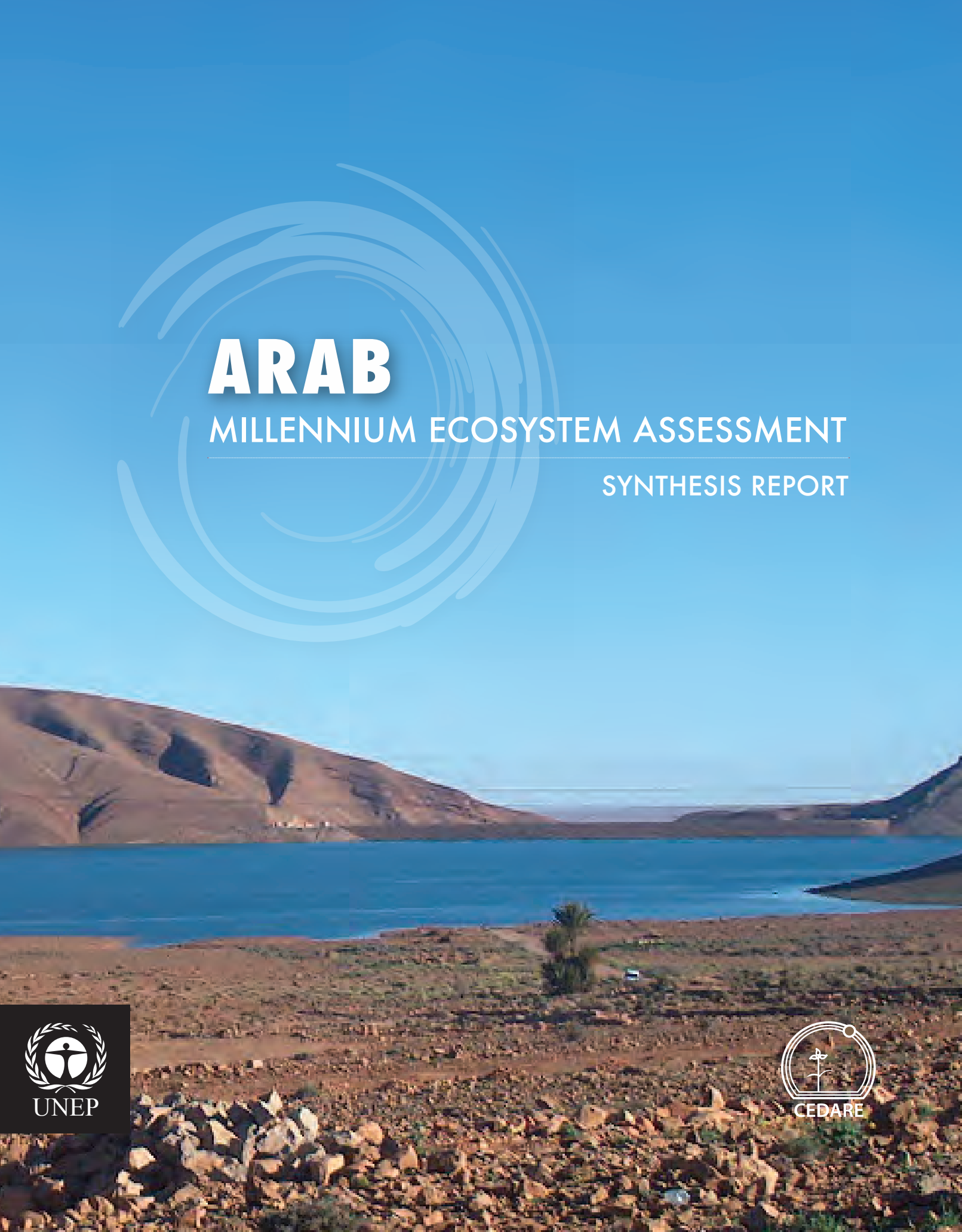
ARAB

MILLENNIUM ECOSYSTEM ASSESSMENT

SYNTHESIS REPORT



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UNEP

United Nations
Environment Programme
(UNEP)

CEDARE

Centre for Environment and
Development for the Arab Region and
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In Collaboration with:

Presidency of Meteorology and Environment (PME)

Ministry of Energy, Mines, Water & Environment, The Kingdom of Morocco

Suez Canal University

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FOREWORD

The Arab Region Sub-Global Assessment began as an associate assessment of the Millennium Ecosystem Assessment (MA). Its remit was to go beyond the global MA and pave the way for the adoption of integrated assessments in the Arab region. Three sites, representing the dominant ecosystems of the region, were selected as the focus of the study – the Sinai Peninsula in Egypt; the Tafilalet Oasis in Morocco; and the Assir National Park in Saudi Arabia.

This Arab Millennium Ecosystem Assessment Synthesis Report integrates the findings of these three assessments. It highlights the commonalities and differences between them and how they relate to the national, regional and global ecosystem. The report also looks at some of the more detailed findings for selected ecosystem services.

The report shows that, despite geographical differences, the three sites bear significant commonalities in a number of key areas, notably: hot, dry and continental climate patterns, water scarcity, resource depletion, land use change, desertification, soil erosion, sand encroachment, overpopulation and urbanization, poverty and unemployment.

The total population of Arab countries will be about 395 million by 2015. This rapid increase, together with changing consumption patterns, puts excessive pressure on fragile land. The report recognizes this

and shows that environmental degradation and diminishing ecosystem services severely impact human well-being and are direct causes of poverty and inferior quality of life. It identifies the most common ecosystem services as water, agriculture, grazing and raising cattle, aromatic and medicinal plants and biodiversity. It also identifies the most significant drivers of ecosystem change as water scarcity, land use change, the impact of extractive industries, and governance.

