Long Lasting Resilience
Within The Arab Realm

UNESCO BIOSPHERE RESERVES AND GEOPARKS IN THE ARAB WORLD

PREPARED BY:

UNESCO Regional Office for Egypt and Sudan
Liaison Office with the League of Arab States

Resilience with Purpose: A Strategic Vision for the Arab Realm - A Preface

Since January 2025, the UNESCO Regional Office for Egypt and Sudan Liaison Office with the League of Arab States has spearheaded a rigorous diplomatic and scientific campaign to reframe the narrative of the Arab environment. Our mission has been to demonstrate that the Arab world is not merely a region defined by water scarcity, but rather the global repository of wisdom on water management accumulated over millennia. From the Aflaj of the Gulf to the Khettaras of the Maghreb, our region offers the world a masterclass in living within ecological limits—a contribution we proudly bring to the global community.

The outcomes of the 5th World Congress of Biosphere Reserves in Hangzhou (September 2025) validated this regional groundwork. The Congress's call to action, crystallized in the MAB Strategic Action Plan (2026–2035), aligns perfectly with our ongoing efforts to transition from passive conservation to active, science-driven management.

This publication articulates a unified strategy where three critical visions converge to define the next decade of action:

1. **The Global Mandate: Engines of the Green and Blue Economy -** We are operationalizing the Hangzhou Declaration by treating Biosphere Reserves and Global Geoparks as active economic engines. By integrating these sites into national development plans, we are fostering a Green and Blue Economy where environmental assets drive sustainable livelihoods. We are proving that biodiversity conservation is not a cost, but an investment in economic stability.
2. **The Regional Strength: Heritage-Based Solutions -** The ArabMAB Network champions a vision where modern science validates ancient wisdom. We contend that the region's distinct biocultural diversity holds the key to modern sustainability. Our drylands are "Living Laboratories" where the resilience required for a hotter planet is being tested and proven every day.
3. **The Political Will: Bridging Science and Policy -** Crucially, this document reflects our strategic commitment to closing the gap between scientific research and high-level decision-making. Through our liaison role with the League of Arab States, we are working to ensure that these sites are recognized as critical national infrastructure—vital for water security, food sovereignty, and regional stability.

This strategy is grounded in the distinct ecosystems that define our region, which serve as the frontline for our climate action:

The Oasis: A Model of Integrated Resilience

The Arab Oasis is more than a refuge; it is a sophisticated socio-ecological system that represents the ultimate triumph of human ingenuity over aridity. These islands of biodiversity have sustained civilizations for centuries through complex, community-managed water sharing and three-tiered agricultural systems. They are the original models of the Water-Energy-Food-Ecosystem (WEFE) Nexus.

However, these ancient systems face existential threats from groundwater depletion and climate change. Our focus is now on revitalizing the oasis model—not as a museum piece, but as a viable system for the future. By combining traditional knowledge with modern hydrological monitoring and sustainable date palm value chains, we are working to ensure these ecosystems continue to support vibrant communities and genetic diversity.

The Mangrove: Guardians of the Blue Economy

On our coasts, the focus shifts to the "Blue Forests" of the Arab world. Our mangrove ecosystems, from the Red Sea to the Arabian Gulf, are critical sentinels against climate change. They act as powerful carbon sinks—sequestering carbon up to four times faster than tropical rainforests—while providing essential nursery grounds for fisheries that support local economies.

Future Horizons: Action in the Deltas

Looking ahead, our most urgent frontier lies in the river Deltas, particularly the Nile Delta. These areas represent the convergence of our greatest challenges: sea-level rise, saltwater intrusion, and high population density. Our future contribution will focus on establishing transboundary biosphere corridors and "living labs" in these deltaic systems. We aim to pioneer adaptive governance models that can secure these vital food baskets against the triple threat of climate change, ensuring that the Arab world remains resilient by design, and resilient with purpose.

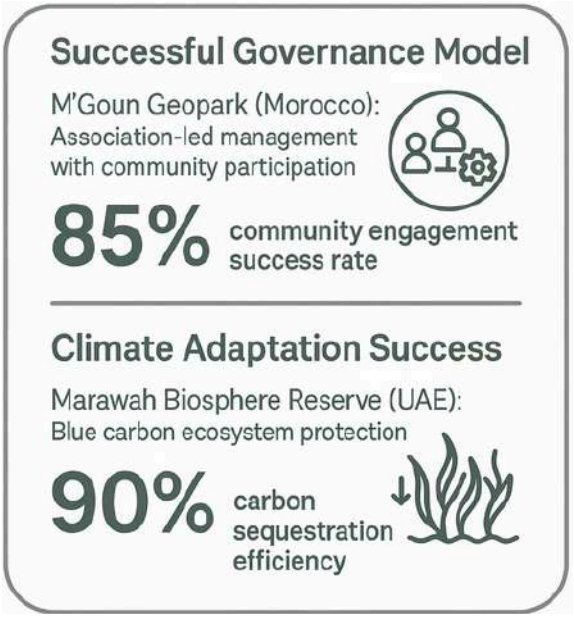
Dr. Nuria Sanz
Director, UNESCO Regional Office for Egypt and Sudan

Executive Summary

This document provides a comprehensive assessment of UNESCO's Man and the Biosphere (MAB) Programme and Global Geoparks in the Arab region. It was prepared by the Regional Office of UNESCO in Cairo following the regional consultation meeting organized by the Office in July 2025. The report synthesizes strategic frameworks, case studies, and current practices. The Arab world, while facing profound environmental challenges such as acute water scarcity and climate vulnerability, is at the same time a hub of scientific strength, a unique repository of natural and cultural heritage, and a model of ecological resilience.

A central finding is the paradigm shift toward "heritage-based solutions," recognizing that the sustainability of socio-ecological systems, particularly arid areas, is rooted in their biocultural diversity—the co-evolution of human cultural practices and biological systems. Traditional Ecological Knowledge (TEK), embodied in ancient systems like agro-terracing in Lebanon's Shouf Biosphere Reserve and the Hima rangeland management system, is being revived and integrated with modern science to enhance food security, restore landscapes, and strengthen climate resilience.

Governance remains a foundational challenge, with progress often hindered by ministerial mandates and incomplete essential infrastructure for financing. However, successful models, such as the association-led M'Goun Geopark in Morocco, provide a blueprint for participatory management that translates geological and cultural heritage into tangible socio-economic benefits. Similarly, the Marawah Biosphere Reserve in the UAE demonstrates how a strong science-policy interface can drive climate adaptation through the protection of "blue carbon" ecosystems.



Critical gaps persist, notably the disconnect between these sites and major climate finance mechanisms. A new narrative is urgently needed to reframe Geoparks and Biosphere Reserves as **"investment-worthy climate assets"** and essential **"actionable applied research hubs."** Future progress hinges on strengthening regional cooperation, establishing thematic research groups, systematically documenting TEK before it vanishes, and strategically engaging youth.

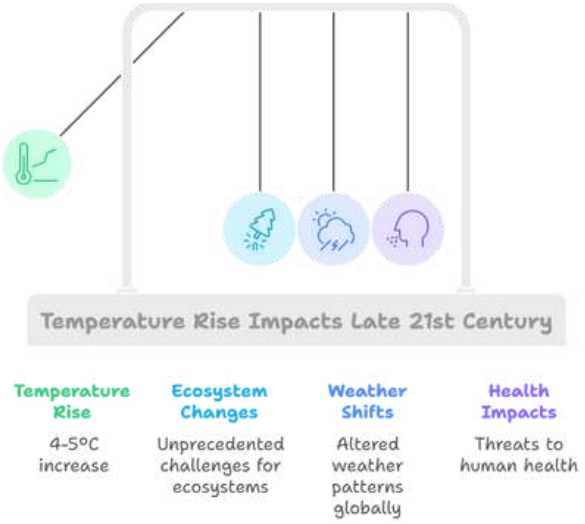

UNESCO GeoParks - ArabMAB Group
UNESCO Biosphere Reserves - ArabMAB Group
Tlemcen Mountains
Chrea
Djurdjura
Gouraya
El Kala
Ichkeul
Iles Zembra et Zembreta
Taza
Belezma
Djebel Chambi
Djebel Bou-Hedma
Atlas Cedar
Ashaafean
Jabal Moussa
Jabal Al Rihane
Shouf
Lajat
Arganeraie
M'goun
Oasis du sud marocain
Omayed
Mujib
Dana
Harrat Uwayrid
Salma
Al Reem
North Riyadh
Marawah
Wadi Wurayah
Tassili N'Ajjer
Wadi Allaqi
Delta du Fleuve
Juzur Farasan
Bura'a
Socotra Archipelago
Jebel El Dair
Dinder
Radom
UNESCO Biosphere Reserves & Geoparks in ArabMAB Group Countries

Contents

Part I: Regional Context and Strategic Imperative

1.1. A Region of Acute Environmental Stress and Profound Heritage

The Arab world, stretching from the Atlantic coast of North Africa to the Arabian Peninsula, is defined by its profound environmental challenges. It is the most water-scarce region on Earth, with 14 of the world's 17 most water-stressed countries (UNESCO, 2021). This scarcity creates a "circular disaster" where land degradation, desertification, and the impacts of climate change are mutually reinforcing.



The region's delta ecosystems, particularly the Nile Delta, represent critical areas where environmental stress and human vulnerability converge most intensely. These deltas face a triple threat of sea-level rise, saltwater intrusion, and reduced sediment flows, jeopardizing agricultural productivity, freshwater resources, and coastal communities that depend on these ecosystems for their livelihoods. The degradation of delta systems not only threatens biodiversity but also undermines food security for millions of people and increases the risk of climate-induced displacement, making their conservation and sustainable management a regional imperative that bridges environmental and human security concerns.

