49,800,000 $277,770,000	The World Bank	GEF Trust Fund	GEF-3	Completed
985	Developing Renewable Ground Water Resources in Arid Lands: a Pilot Case - the Eastern Desert of Egypt	International Waters	$830,000 $1,005,000	United Nations Development Programme	GEF Trust Fund	GEF-2	Completed
926	Fuel Cell Bus Demonstration Project in Cairo, Phase I	Climate Change	$6,190,000 $7,088,000	United Nations Development Programme	GEF Trust Fund	GEF-2	Cancelled
827	Climate Change Enabling Activity (Additional Financing for Capacity Building in Priority Areas)	Climate Change	$48,000 $0	United Nations Development Programme	GEF Trust Fund	GEF-2	Project Approved
776	Conservation and Sustainable Use of	Biodiversity	$4,117,000 $4,765,998	United Nations Development Programme	GEF Trust Fund	GEF-2	Completed

ID	Title	Focal Areas	Grant and Cofinancing	Implementing Agencies	Fund Source	Period	Status
	Medicinal Plants in Arid and Semi-arid Ecosystems						
428	Clearing House Mechanism Enabling Activity	Biodiversity	$14,000 $0	United Nations Environment Programme	GEF Trust Fund	GEF-1	Completed
395	Lake Manzala Engineered Wetlands	International Waters	$4,500,000 $0	United Nations Development Programme	GEF Trust Fund	Pilot Phase	Completed
282	Building Capacity for GHG Inventory and Action Plans in Response to UNFCCC Communicatio ns Obligations	Climate Change	$402,000 $115,000	United Nations Development Programme	GEF Trust Fund	GEF-1	Completed
154	National Biodiversity Strategy, Action Plan and First National Report to the CBD	Biodiversity	$288,000 $0	United Nations Environment Programme	GEF Trust Fund	GEF-1	Completed
66	Red Sea Coastal and Marine Resource Management	Biodiversity	$4,750,000 $0	The World Bank	GEF Trust Fund	Pilot Phase	Completed
31	Introduction of Viable Electric and Hybrid-Electric Bus Technology	Climate Change	$748,600 $0	United Nations Development Programme	GEF Trust Fund	GEF-2	Completed