Water scarcity is a serious concern and the most influential driver on ecosystem services. While the population in the Arab

region accounts for five per cent of the world population, the region is the source of less than one per cent of the world's renewable fresh water. Water deficits and poor water quality jeopardize human security at many levels, and additional water shortage and pollution remain one of the biggest challenges.

The three assessments had a strong input from local inhabitants, who are inextricably linked to the conditions of the surrounding environment. The report provides abundant examples of how local knowledge has built a valuable body of information which reflects people's ability to combat environmental hardship. Local plants, for example, are used to augment food supplies, as is the case in both El Maghara and Tafilalet.

The report also acknowledges the many positive developments that have occurred in the Arab World since the Stockholm Conference. However, it reveals that these still fail to realize the aims of the Brundtland report, and only the GCC countries are considered likely to reach the MDGs by 2015. Critical to achieving these goals, the report emphasizes the need for a new paradigm: one that recognizes that environmental sustainability is the foundation upon which economic health depends. A number of interventions are proposed, occurring in three spheres of action: i) regenerating the ecosystem; ii) human resources development, which includes both social and economic interventions; and iii) institutional reforms.

Progress towards sustainable development is vitally dependent upon sound decision making. It is my hope that this report will not only meet the needs of decision-makers, but will help promote sound ecosystem management practices and sustainable development strategies to improve ecosystems and human well-being in the Arab region.

I would like to extend my thanks to the Government of the Kingdom of Saudi Arabia for providing initial financial support for this report, as well as the Center for Environment and Development for the Arab Region and Europe (CEDARE) for their continuous support and professionalism. I would also like to thank all of the authors and contributors for their painstaking work in realizing this important publication.

Achim Steiner

United Nations Under-Secretary General and Executive Director, United Nations Environment Programme

PREFACE

Ecosystems matter! The Arab region, this vast and cherished homeland, has been blessed with great wealth, its own unique natural resources, and has enriched us with the glory of its ancient civilizations.

While our region faces many interrelated environmental challenges, at the same time, they represent attractive opportunities for development. Partnerships, progressive thinking, scientific, technological and evidence-based knowledge, as well as strong determination and confidence, are key to meeting these challenges and reaffirming our commitment to a unified Arab vision for the environment, in line with global environmental thinking and action.

The Arab region's ecosystems, - our very life support systems - are subject to rapid depletion, posing a significant challenge to sustain future generations. Today's technology and knowledge can considerably reduce the damaging human impact on ecosystems. That said, they are unlikely to be fully deployed until ecosystem services cease to be perceived as free and limitless, and their full value is taken into account.

It has been an honour to collaborate with the United Nations Environment Programme (UNEP), Presidency of Meteorology and Environment (Kingdom of Saudi Arabia), Ministry of Energy, Mines, Water and Environment (Morocco), and the Suez Canal University (Egypt), in the production of the Arab Millennium Ecosystem Assessment Report.

The assessment examines the environment through the framework of ecosystem services, to identify how changes in ecosystems influence human well-being and to provide information in a form that decision-makers can weigh, alongside other social and economic information.

Many messages emerge from the report. These are rooted in three main pillars: Sustainability, Leadership and Innovation:

1. Sustainability: teaming up with countries and institutions to address, - in parallel - environmental, economic, social and governance concerns as an integral part of policies and strategies for balanced and inclusive growth.

2. Leadership: empowerment of human capital, particularly since this region is blessed with human resources of inestimable value. People's involvement in the decision-making process, ownership of the problem and sharing the benefits and knowledge, yield positive synergies - the backbone for environment-friendly resilient communities of the future.

3. Innovation: advancement of people and societies through knowledge-sharing, reshaping traditional approaches, progressive environmental governance, creative solutions and circulation of best practices.

The backbone of our credibility is action. This lies in achieving tangible results to enrich our accomplishments - and these are many - and in dealing scientifically, practically and collectively with what lies ahead.

Nadia Makram Ebeid

Executive Director
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CHAPTER 1

INTRODUCTION

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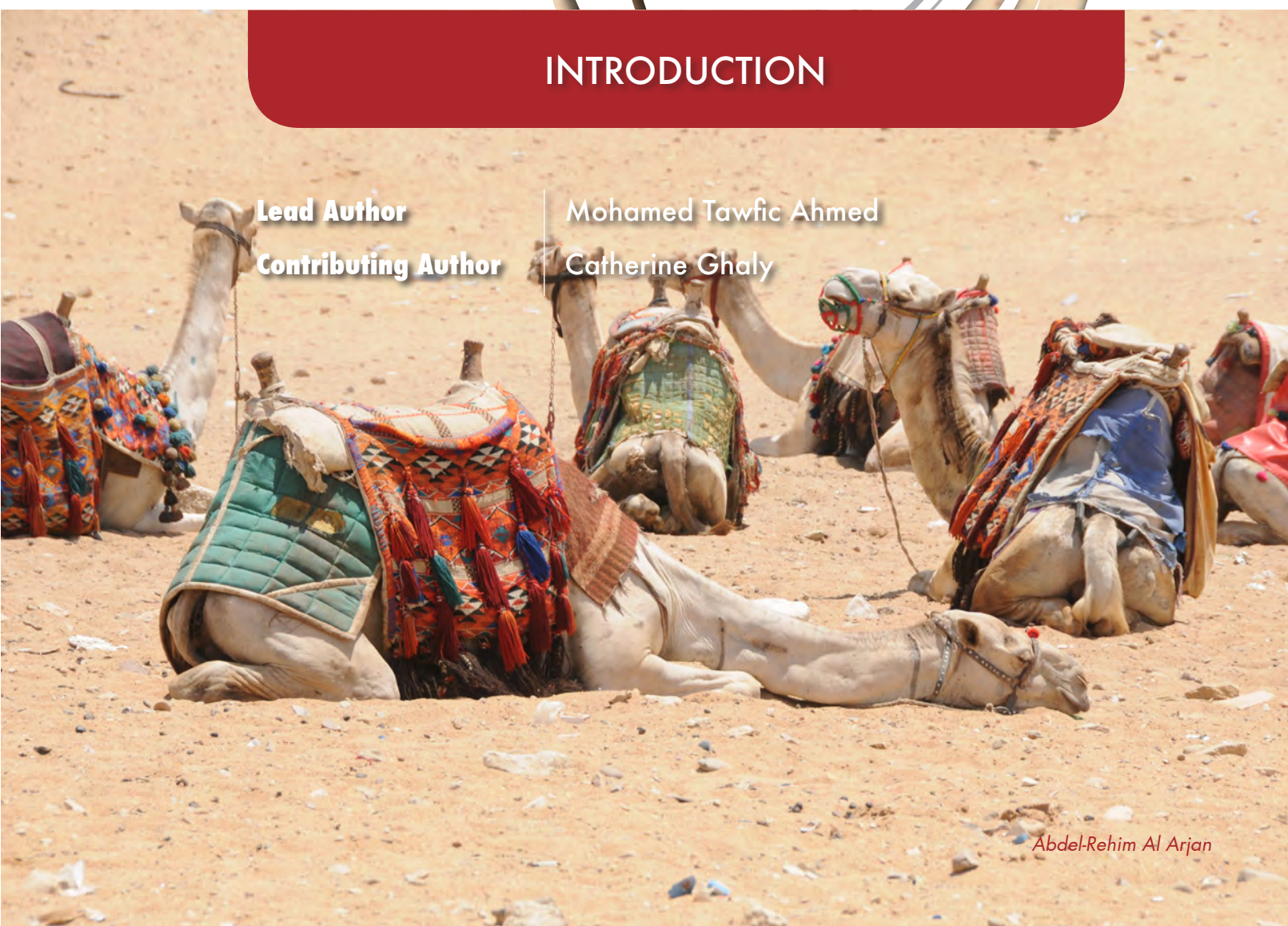