Climate Vulnerability Hotspots

Climate vulnerability assessments identify several hotspots across the region:

- **North African Coast:** Highly vulnerable to sea-level rise, with projections indicating that by 2050, coastal cities like Alexandria, Egypt could experience regular flooding, affecting millions of people and critical infrastructure (World Bank, 2021).
- **The Levant:** Facing significant temperature increases and decreased precipitation, with projections suggesting a 20-30% reduction in rainfall by mid-century, exacerbating water scarcity in already stressed river systems (UNEP, 2020).
- **Arabian Peninsula:** rising temperatures, decreasing precipitation, and more frequent droughts—driven by climate change—are heightening water scarcity, undermining agricultural yields, and aggravating food insecurity (FAO, 2023).

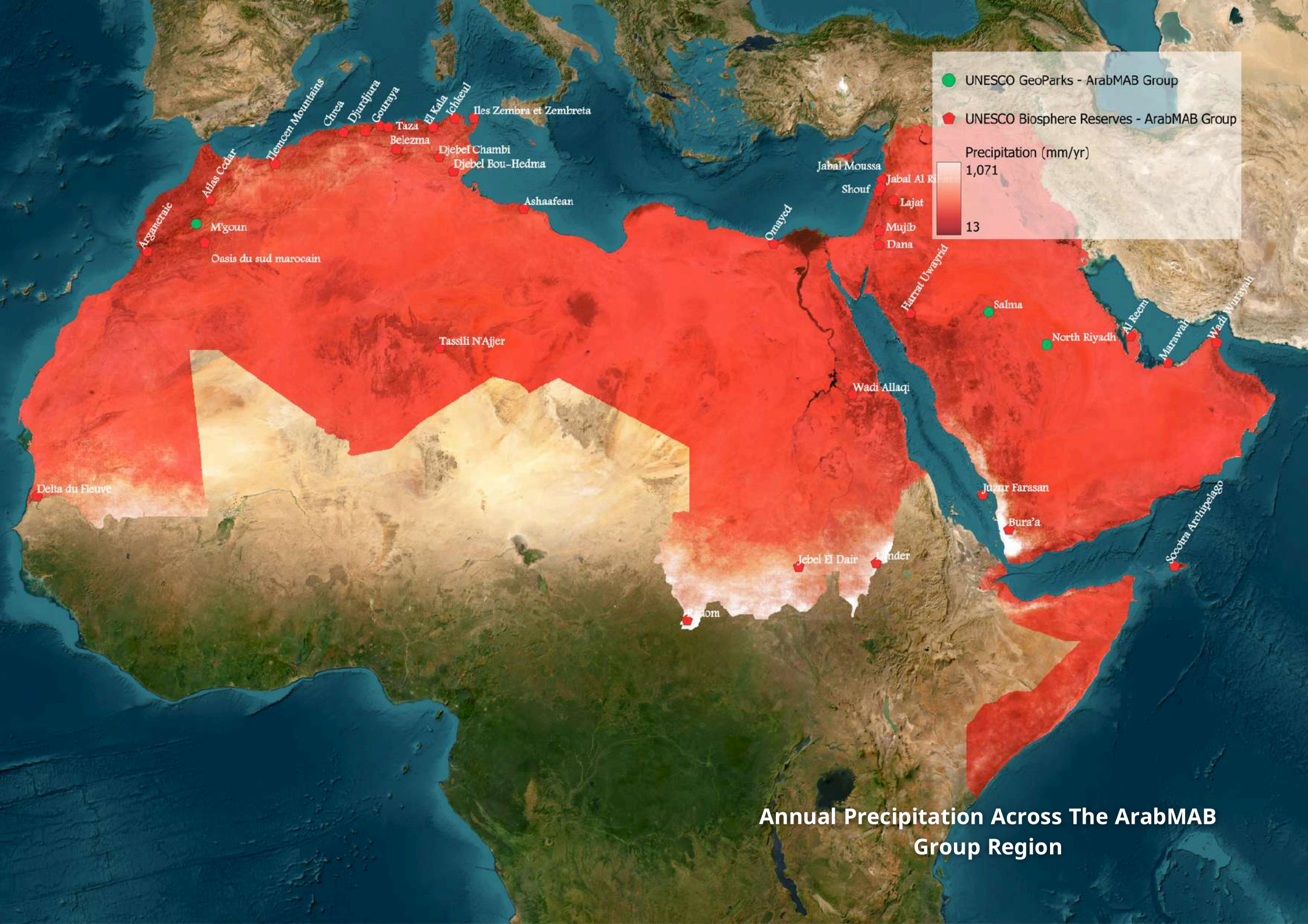
Drought costs globally already exceed US$307 billion per year. (UNCCD; UNU-INWEH; ELD, 2024)

Biodiversity in a Changing Climate

Despite its harsh conditions, the Arab region hosts remarkable biodiversity, including:

- **Mediterranean Forests:** The cedar forests of Lebanon and Morocco, which are biodiversity hotspots and critical watersheds.
- **Mountain Ecosystems:** The High Atlas and Anti-Atlas ranges in Morocco, the Taurus Mountains in Turkey, and the Hijaz and Asir mountains in Saudi Arabia, which host unique flora and fauna adapted to high-altitude conditions.
- **Coastal and Marine Ecosystems:** The Red Sea coral reefs, which exhibit exceptional resilience to warming waters, and the mangrove ecosystems along the Arabian Gulf, which provide critical nursery habitats for fish species and coastal protection.
- **Desert Ecosystems:** The Sahara, Arabian, and Syrian Deserts, which host specially adapted species and play a crucial role in global dust cycles and climate regulation.

Only 12.5% of existing Biosphere Reserves in the region are categorized as dryland ecosystems, despite the vast geographical dominance of drylands.



Annual Precipitation Across The ArabMAB Group Region


Marawah, Abu Dhabi, UAE

The Human Dimension

Environmental challenges in the Arab region are inextricably linked to human security and well-being. Water scarcity affects approximately 350 million people in the region, with per capita renewable water availability projected to decrease by 50% by 2050 (World Bank, 2021). This scarcity has implications for food security, as agriculture accounts for approximately 85% of freshwater withdrawals in the region (FAO, 2020).

Yet, this narrative of vulnerability is incomplete. The region is also a cradle of civilization, a global center of agrobiodiversity, and a repository of immense Traditional Ecological Knowledge (TEK) developed over millennia to sustain life in extreme environments. It possesses a "hidden strength" in its robust scientific and research hubs, which produce thousands of publications on water science, climate modeling, and biodiversity.

1.2. The Scope of UNESCO's Earth Sciences Network in the Region

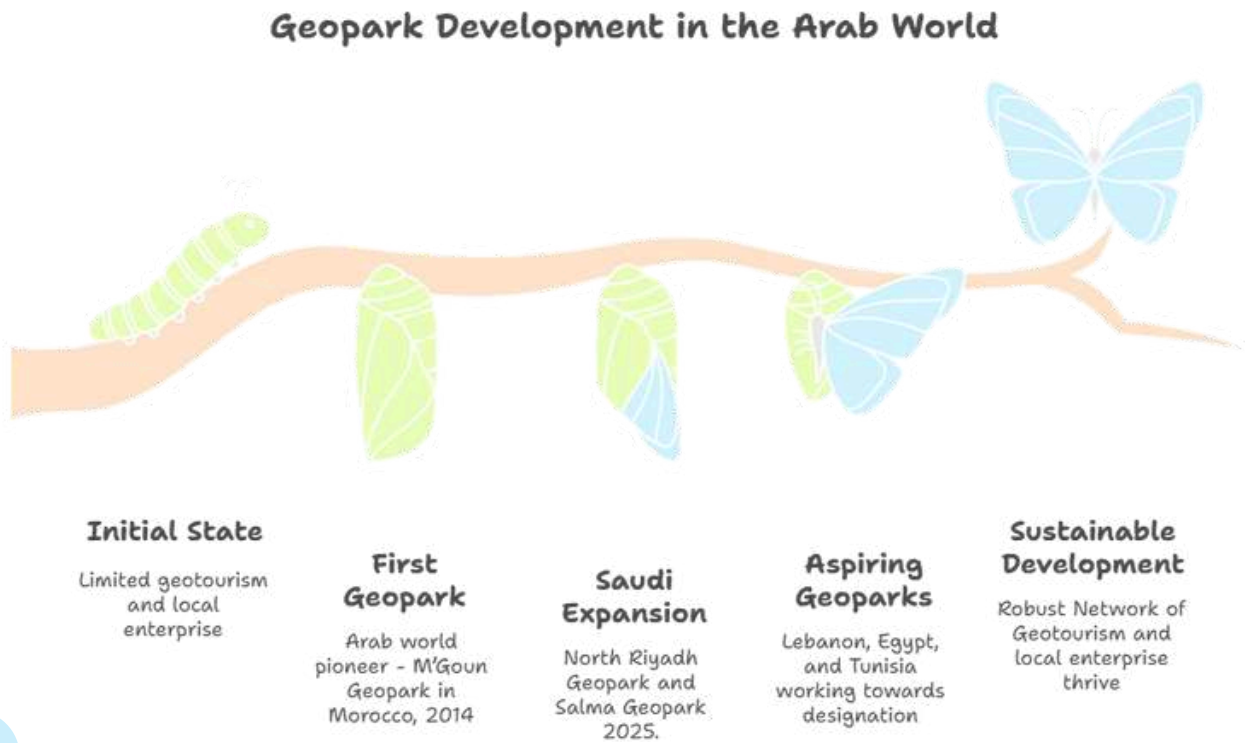
The UNESCO network provides the institutional backbone for this work. The ArabMAB network, launched in 1997, now connects 36 Biosphere Reserves across 14 countries, creating a framework for scientific cooperation and knowledge exchange (UNESCO, 2023). The UNESCO Global Geopark network is more nascent but gaining significant momentum, with Morocco's M'Goun Geopark (2014) serving as a regional pioneer.

ArabMAB Network: Structure and Function

The ArabMAB network operates through a Coordinating Council that meets regularly to elect leaders and establish biennial work plans. Its key functions include:

UNESCO Global Geoparks in the Arab Region

The development of Geoparks in the Arab region has been more gradual compared to other regions, but recent years have seen significant progress:



M ' goun Geopark, Morocco


North Riyadh Geopark, KSA

1.3. Strategic Foundations: Networks, Challenges, and Opportunities

The Arab region's engagement with UNESCO's ecological and earth science programs is grounded in both environmental necessity and scientific opportunity. Despite facing significant challenges, the region possesses substantial scientific and institutional assets:

- **Research Output:** The region demonstrates robust intellectual capacity, with research institutions in Saudi Arabia producing >15,000 scientific publications and Qatar >8,100, particularly in water science, climate modeling, and biodiversity (SCImago, 2022).
- **UNESCO Chairs and Centres:** A network of UNESCO Chairs and Category II Centres focused on critical areas such as water governance, desalination, water-energy-food nexus, and geoparks development. These institutions serve as "operational hubs of excellence" bridging research with technical assistance and capacity building.
- **Growing Interest in UNESCO Designations:** An unprecedented number of new Biosphere Reserve applications (35 from 5 new countries, including Arab nations) signals growing global interest in these sites as tangible contributors to national and global biodiversity and climate goals.

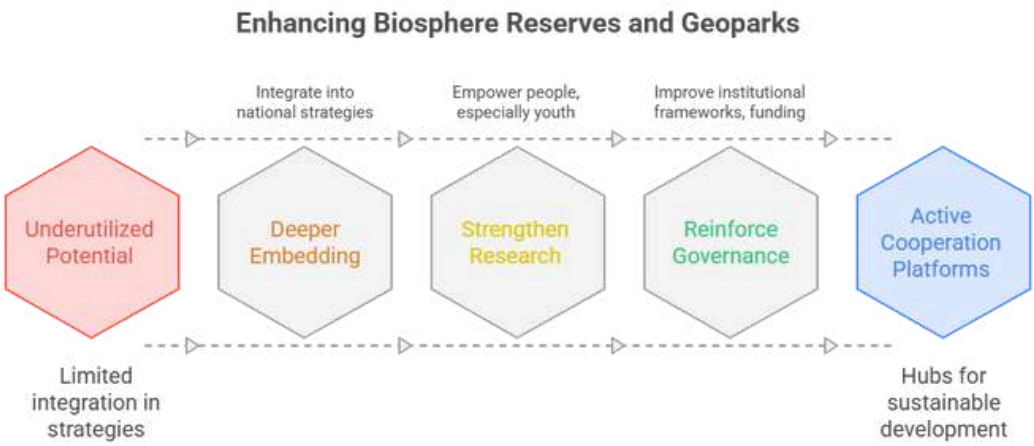
Key Priorities for Joint Action

Three key priorities for UNESCO and its partners' joint action have been identified, particularly in light of the Hangzhou MAB Strategic Action Plan (2026-2035):

- **Deeper Integration of Biosphere Reserves and Geoparks into National and Local Strategies:** Emphasizing the need to embed these sites into national sustainable development and biodiversity strategies, addressing the current oversight where national reports to the The Convention on Biological Diversity (CBD) often fail to highlight these sites' contributions.
- **Strengthening Research, Education, and Youth Engagement:** Emphasizing knowledge sharing, citizen science, open science, and combining traditional wisdom with cutting-edge research. This includes initiatives that integrate youth into conservation efforts.
- **Reinforcing Governance, Funding, and Capacity Building:** Through new partnerships and twinning programs to ensure sites are "vibrant and inclusive and resilient in practice." This includes developing sustainable financing mechanisms and strengthening institutional frameworks for site management.

The Arab Region as a Bridge Between Continents

The Arab region's unique geographical position as a "bridge between continents" facilitates Mediterranean and African synergies, particularly evident in the transboundary nature of delta systems that connect multiple countries and ecosystems. This location enables ambitious South-South cooperation projects like transboundary biosphere corridors, shared data platforms, and Sahara solar initiatives, offering collective solutions for water, food, and biodiversity challenges. The Nile Delta, for instance, represents a critical node in this continental bridge, where upstream-downstream cooperation across eleven countries is essential for addressing sediment flow management, water allocation, and ecosystem restoration. For example, the Intercontinental Biosphere Reserve of the Mediterranean, shared by Spain and Morocco, is already considered a model of integrated management and cooperation that could be replicated for delta systems, creating networks of delta reserves that span political boundaries while addressing shared environmental challenges through coordinated conservation and sustainable development strategies.



UNESCO Chairs	Host	Country
Water, Women and Decision-making	Al-Akhawayn University	Morocco
Aflaj Studies - Archaeohydrology	University of Nizwa	Oman
Sustainable Water Resources Management	Islamic University of Gaza	Palestine
Desalination and Water Treatment	Qatar University	Qatar
Water Resources	Omdurman Islamic University	Sudan
Water, Energy and Food Security for Sustainable Development	IHE Delft / Al-Balqa Applied University	Jordan
Water Diplomacy / Water for Sustainable Development	Jordan University of Science and Technology	Jordan
Marine Biology and Oceanography	An-Najah National University	Palestine
Sustainable Development	University of Tunis	Tunisia
Marine Biotechnology	United Arab Emirates University	UAE
Geoparks, Geo-tourism, and Sustainable Development	Mohammed V University	Morocco

UNESCO Category II Centres	Country
Regional Centre for Training and Water Studies of Arid and Semi-Arid Zones (RCTWS)	Egypt
Arab Regional Centre for World Heritage (ARC-WH)	Bahrain
International Centre for Water and Sanitation (ISWAC)	Iraq
International Centre on Water for Sustainable Development (i-WSSM)	Jordan
Regional Centre for Water Harvesting (RCWH)	Sudan
International Center for Biosaline Agriculture (ICBA)	UAE
Regional Center for Drought and Water Scarcity Management for West Asia and North Africa	UAE

Research Centers, Chairs and Facilities concerned with BR and Geoparks

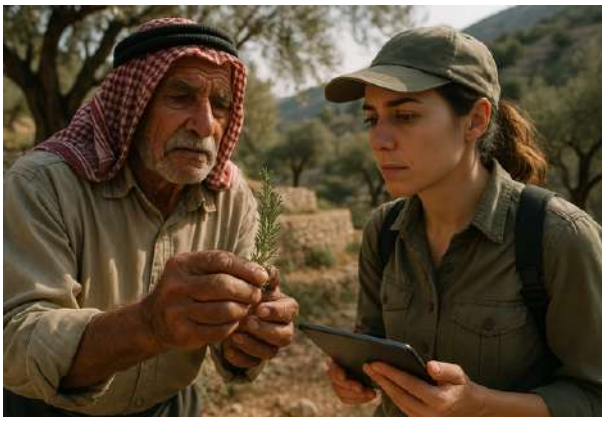
Camel Rock, Sharjah, UAE

Part II: Methodological Framework for Analysis

2.1. The "Living Laboratory" Concept

The core methodology for assessing UNESCO sites is the "living laboratory" concept. This frames Biosphere Reserves and Geoparks not as static protected areas, but as dynamic socio-ecological systems where scientific research, monitoring, and experimentation can be conducted to test and scale up innovative approaches to sustainable development. This report evaluates the sites based on their effectiveness in fulfilling this function—bridging the gap between scientific knowledge, policy-making, and community action on the ground.

- **Experimental Approaches to Sustainable Development:** Sites serve as testing grounds for innovative approaches to sustainable land management, water conservation, renewable energy, and community-based natural resource management. For example, the Shouf Biosphere Reserve in Lebanon has experimented with terrace restoration techniques that combine traditional knowledge with modern soil conservation methods.
- **Long-Term Ecological Research:** Many sites host long-term monitoring programs that track changes in biodiversity, ecosystem health, and climate impacts. The Marawah Biosphere Reserve in the UAE, for instance, conducts long-term ecological monitoring of its marine ecosystems, providing valuable data on coral resilience to warming waters.
- **Knowledge Co-Production:** Sites facilitate collaboration between scientists, local communities, and policymakers to co-produce knowledge that is both scientifically rigorous and locally relevant. This approach is evident in the water management projects in Morocco and Tunisia, where traditional water management knowledge is being documented and integrated with modern hydrological science.
- **Scaling Up Successful Practices:** Successful approaches developed in individual sites are scaled up to broader landscapes and integrated into national policies. The revival of the Hima system in Jordan and Lebanon, for example, has been scaled from pilot sites to broader landscapes through policy integration and capacity building.