Abdel-Rehim Al Arjan

Main Messages

The Arab region sub-global assessment started in the latter stage of the MA as an associate assessment. Assessments at sub-global scales are essential. Ecosystems are highly differentiated in space and time, thus sound management requires rational local planning and action.

This synthesis report sheds light on the ailing environmental conditions and the root causes of these conditions, as a prelude to prompt corrective plans and actions.

Three sites were selected to be the focal sites for the Arab Millennium Ecosystem Assessment: The Sinai Peninsula, Egypt; Tafilalet Oasis, Morocco; and Asir National Park, Saudi Arabia. The selection of these study areas was based on a number of factors; first and foremost that the areas should embrace a number of unique, biodiversity-rich ecosystems that undergo changes affecting both environmental integrity and the well-being of its inhabitants.

The report highlights the following key messages:

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services which directly affect people, in addition to the supporting services needed to maintain the other services.

Human well-being has multiple dimensions and includes attainment of basic materials for human well-being, good social relations, and freedom of choice, health, and security. Well-being can be perceived differently by different people and cultures, time, situation, and ecological circumstances.

Poor environmental management is related to poverty, environmental degradation, resource scarcity and poor quality of life in the three case study areas.

1.1 INTRODUCTION

Background

Humanity has always relied on the services provided by the biosphere and its ecosystems. Furthermore, the biosphere is itself the product of life on Earth. The composition of the atmosphere and soil, the cycling of elements through air and waterways, and many other ecological assets are all the result of living processes – and all are maintained and replenished by living ecosystems. The human species, while buffered against environmental immediacies by culture and technology, is ultimately fully dependent on the flow of ecosystem services.

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services which directly affect people, in addition to the supporting services needed to maintain the other services. Changes in these services affect human well-being through impacts on