2.2. A Tripartite Analytical Framework

All findings are analyzed through the following three pillars:

Governance and Institutional Architecture

This pillar examines the legal, financial, and participatory structures that enable or constrain the sites. It assesses the effectiveness of management models, the degree of integration with national policies, and the challenges of inter-ministerial coordination and sustainable financing. Effective governance is the most significant underlying challenge for sustainable development in the Arab region, directly impacting environmental sustainability and human well-being.

Governance fragmentation across multiple ministries remains the single most critical obstacle to effective management.

Governance Models in Practice

The Arab region exhibits a diversity of governance models for UNESCO sites, each with strengths and challenges:

- **State-Led Models:** In some countries, UNESCO sites are managed primarily by government agencies, often with limited community participation. While this approach can ensure alignment with national policies, it often struggles with limited resources and insufficient local engagement.
- **Community-Based Models:** Some sites, particularly those with strong traditional governance systems, are managed primarily by local communities. The Hima reserves in Jordan and Lebanon are managed by local communities according to traditional principles, with support from NGOs and government agencies.
- **Association-Led Models:** The M'Goun Geopark in Morocco is managed by an association under Moroccan law, with a governing board implementing UNESCO's criteria. This model fosters annual work programs and protection efforts for geological, cultural, archaeological, ecological, and biological heritage.
- **Hybrid Models:** Many sites employ approaches that combine elements of state, community, and association management, attempting to balance policy alignment with local participation and ownership.

Socio-Ecological Resilience

This pillar focuses on the scientific basis for how these sites contribute to the resilience of both ecosystems and human communities in the face of shocks, particularly climate change and resource scarcity. It analyzes the application of Natural Culture-Based Solutions (NBS) and the data-driven monitoring of environmental health. The region's acute vulnerability to climate change makes this dimension particularly critical.

Climate Resilience Strategies

UNESCO sites in the Arab region are implementing diverse strategies to enhance climate resilience:

- **Ecosystem-Based Adaptation:** Many sites implement approaches that harness biodiversity and ecosystem services to help communities adapt to climate change. For example, mangrove restoration in the UAE's Marawah Biosphere Reserve provides coastal protection, carbon sequestration, and nursery habitats.
- **Water Security Initiatives:** Sites implement innovative water management approaches, including traditional water harvesting systems, modern irrigation efficiency measures, and groundwater recharge techniques. The Aflaj systems in Oman are being revitalized and integrated with modern water management approaches.
- **Sustainable Livelihoods:** Many sites develop livelihood options resilient to climate change, such as climate-smart agriculture, ecotourism, and value-added processing of local products.

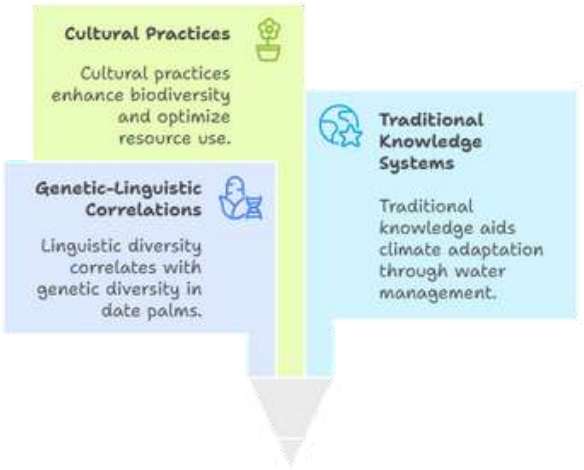
Heritage-Based Solutions

This pillar advances a paradigm shift, recognizing that in the Arab region, ecological sustainability is inextricably linked to cultural heritage. It assesses the degree to which sites successfully integrate TEK, agrobiodiversity, and cultural practices into their core management strategies, thereby treating heritage not as a relic to be preserved, but as a dynamic asset for solving contemporary problems.

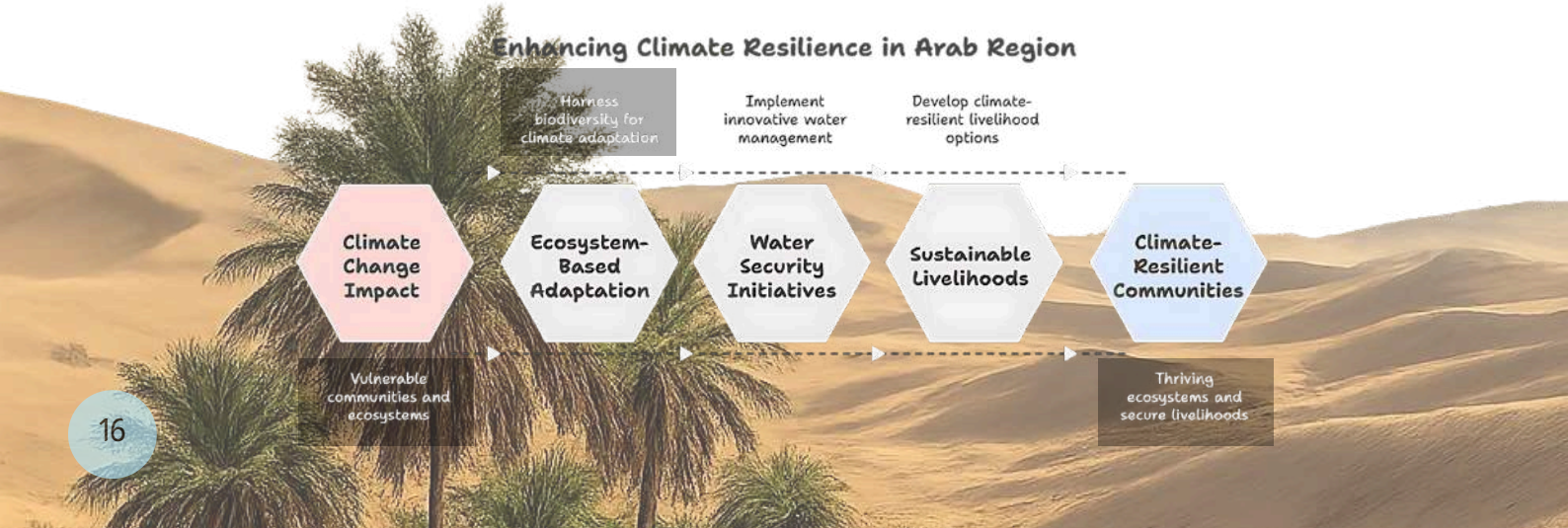
Biocultural Diversity as a Foundation for Resilience

The concept of biocultural diversity—the interdependent relationship between biological and cultural diversity—emerges as a critical measure of ecosystem health and resilience in the Arab region:

- **Genetic-Linguistic Correlations:** Research in the Oases du Sud Marocain Biosphere Reserve, demonstrates a direct correlation between linguistic diversity and genetic diversity of date palms. The local Amazigh language contains specific terminology for traditional cultivation techniques, water management practices, and genetic selection processes.



- **Traditional Knowledge Systems:** Sophisticated traditional knowledge systems, particularly related to water management and agriculture, represent invaluable assets for climate adaptation. The Aflaj system in Oman employs precise water allocation mechanisms based on stellar observations.
- **Cultural Practices and Ecosystem Services:** Traditional agricultural practices in arid areas—such as three-tiered cultivation, crop rotation, and organic fertilization—enhance biodiversity, improve soil fertility, and optimize water use efficiency.
- **Social Cohesion:** The preservation and revitalization of biocultural diversity strengthen social cohesion and community resilience by maintaining intergenerational knowledge transfer, fostering collective identity, and creating shared responsibility for natural resource management. Traditional governance systems like the Hima reserves demonstrate how cultural practices of cooperation and mutual support not only conserve biodiversity but also build social capital that enables communities to better withstand environmental shocks and adapt to changing conditions, creating a virtuous cycle where cultural preservation enhances ecological resilience and vice versa.



Part III: Scientific and Thematic Analysis: Findings from the Field

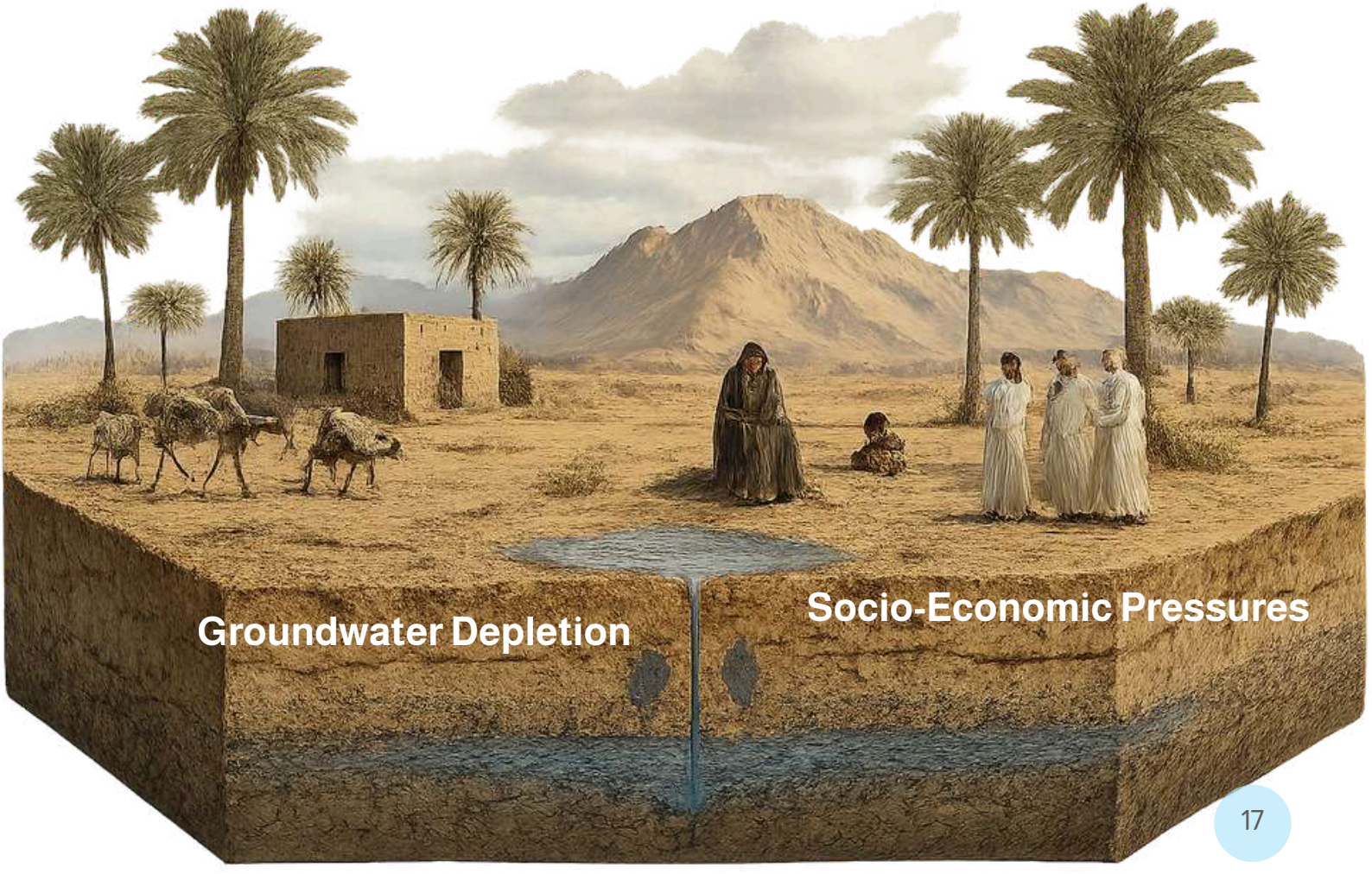
3.1. Arid Land Systems: Traditional Water Management Systems as a Microcosm of Resilience within the MAB Framework

Traditional water management systems represent quintessential socio-ecological systems within the Arab region's Biosphere Reserves, embodying the MAB program's core objective of reconciling biodiversity conservation with sustainable use. These systems face existential threats from groundwater depletion—exceeding recharge by up to 1.1 billion cubic meters annually in some areas—climate change reducing precipitation by nearly 30% in key regions, and socio-economic transformations disrupting traditional management practices.

Groundwater depletion exceeds recharge by up to 1.1 billion cubic meters annually in some arid areas

The MAB Program's Approach to Traditional Water Conservation Systems

Within the MAB framework, traditional water management systems in arid areas, are recognized as complex socio-ecological systems that require integrated approaches to conservation and sustainable development. The MAB program's three-zone concept provides a structural approach to their management:



Heritage-Based Solutions: The Biocultural Diversity Paradigm in MAB Reserves

The MAB program promotes a paradigm shift toward recognizing historically arid areas as heritage-based solutions rather than purely technical water management challenges. Research in the Oases du Sud Marocain Biosphere Reserve, demonstrates a direct correlation between linguistic diversity and genetic diversity of date palms, showing how traditional knowledge systems maintain and enhance biodiversity over centuries.

Case Studies: MAB Reserves as Models for Water Management in Arid Areas

Oases du Sud Marocain, Morocco

- **Approach:** Integrated management
- **Innovation:** Traditional khettaras + modern infrastructure
- **Water Management:** Hybrid resilient systems
- **Focus:** Sustainable development in buffer zones
- **Results:** Enhanced water security

UNESCO Cairo competition "WEFE Trail in Motion"

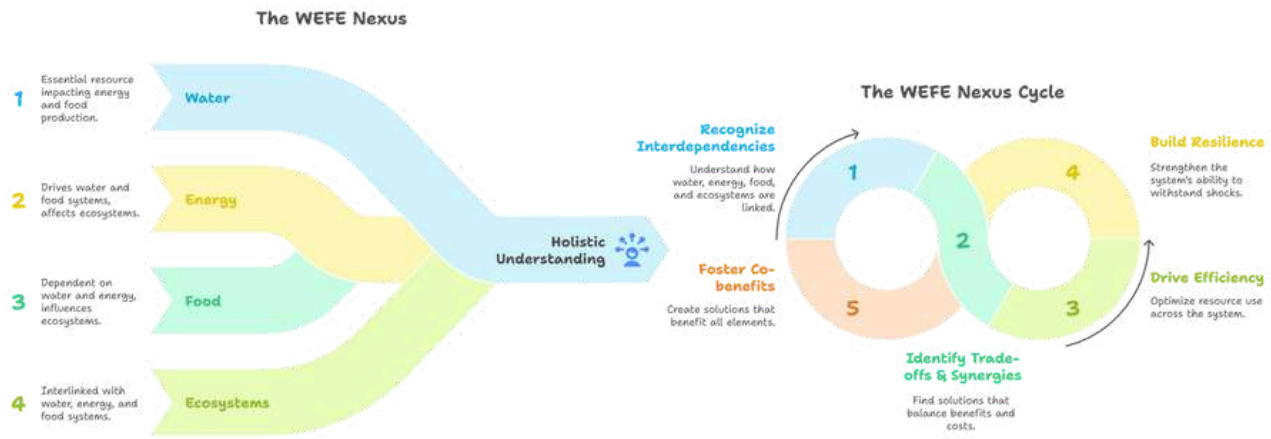
- **Approach:** Integrated cultural solutions
- **Innovation:** Traditional khettaras + modern infrastructure
- **Water Management:** Hybrid resilient systems
- **Focus:** Sustainable development in arid areas
- **Results:** Enhanced water security and WEFE nexus implementation

Oases du Sud Marocain Biosphere Reserve, Morocco

- **Integrated Management Approach:** Combines conservation of core areas with sustainable development in buffer and transition zones within the MAB framework.
- **Water Management Innovation:** Combines traditional khettaras systems with modern infrastructure, creating resilient hybrid systems that address water scarcity challenges.

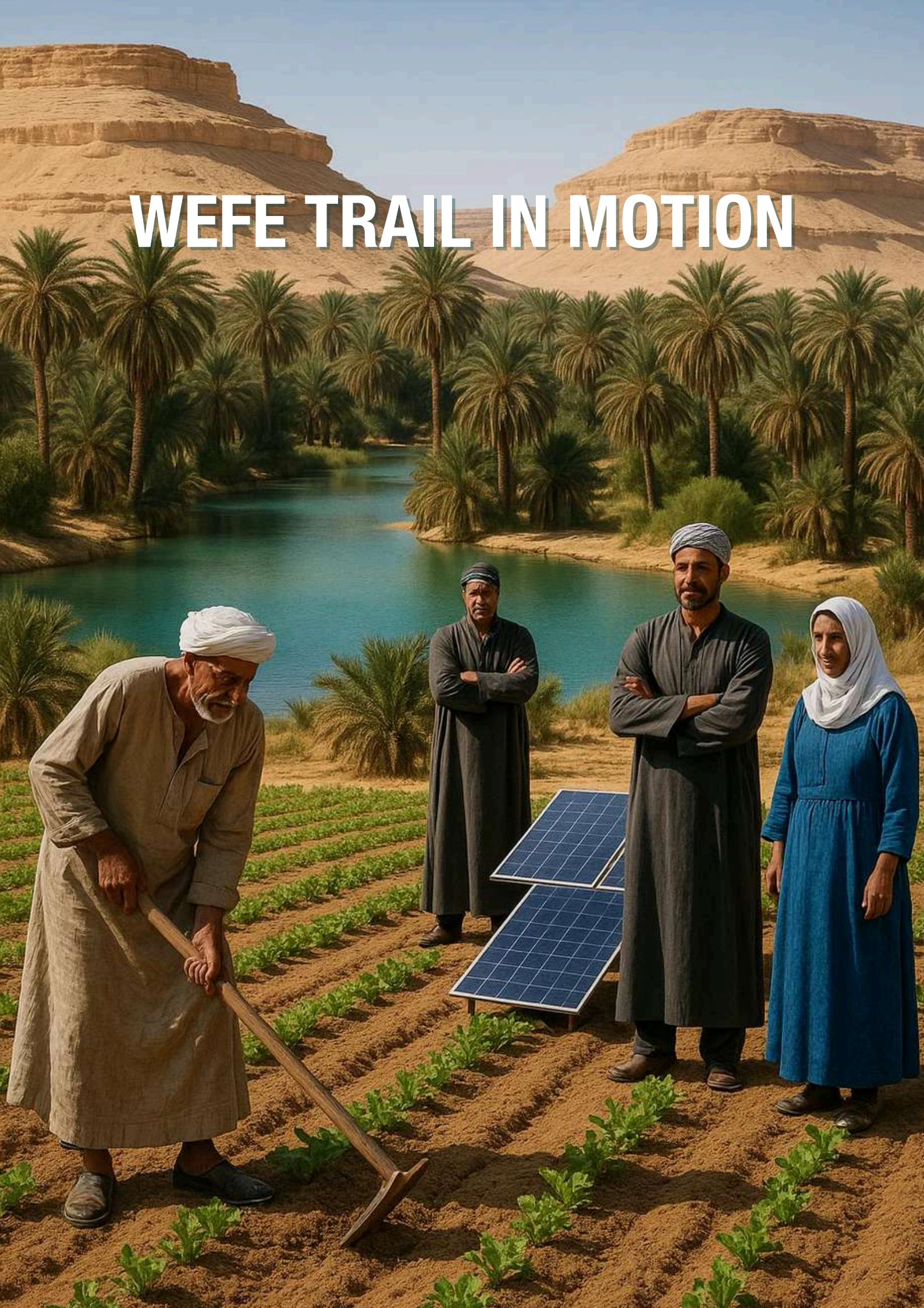
UNESCO Cairo competition "WEFE Trail in Motion"

exemplifies this innovative approach by combining WEFE Nexus principles with cultural pillars in arid landscapes of Egypt. This initiative demonstrates how traditional cultural practices can be translated into modern technological WEFE solutions, creating a bridge between ancestral wisdom and contemporary innovation. For instance, ancient water harvesting techniques and traditional agricultural calendars have informed the development of smart irrigation systems and precision farming technologies that optimize water use while enhancing food production. Similarly, traditional energy practices, such as the use of wind energy for grain processing, have inspired modern renewable energy solutions that power water pumping and food processing facilities while preserving ecosystem services.