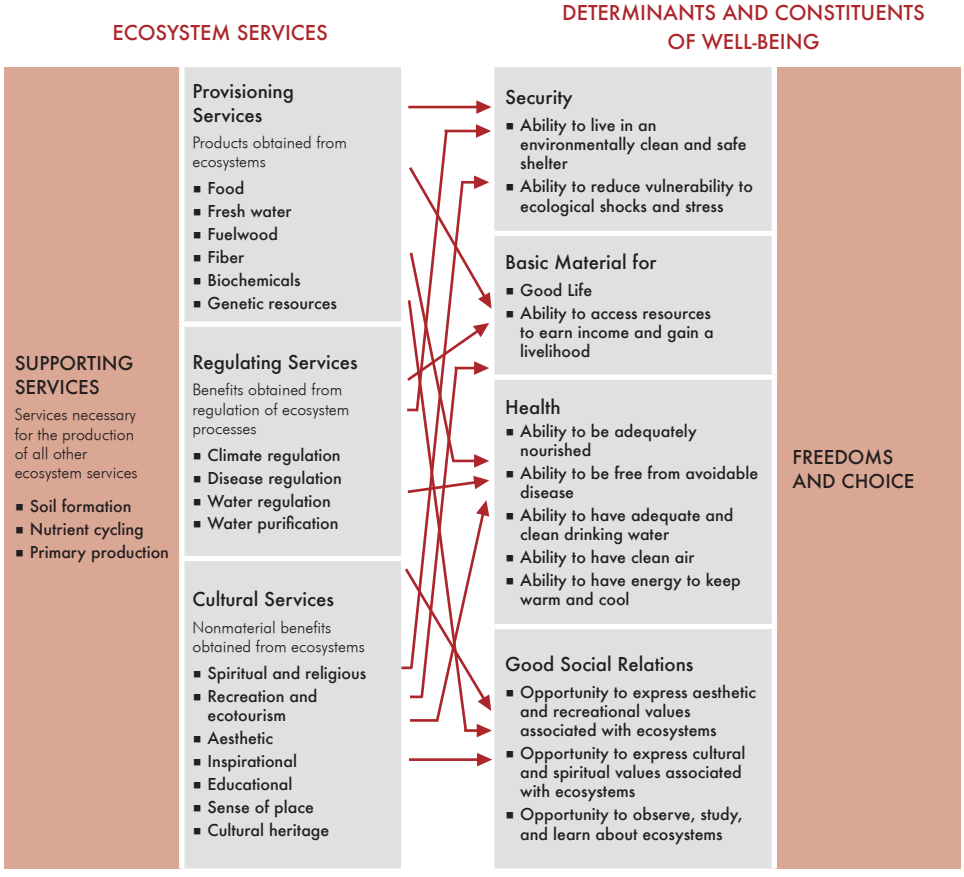


Figure 1.1 Ecosystem Services, Relationship with Human Well-being

Source: UNEP, 2003

security, the basic material for a good life, health, and social and cultural relations. These constituents of well-being are, in turn, influenced by and have an influence on the freedoms and choices available to people (UNEP 2005).

There are economic social and environmental drivers that hinders the sustainability of communities and ecosystems. The demands for ecosystem services are now so great that trade-offs among services have become the rule. There are many indications that human demands on ecosystems will grow still greater in coming decades. Current estimates of 3 billion more people and a quadrupling of the world economy by 2050 imply a formidable increase in demand for and consumption of biological and physical resources, as well as escalating impacts on ecosystems and the services they provide.

This combination of ever-growing demands being placed on increasingly degraded ecosystems seriously diminishes the prospects for sustainable development. Human well-being is affected not just by gaps between ecosystem service supply and demand but also by the increased vulnerability of individuals, communities, and nations. Productive ecosystems, with their array of services, provide people and communities with resources and options they can use as insurance in the face of natural catastrophes or social upheaval. While well-managed ecosystems reduce risks and vulnerability, poorly managed systems can exacerbate them by increasing risks of flood, drought, crop failure, or disease. With the growth of human population, the demand for ecosystem services is continuously increasing and some of the services are traded-off for others. For example, forest gives way to agriculture while agricultural areas are developed into settlements and other built-up areas. In this process, the capacity of the ecosystem to perform other services such as regulatory and supporting, and even cultural, is significantly reduced. Continued deforestation clearly diminishes the ability of forest ecosystems to store carbon or regulate climate and to an extent, regulate floods.

Human well-being has multiple dimensions and includes attainment of basic materials for good life (although this is subjective), good social relations, freedom of choice, health, and security. Well-being can be perceived differently by different people and cultures, time, situation, and ecological circumstances (UNEP 2003).

1.2 MILLENNIUM ECOSYSTEM ASSESSMENT (MA)

The Millennium Ecosystem Assessment is an international initiative launched in 2002 as a response to ailing global environmental conditions. It is designed to meet the needs of decision-makers and the public for scientific information concerning the consequences of ecosystem changes on human well-being or concerning the consequences of changes in ecosystem services on human well-being. It is the main objective of the MA to bring the findings of science to bear on the needs of decision-makers. Leading scientists from over 100 nations have been involved in

the assessment, with oversight by a board comprised of representatives from four international conventions, five United Nations agencies, international scientific organizations, and leaders from the private sector, NGOs, and indigenous groups. The MA is designed to meet some of the needs of the Convention on Biological Diversity, (CBD) Convention to Combat Desertification, (UNCCD) and Wetland Convention (RAMSAR), as well as the needs of other users in the private sector and civil society. It is anticipated that the MA will be repeated every 5-10 years. The MA focuses on ecosystem services and the consequences of changes in the ecosystem on human well-being, as well as on other life on Earth (see Figure 1.2).

The scope of the assessment of changes in ecosystems has been further focused through consultation with MA users. The international conventions have requested specific information, such as an assessment of the impacts of climate change on biodiversity (Convention on Biodiversity). One of the central issues of the MA is human well-being and the interrelationship with the environment, represented by its goods and services and quality of human life.

Definition of Ecosystem Assessment

An assessment is a critical evaluation of information and knowledge that guides decisions on a complex, public issue. It should also refer to a situation at a specific time in a particular geographical and societal domain. Stakeholders, including decision-makers, play a major role in development of an assessment module, orientation, and outcome.

An ecosystem assessment is usually conducted by a large group of people with different backgrounds and interests. It aims to address a vast portion of the population, with special

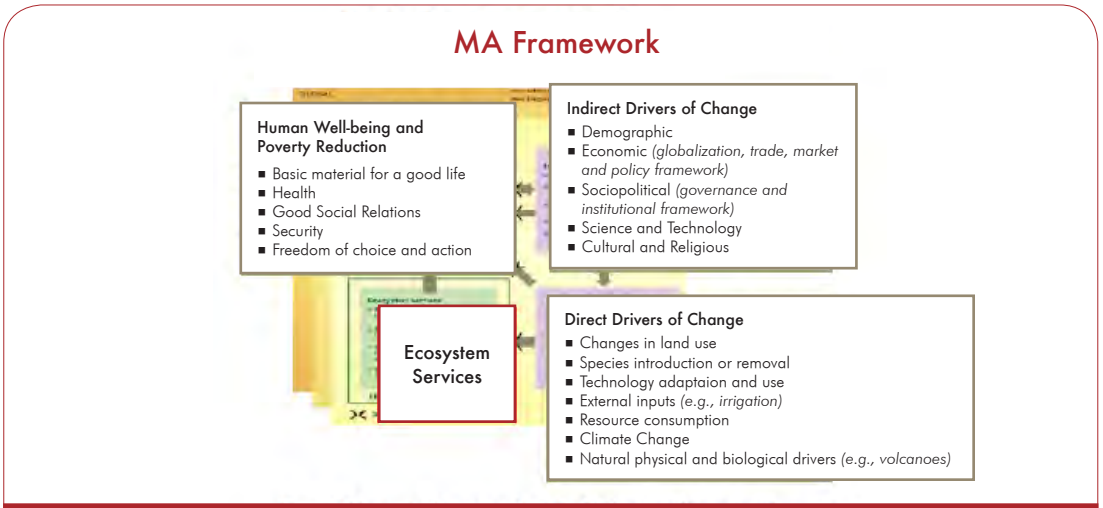


Figure 1.2 Conceptual Framework of the Millennium Ecosystem Assessment
Source: UNEP, 2010

reference to decision-makers and the like. It should also present scientific endeavours in an explicit manner. Another definition considers assessment as "a social process that uses published peer-reviewed material, and other forms of knowledge/publications to bring the findings of science to bear on the needs of decision-makers" (UNEP and IISD1999).

1.2.1 Global and Sub-global Assessments

An ecosystem assessment should relate to a situation at a specific time in a particular geographical and societal domain. Stakeholders play a major role in the development of an assessment module, orientation and outcome. Decision-makers are key stakeholders of any assessment.

Unlike a scientific review, an assessment is policy relevant, usually conducted by a large group of people with different backgrounds and interests. Assessments should be far from complex and able to address people of different cultural and scientific background. The MA is a multi-scale assessment, consisting of interlinked assessments undertaken at local, national, regional and global scales.

Assessments at sub-global scales are needed because ecosystems are highly differentiated in space and time, and because sound management requires careful local planning and action.

Local assessments alone are insufficient, however, because some processes are global and because local goods, services, matter, and energy are often transferred across regions. Sub-global assessments (see Figure 1.3), will directly meet the needs of decision-makers at the scale at which they are undertaken, strengthen the global finding with on-the-ground reality, and strengthen the local findings with global perspectives, data and models.

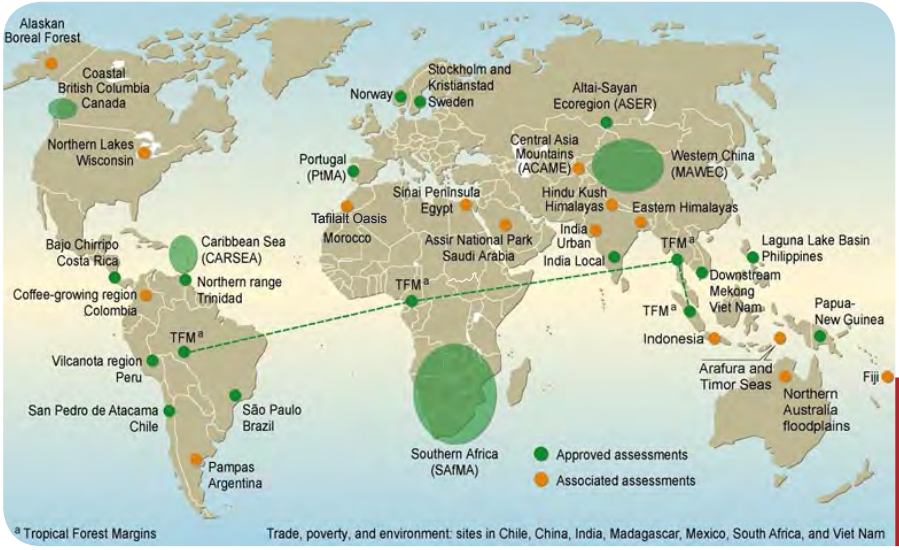


Figure 1.3 Map of Sub-global Assessments
Source: Updated from UNEP, 2005

1.2.2 Arab Millennium Ecosystem Assessment

The Arab region sub-global assessment started in the latter stage of the MA as an associate assessment; as such, it was intended to go beyond the global MA. Three sites were selected to be the focal sites for the Arab Millennium Ecosystem Assessment-Sinai Peninsula in Egypt; Tafilalet oasis in Morocco; and Asir National Park in Saudi Arabia. (Figure 1.4)

The objective of the Arab MA aims to:

- Meet the needs of and communicate the assessment information to decision-makers concerned with the pilot sites at national and local levels, and integrate the findings into regional and global perspectives;
- Build capacity to undertake integrated assessments of ecosystems of key partners;
- Help develop and test methodologies for integrated multi-scale ecosystem assessments and methodologies for integrating local and "scientific" knowledge;
- Promote widespread adoption of integrated assessment approaches in the region;
- Build a framework for the collection, analysis, and synthesis of ecosystem-wide data for decision making at multi-level, including the local community;
- Link and incorporate the outcomes into global assessments;
- Identify networks of actors and organizations playing critical roles in the sustainable management of ecosystems of those sites and to bridge gaps between science, technology, and sustainable development and define the existing resource base devoted to bridging these gaps.

The Arab MA also intended to generate problem-solving knowledge that facilitates action on critical issues of sustainable development and protection of the environment through the design of institutional arrangements that foster the generation, collection, analysis, diffusion, and use of scientific knowledge for the sustainable use of ecosystems.

Figure 1.4 Locations of Arab MA

Source: Adapted from UNEP, 2010

Egypt Sub-global Assessment at Sinai Peninsula, El Maghara

Egypt's sub-global assessment is a community-based assessment, conducted in the El Maghara area, North Sinai Peninsula (Figure 1.5). Community-based assessments are necessary components of multi-scale assessments such as the MA. They capture real life experience of changes in ecosystems and human well-being.

Sinai, located between the Nile Valley in Africa and West Asia, is an important heritage site embracing a unique collection of sacred shrines and ecologically valued landmarks, including a number of rare animal and plant species. St. Catherine's monastery, located in Southern Sinai, is one of the oldest Christian establishments. The original chapel is believed to have been established in 330 AD at the place of the Biblical Burning Bush. Other sacred sites include Gebel Mousa (Mount Sinai), where it is believed Moses received the Ten Commandments. Because the Sinai is a land bridge between Asia and Africa, it combines a distinguished faunal and floral wealth. The Sinai has a diverse landscape encompassing wetlands, desert terrain, sand dunes, and mountainous highlands. The unique culture and traditions of the Bedouin, the main inhabitants of the Sinai, are other salient factors in the mosaic diversity of Sinai. Their local knowledge, wisdom, and experience are important historical features of the Sinai that have allowed them to survive the harsh spells Sinai has frequently faced.