Oases du Sud Marocain Biosphere Reserve

WEFE TRAIL IN MOTION



3.2. Coastal Systems: Blue Carbon and Climate Adaptation in MAB Reserves

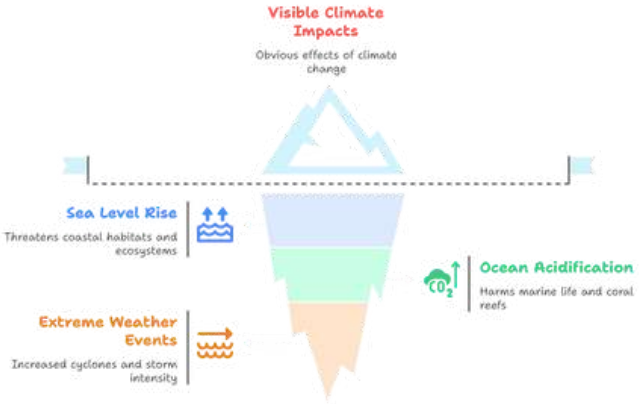
Coastal Biosphere Reserves in the Arab region represent critical frontline areas for climate change impacts and adaptation efforts. These reserves protect vital blue carbon ecosystems while serving as testing grounds for innovative approaches to climate resilience within the MAB framework.

Blue carbon ecosystems sequester carbon at rates up to ten times higher than terrestrial forests.

Climate Vulnerability of Coastal Ecosystems in MAB Reserves

Coastal Biosphere Reserves in the Arab region are on the frontlines of climate change impacts:

- **Sea Level Rise:** Many coastal Biosphere Reserves are vulnerable to sea level rise, which threatens critical habitats such as mangroves, seagrass beds, and nesting beaches.
- **Ocean Acidification and Warming:** Marine ecosystems within Biosphere Reserves are experiencing impacts that threaten coral reefs, shellfish, and other marine organisms.
- **Extreme Weather Events:** Coastal Biosphere Reserves are experiencing increased frequency and intensity of extreme weather events, including cyclones and storms.

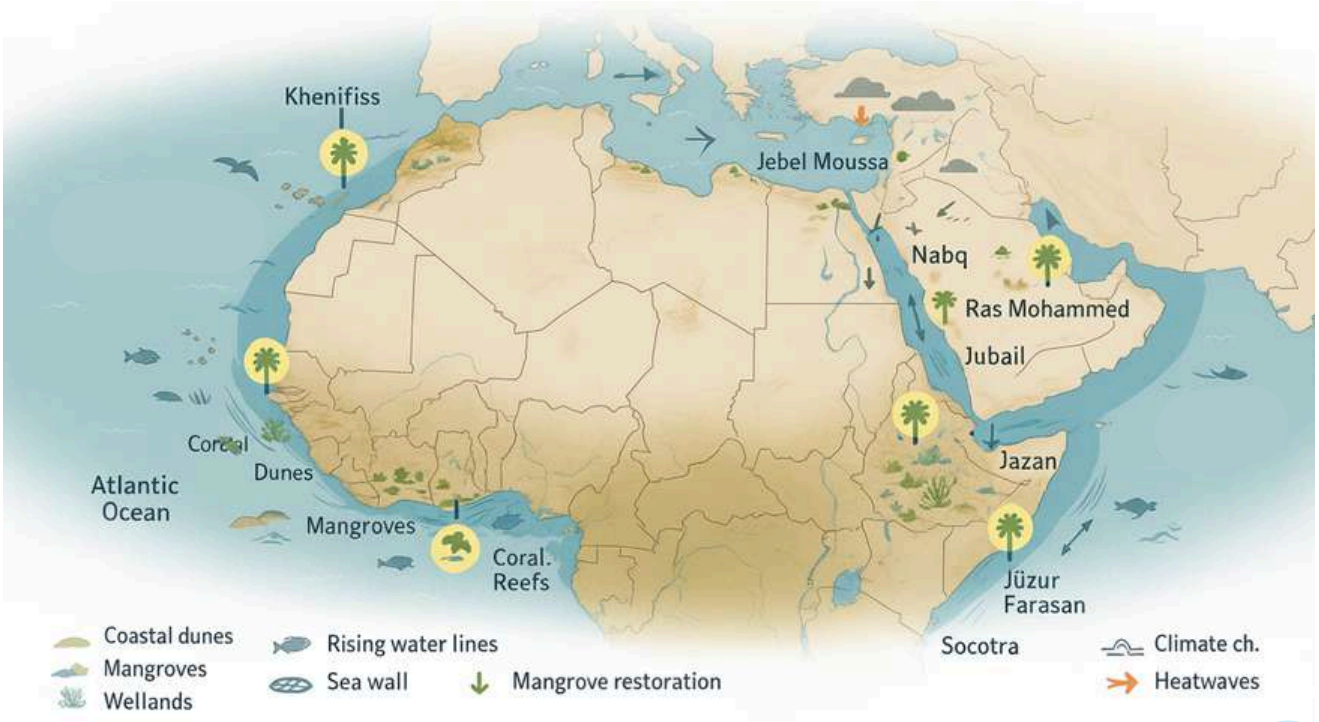


Case Study: Marawah Biosphere Reserve as a MAB Model for Coastal Resilience

The Marawah Biosphere Reserve in the UAE exemplifies the MAB program's approach to coastal conservation and climate adaptation. Designated in 2007, it is the largest marine protected area in the Arabian Gulf, covering 4,255 square kilometers.

Marawah Biosphere Reserve: Key Features

- **MAB Zonation and Management:** Implements comprehensive zonation with core areas including sensitive marine ecosystems, buffer zones for sustainable resource use, and transition areas for sustainable development.
- **Blue Carbon Quantification:** Development of a "blue carbon mapping toolkit" quantifies carbon stored in mangroves, seagrass, and salt marshes, supporting climate reporting and policy development.
- **Nature-Based Solutions:** Implementation of innovative approaches including drone-based mangrove planting and aerial seeding for desert rangeland restoration.



3.3. Mountain Systems: Geoheritage, Agrobiodiversity, and Sustainable Development in MAB Reserves

Mountain Biosphere Reserves in the Arab region represent critical areas for biodiversity conservation, cultural heritage preservation, and sustainable development. These reserves face unique challenges including climate change impacts, land degradation, and socio-economic pressures.

Climate Vulnerability of Mountain Ecosystems in MAB Reserves

Mountain Biosphere Reserves are particularly vulnerable to climate change impacts:

- **Temperature Increases:** Mountain areas are experiencing temperature increases at rates higher than the global average, affecting snow cover, glacier melt, and water availability.
- **Changes in Precipitation:** Alterations in precipitation patterns affect water resources and increase risks of landslides and floods.
- **Biodiversity Impacts:** Climate change is causing shifts in species distributions with implications for ecosystem functioning and services.

Case Study: Shouf Biosphere Reserve as a MAB Model for Mountain Conservation

The Shouf Biosphere Reserve in Lebanon exemplifies the MAB program's approach to mountain conservation. Designated in 2005, it covers approximately 50,000 hectares of mountain terrain and is one of the largest protected areas in the Middle East.

The Shouf Biosphere Reserve covers approximately 50,000 hectares, making it one of the largest protected areas in the Middle East

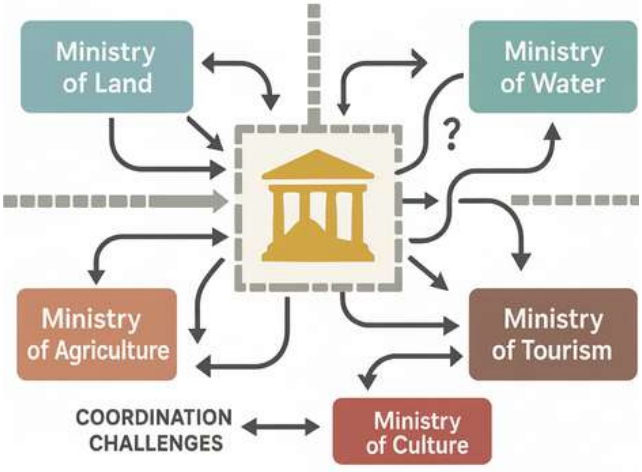
- **Agrobiodiversity Conservation:** Implements terrace restoration, community seed banks, and promotion of traditional crop varieties, embodying the MAB program's approach to integrating conservation with sustainable development.
- **Value Chain Development:** Supports development of value chains for local products, particularly those produced by women's cooperatives, demonstrating economic incentives for conservation.
- **Cultural Heritage Integration:** Integrates cultural heritage preservation with biodiversity conservation, recognizing interconnections between natural and cultural diversity.

Part IV: Cross-Cutting Synergies and Systemic Challenges

4.1. The Governance Deficit and the Path Forward

Fragmented governance remains the single most critical obstacle to the effective management of UNESCO sites in the Arab region. Responsibilities for land, water, agriculture, tourism, and culture are often siloed in different ministries, hindering the integrated, landscape-level management required by UNESCO designations.

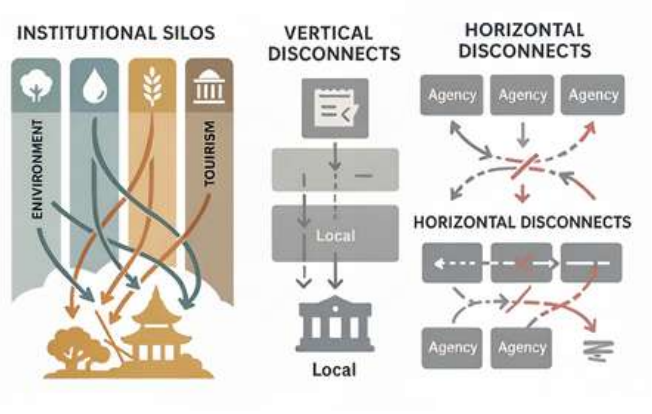
Fragmented governance across multiple ministries remains the single most critical obstacle to effective management of UNESCO sites in the Arab region.



The Challenge of Fragmented Governance

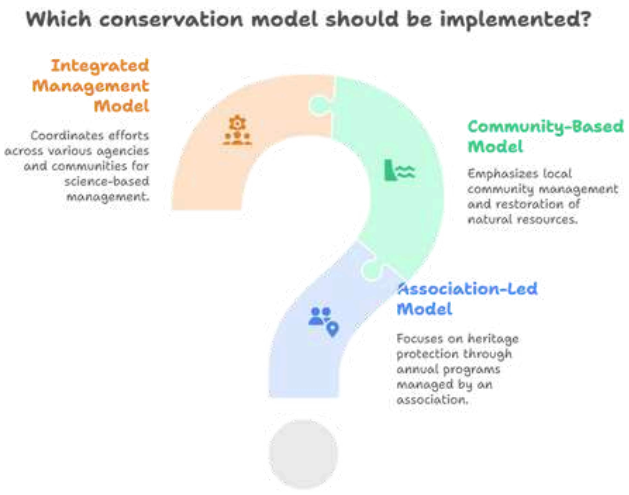
Governance fragmentation manifests in various ways:

- **Institutional Silos:** Environmental responsibilities split between ministries of environment, water, agriculture, and tourism, leading to overlapping mandates and coordination challenges.
- **Vertical Disconnects:** Disconnect between national policies and local implementation, where local authorities may lack capacity, resources, or political will.
- **Horizontal Disconnects:** Weak coordination among different government agencies at the same level, leading to duplicated efforts and conflicting policies.



Successful Governance Models

- **Association-Led Model (M'Goun Geopark):** Managed by an association under Moroccan law, fostering annual work programs and protection efforts for geological, cultural, archaeological, ecological, and biological heritage.
- **Community-Based Model (Hima System):** Local communities manage natural resources according to traditional principles with support from NGOs and government agencies, successfully restoring degraded rangelands.
- **Integrated Management Model (Marawah Biosphere Reserve):** Coordinated approach across government agencies, research institutions, and local communities enabling science-based management.



4.2. The Untapped Potential of Multi-Designated Areas and OECMs

A significant strategic opportunity lies in integrating different UNESCO designations. Landscapes with multiple designations could benefit from harmonized management plans that create economies of scale for conservation and tourism. The framework of "Other Effective Area-based Conservation Measures (OECMs)" offers a powerful tool to legally recognize and support traditional community-managed areas.

OECMs can help nations achieve global biodiversity targets like "30x30" through traditional conservation approaches

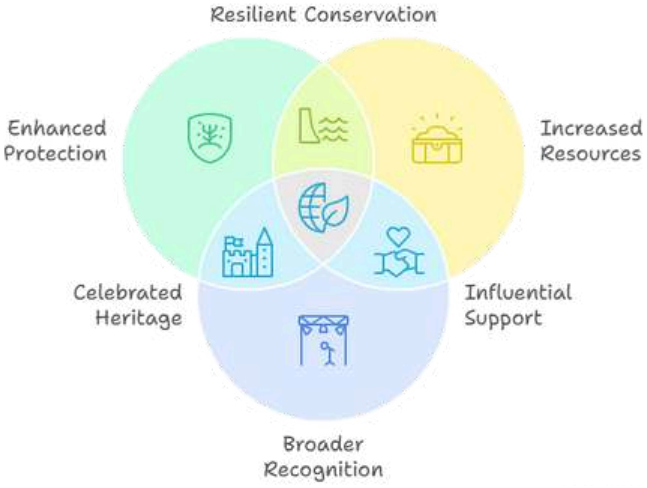
Multi-Designated Areas: Synergies and Benefits

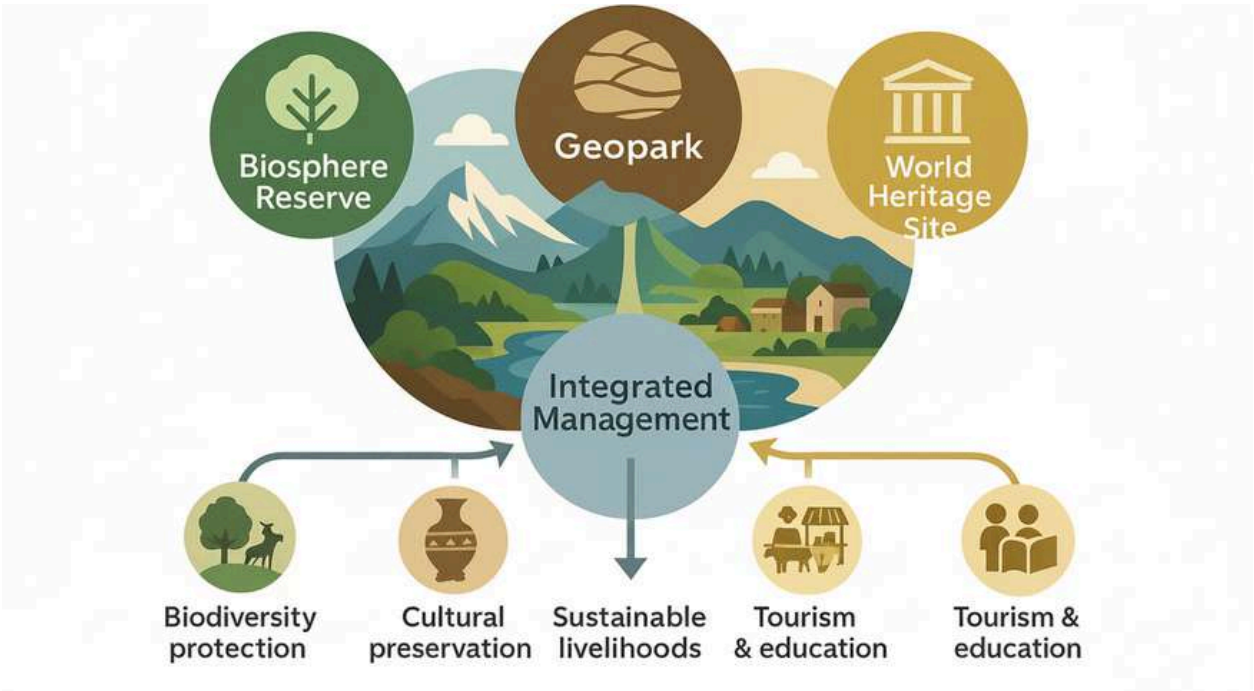
- **Enhanced Protection:** Multiple designations provide complementary layers of protection, addressing different aspects of conservation (biodiversity, geological heritage, cultural values).
- **Increased Resources:** Multiple designations attract diverse funding streams and technical support from different UNESCO programs and partners.
- **Broader Recognition:** Multiple designations raise the profile of sites, attracting more visitors, researchers, and international attention.

OECMs in the Arab Context

In the Arab region, the OECM framework is particularly relevant given the long history of community-based conservation and traditional resource management systems:

- **Hima System:** The traditional Hima system of rangeland management, revived in Jordan and Lebanon, represents a prime example of community-based conservation that could be recognized as an OECM.
- **Tribal-Managed Grazing Reserves:** Many areas are managed by tribal communities according to traditional practices that conserve biodiversity and ecosystem services.
- **Municipal Water-Protection Zones:** Areas managed by municipalities for water protection often achieve biodiversity conservation as a secondary benefit.





4.3. The Urgent Need for Human Capital: Youth and Citizen Science

The long-term success of UNESCO's MAB and Geopark programs in the Arab region depends on the next generation of scientists, managers, and community leaders. The Arab region has one of the youngest populations in the world, with approximately 60% under age 25. Initiatives that engage youth and promote citizen science offer dual benefits: addressing chronic data gaps and fostering environmental stewardship.