The selection of El Maghara as the assessment site was based on a number of factors. The area embraces a number of biodiversity-rich and special ecosystems that undergo changes and transitions that

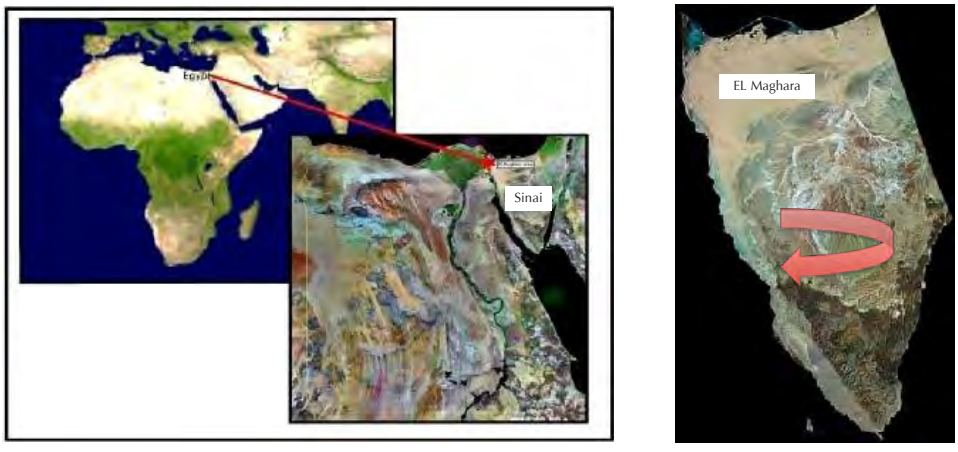


Figure 1.5 Location Map of El Maghara Area with Reference to the Middle East Region
Source: UNEP , 2010

affect the environmental integrity and the well-being of the inhabitants. El Maghara is considered one of the most important floral centres for medicinal plants in the Middle East. Sixty-one per cent of its flora is considered medicinal (Abd El-Wahab and others 2004, Farnsworth and Soejarto 1991).

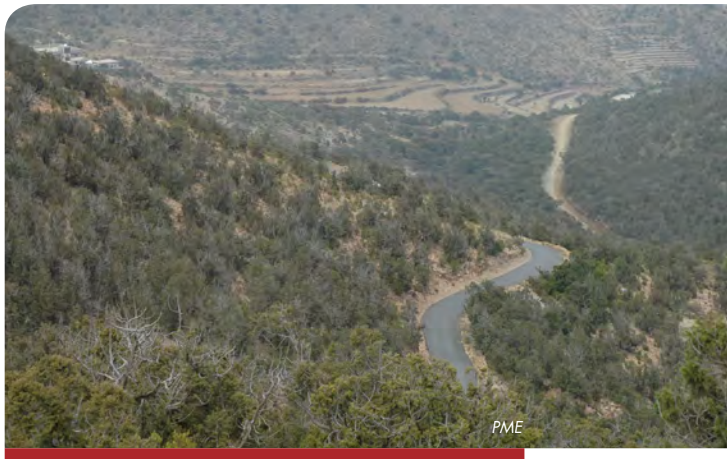
In addition, it represents an important area of anthropological value due to the presence of a number of Bedouin tribes that each has unique traditional knowledge. An appreciation of biodiversity and the importance of each and every living organism are deeply rooted in Bedouin culture.

The inhabitants of El Maghara area are among the poorest in Sinai. This hardship has limited the migration of non-Bedouin to the area and has also limited the sweeping urbanization that has sprawled over other parts of Sinai. El Maghara remains as the one area in the whole of Sinai where pristine Bedouin culture and practices prevail.

The remoteness and isolation of the area have also made it very difficult for key decision- makers to understand the magnitude of damage in the area. It also makes it even harder for the people of El Maghara to convey their message to decision-makers. One of the main objectives of the El Maghara assessment was to draw decision-makers' attention to the magnitude of damage in the area, and to provide them with some new leads for better, more rational management of the area's natural stocks.

Saudi Arabia Sub-global Assessment at Asir National Park

The Kingdom of Saudi Arabia covers an area of more than two million square kilometres. It is located approximately between latitudes 18° and 19° N and longitudes 41° and 42° E, and is characterized by dry, harsh climatic conditions and limited natural resources of water, soil and vegetation.



Asir National Park, Saudi Arabia

The sub-global assessment in Saudi Arabia was conducted at Asir National Park (ANP), located in the Asir Mountains which contain one of the most important ecological hotspots in the Arab region.

ANP is a vast area spread over 45 000 hectares. ANP includes a combination of four ecosystems, namely, mountain ecosystem with juniper forest, terrace agriculture, grazing land, and coastal and marine ecosystems. The Asir mountain area (Figure 1.6), occupies the south part of Sarawat Mountains, which are particularly important for agricultural production in the country.

Figure 1.6 Map of Saudi Arabia, Showing the Location of Asir Province

Source: UNEP, 2010

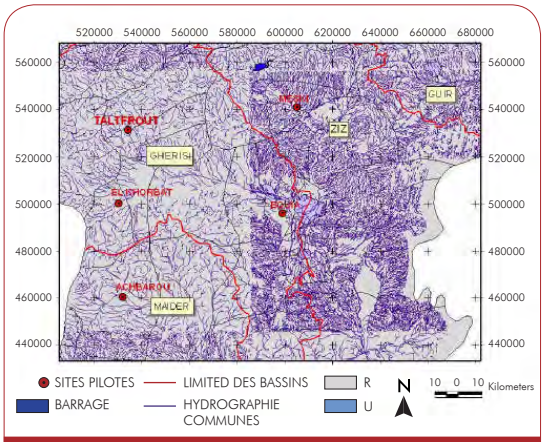


Figure 1.7 Watersheds of Tafilalet and Hydrographic Network

Source: UNEP, 2009

Most of the forest area covers the Sarawat Mountains, which represent about 1.2 per cent of the area of Saudi Arabia. The complex landscape of the mountainous areas consists of steep slopes, terraced croplands, sloping rangelands, and scattered patches of shrubs and trees.

Morocco, Sub-global Assessment at Tafilalet Oasis

Tafilalet is part of Errachidia province, located within the region of Meknès-Tafilalet that covers an area of 77 250 km^2, roughly 20 per cent of total Moroccan oasis zones. Tafilalet lies in the structural area of the Anti-Atlas and the southern part of the Oriental High Atlas. Its northern part dates back to the Jurassic age, the middle part to the Cretaceous period and its southern part to the Paleozoic and Precambrian ages. Tafilalet covers, among other parts, four watersheds that are, from west to east, Ghéris, Ziz, Guir and Maeder in the south (Figure 1.7). These four watersheds cover a total area of 60 000 sq. km, or 9 per cent of the national territory, accommodating a population of approximately 0.81 million inhabitants, or 2.7 per cent of the national population of Morocco. These four watersheds cover three economic regions (Bouanane-Bouarafa, Sous Massa-Draa and Meknes Tafilalet) and four provinces (Errachidia, Zagora, Ouarzazate and Figuig).

1.2.3 Arab Ecosystem Assessments

Types of Ecosystems

An ecosystem is a dynamic complex of plant, animal and micro-organism communities

and their non-living environment interacting as a functional unit. Humans are an integral part of ecosystems. Ecosystems and their biomes are the products of a huge array of interacting factors, both biotic and abiotic. Ecosystems may also interfere with each other. The three assessments represent different types of ecosystems. While Asir includes a diverse combination of four ecosystems, namely, mountain ecosystem with forest and terrace agriculture, agricultural and grazing land, and coastal and marine ecosystems, El Maghara is a desert hyper-arid ecosystem, while Tafilalet is an oasis, with a predominant cultivated ecosystem.

Common Features of Ecosystems, Arab Ecosystem Assessments

Despite the spatial differences between the three assessment areas, and the various dominant traits of each, they bear some significant commonalities in a number of issues.

Hot, dry and continental patterns of climate prevail in the three sites, with temperatures soaring up to 40°C in summer. In Asir, the average rainfall ranges from 305 mm/year in Tagir, to 535 mm/year, in Tamnia. El Maghara stands as the driest assessment area with an average rainfall of about 100 mm/year. In Tafilalet, the average annual rainfall is about 250 mm in the North and less than 60 mm in the South.

Water scarcity is a major common feature and a serious concern at the three sites alike, with a wide range of impacts manifested in both economic and social spheres. Groundwater is the basic source of drinking water for the inhabitants. Flash floods are the main resource of water stocks at the three sites, with a number of dams established to store water and to protect surrounding areas from flood hazards. Inhabitants attach great importance on flash floods to irrigate their crops since it requires no investment or special facilities, such as pumping.

Fluctuating rainfall has marked the last few years in the three assessment sites, with prolonged spells of drought, especially in Sinai and Tafilalet, leading to a number of environmental and economic repercussions. Tafilalet has had prolonged drought spells during the last century and the beginning of this century: 1913-1918, 1927-1931, 1933-1939, 1945-1947, 1955-1957, 1973-1976, 1979-1984, 1987-1988, 1993-1995, 1997 (Benmohammadi and others 2000, Kabiri and others 2003). Similarly, El Maghara has had a long spell of drought extending through the last 10 years (UNEP 2010).

Lack of clean water causes a number of diseases that affect the community at all stages of life. Water shortage is one of the main reasons, along with unemployment, for the migration of many young men and families seeking a better income and quality of life in other parts of the country. Hence, water shortage has affected the age structure of the people, leading to a high ratio of elderly Bedouin, in comparison to other ages. Water shortage has also had economic repercussions. Cash flow is very

limited, as grazing and agriculture, the most important activities in the area, have been badly hit by long-lasting droughts.

Resource depletion, ecosystem and vegetative cover degradation are evident in the three assessments. In Asir, the natural vegetal cover is currently at risk in some parts due to the adverse climatic factors and anthropogenic misuse. This risk is posed by unplanned tree removal, intensive unbalanced pasturing, fires, diseases, tree senescence and weak natural regeneration. This, in turn leads to the continuation of deterioration of natural resources such as forest trees soil, water and wildlife unless appropriate actions are taken at various levels.