Approximately 60% of the Arab region's population is under the age of 25, representing enormous potential for environmental engagement

Youth Engagement Initiatives

Citizen Science: Expanding Scientific Participation

Citizen science involves members of the public in scientific research and offers several benefits for UNESCO sites:

- **Addressing Data Gaps:** The region faces chronic gaps in environmental data. Citizen science can help fill these gaps by mobilizing large numbers of people for data collection.
- **Building Public Awareness:** Participation in citizen science fosters greater awareness and understanding of environmental issues among participants and the broader public.
- **Fostering Ownership:** When local communities participate in scientific monitoring, they develop greater sense of ownership and stewardship for local ecosystems.

Part V: A Strategic Roadmap for Regional Action

Pillar 1: Institutional Strengthening & Governance Reform

Establishing robust governance structures and institutional frameworks to support UNESCO sites in the Arab region.

Action 1.1: Establish Thematic Working Groups

Form interdisciplinary working groups focused on key ecosystems to facilitate peer-to-peer learning:

Action 1.2: Launch a High-Level Policy Initiative

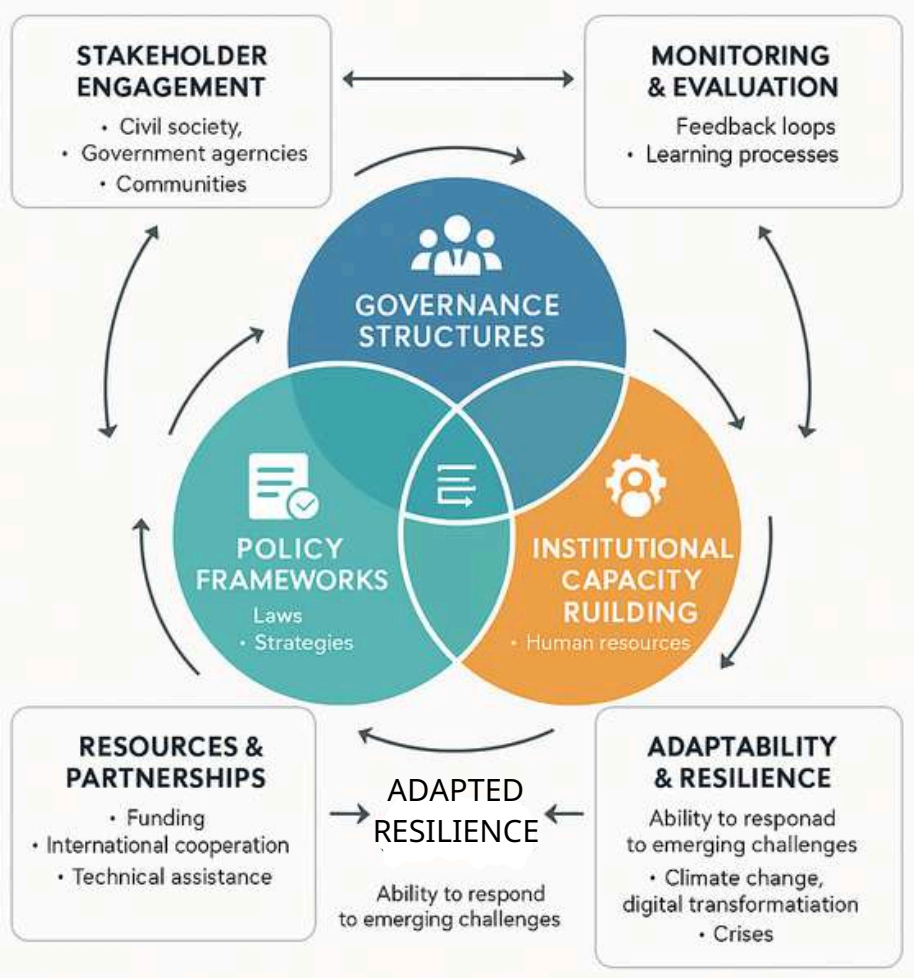
Work with the League of Arab States to systematically integrate UNESCO's MAB Programme and Global Geoparks initiatives into core governmental agendas. Prepare policy briefs, organize high-level dialogues, develop integration guidelines. Timeline: Policy briefs by Q1 2026; dialogues by Q2 2026; guidelines by Q4 2026.

Action 1.3: Establish a Permanent Water Management Committee Emphasizing Cultural Practices

Create a permanent institutional mechanism for regional coordination, policy development, and resource mobilization for heritage conservation and sustainable development for cultural water management practices under the Arab Ministerial Council on Water. Timeline: Proposal development by Q4 2025; establishment by Q2 2026.

Action 1.4: Reform Perverse Subsidies

Assess and reform government subsidies for water and energy that incentivize over-exploitation of finite resources, particularly groundwater in arid systems. Timeline: Assessment completed by Q3 2026; policy options developed by Q1 2027.



Pillar 2: Advancing Site-Based Science & Knowledge Management

Site-Based Science

Enhancing scientific research and knowledge management to support evidence-based decision making.

Action 2.1: Create a Regional Knowledge Platform

Develop a comprehensive digital platform to share data, scientific publications, case studies, and best practices on wa, Biosphere Reserve, and Geopark management. Timeline: Platform design by Q2 2026; core modules by Q4 2026; full operationalization by Q2 2027.

Action 2.2: Traditional Ecological Knowledge Documentation Program

Launch an urgent, region-wide program to document TEK related to water management, agrobiodiversity, and climate adaptation, combining it with scientific validation. Timeline: Methodologies by Q3 2026; documentation teams by Q4 2026; documentation completed by Q4 2027.

Action 2.3: Implement a Common Monitoring Framework

Develop standardized framework with clear hydrological, ecological, and socio-economic indicators to track site health and enable adaptive management. Timeline: Indicator framework by Q2 2026; protocols and systems by Q4 2026; implementation by Q2 2027.

Pillar 3: Unlocking Sustainable Finance & Livelihoods

Sustainable Finance

Developing innovative financing mechanisms and sustainable livelihood opportunities for local communities.

Action 3.1: Reinforce National and Regional Agendas With Financial Partners

Form a high-level group to champion UNESCO sites as investment-ready 'natural infrastructure' for climate resilience. This alliance must establish direct working relationships with the Green Climate Fund (GCF) and Global Environment Facility (GEF) secretariats, creating specialized working groups that systematically map funding opportunities, prepare tailored proposals meeting fund requirements, and maintain ongoing communication with regional and national fund representatives. These working groups will serve as the primary interface between UNESCO sites and climate finance institutions, preparing regular reports, organizing consultations with fund representatives, and ensuring UNESCO site adaptation plans integrate seamlessly into national climate strategies eligible for GCF and GEF financing.

Action 3.2: Launch a Regional Value Chain Development Program

Create sustainable value chains for unique biosphere products and promote sustainable geotourism. This program will establish direct coordination with GCF and GEF secretariats through dedicated working groups that develop investment-ready proposals demonstrating clear climate co-benefits. These groups will engage directly with fund country teams and regional offices to align project design with funding priorities, conduct pre-feasibility studies, and prepare detailed financing applications. The working groups will also serve as technical advisors to national governments, helping integrate UNESCO site projects into National Adaptation Plans and other climate planning documents required for climate finance access.

Action 3.3: Design Multi-National Project Proposals

Shift from single-country projects to larger, regionally-focused initiatives addressing shared challenges. This action establishes a regional coordination mechanism working directly with GCF and GEF secretariats to develop multi-country programs leveraging the scale these funds prioritize. Specialized working groups composed of country experts, UNESCO site representatives, and climate finance specialists will collaborate on comprehensive regional programs, maintaining continuous dialogue with fund secretariats to understand evolving priorities and requirements.

Pillar 4: Cultivating Human Capital & Regional Leadership

Human Capital

Building capacity and leadership for the next generation of environmental stewards.

Action 4.1: Establish a Recurring Arab Youth Leadership Program

Create a recurring program using Biosphere Reserves and Geoparks as campuses for hands-on training in conservation science, governance, and social enterprise. Timeline: Strategy by Q3 2026; training centers by Q1 2027; mentorship programs by Q2 2027.

Action 4.3: Craft a Unified Vision for Global Agendas

Convene key MAB and Geopark delegates from Arab countries to craft a unified position paper and common proposals for international forums. Timeline: Preparatory meeting by Q2 2025; position paper by Q3 2025; Congress participation September 2025.

Conclusion

UNESCO Biosphere Reserves and Global Geoparks in the Arab region represent critical platforms for addressing the complex interplay of environmental conservation, sustainable development, and climate resilience. Despite facing significant challenges—including water scarcity, climate vulnerability, governance fragmentation, and funding limitations—these sites are emerging as models of innovation and sustainability.

The success of these sites hinges on several key factors: effective governance structures that bridge traditional and contemporary management approaches; integration of traditional ecological knowledge with modern science; active community engagement in planning and management; enhanced regional cooperation and knowledge sharing; and innovative financing mechanisms that blend public and private funding.

The time for action is now - strategic implementation of this roadmap can ensure these unique systems continue to sustain communities and biodiversity for generations to come

As the Arab region faces increasing environmental challenges, UNESCO-designated sites offer proven models for resilience and sustainability. By investing in these sites and the communities that steward them, the region can preserve not only critical ecosystems but also valuable cultural heritage and traditional knowledge that can guide sustainable development in an increasingly challenging world.

The challenge is significant, but the strategic framework outlined in this report demonstrates that the solutions are within reach—if we have the wisdom to learn from the past and the courage to embrace a new paradigm for the future.

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North Riyadh Geopark

PREPARED BY:

UNESCO Regional Office for Egypt and Sudan
Liaison Office with the League of Arab States