Drought in Tafilalet, Morocco

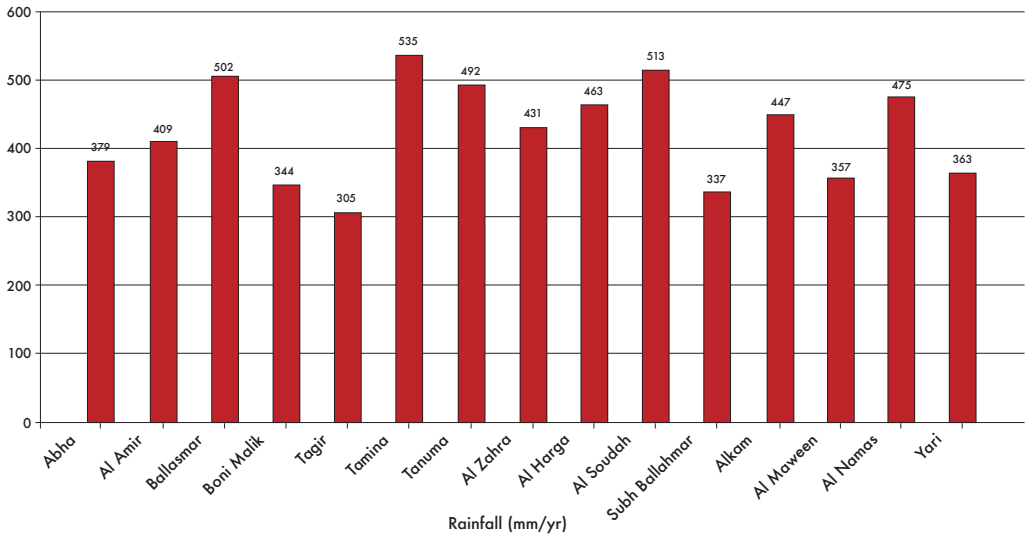


Figure 1.8 Average Rainfall in Various Parts of Saudi Arabia

Source: UNEP, 2010

Changes in land-use pattern, unauthorized mining of stones, marble and sand in El Maghara are among the major causes of the degraded environmental condition. A major manifestation is landscape fragmentation, and genetic discontinuity. The destruction of Sheikh Hemid wood, one of the vibrant characteristics of Sinai is a sad example of uncontrolled land-use norms and practices. Similar cases of gross violations of land-use pattern, with subsequent manifestations on environmental assets were also reported in the Asir and Tafilalet assessments.

Impact of Mining on Acacia Trees, El Maghara, Sinai

Desertification, soil erosion, sand encroachment, and other features of ecosystem degradation were reported in the three sites alike. Man-made causes are the main drivers for this degradation. However, natural causes, represented by wind and water erosion and sand encroachment are central factors for the desertification currently witnessed in the three assessment sites.

Overpopulation and urbanization are key factors in the environmental degradation reported in both the Asir and Tafilalet assessments. In Tafilalet, inhabitants tend to abandon Ksours, the old traditional houses for new modern houses inconsistent with the natural surrounding landscape. Traditional construction style, well-known in the oases for ages, is currently threatened as it is being replaced with multi-storied concrete constructions, built to accommodate large numbers of families, rather than only one family as Ksours tend to accommodate.

A change in lifestyle is an emerging social trait in all three assessments with some apparent repercussions. Changing patterns of consumption and production, heavy demand on natural resources, and decline of local knowledge and traditional practices are some of the common manifestations of changes in lifestyle.

Poverty and unemployment are common factors in both Tafilalet and El Maghara, and are considered behind much of the degradation inflicted on the environment. The relationship between poverty and the environment, and between poor people and natural resources, is complex and has been the subject of extensive debate.

Poor people are often impoverished by an austere resource base, and thus forced by their circumstances to degrade the environment even

further (World Commission on Environment and Development 1987, Durning 1989, Cleaver and Schreiber 1994, Ekbom and Bojo 1999). Poverty reduction is becoming a global issue. Generally, demand on natural resources exceeds its biocapacity in some parts of the Region increasing its ecological deficit (see chapter 4). The Millennium Development Goal (MDG) objective of halving the number of poor people by 2015 is one of the major driving forces in this field.

In Tafilalet, the unemployment rate is quite significant and women are the most vulnerable and disadvantaged. Lack of income for these populations is one of the main causes of damages affecting the environment, particularly the overuse of agricultural lands.

Sand Encroachment in Tafilalet, Morocco
Source: UNEP, 2009

Impact of Housing and Road Construction on Terrace Agriculture System, Asir, Saudi Arabia

Socio-economic Background

Communities are the vibrant units that make up the mosaic component of societies. Community construct is a composite in which ethnicity, culture, and history along with other attributes mingle together to provide the ultimate texture of the community. A good degree of resemblance seems to shape the community fabric of the three assessments involved in the present study. Being tribal and with some nomadic nature, has had an apparent impact on the socio-economic identity of the communities involved. Local knowledge, a valuable asset in the three assessments, is inherently used in coping with resource depletion, and managing and harnessing environmental externalities, such as water scarcity. Local plants in the vicinity are used to augment food supplies, and compensate for poverty, as is the case in both El Maghara and Tafilalet. The three reports provide abundant examples of how local knowledge has built a valuable body of information that reflects on people welfare and ability to combat prevailing environmental hardship. Water scarcity is a central subject that local knowledge has tackled, especially in El Maghara and Tafilalet.

Table 1.1 Major Drivers of Ecosystem Change, Tafilalet, Morocco

Change Driving Forces	Direct Impact	Indirect Impact
Inadequate Governance		x
Agricultural Expansion and Intensification	x	
Ignorance / Illiteracy		x
Poverty		x
Population Growth		x
Excessive Livestook	x	
Market Forces		x
Changes in the Way of Living		x
Exclusion and Marginalization		x
Inadequate Mobilization of Surface Water		x
Isolation		x
Urban Sprawl		
Changes in Land Use	x	
Tourism Development	x	
Locust Invasion	x	

Source: UNEP, 2009

In Tafilalet, inhabitants have developed an innovative process of mobilizing groundwater and/or surface water, using rudimentary techniques to cope with violent flash floods, high loss through evaporation and sand invasion. Similar trends of using local adaptive capacities in water and drought management have been recorded in Asir and El Maghara. Local knowledge is also considered the main think tank of each of the three assessments, used in managing a number of crucial issues that would include but not restricted to disease management, risk management including droughts and flash floods, sand storms and others.

Customary law, a major tributary of local knowledge, and a major cornerstone of tribal communities is still playing an influential role, particularly in El Maghara, Sinai, though winds of change have affected the status of local knowledge gained through centuries as is the case at Asir where the role of Hemaia seems to be in decline. Change of life style is a potential threat to local knowledge in the three sites.

Poverty and unemployment have had severe tolls, manifested in a number of humanitarian and socio-economic domains in both El Maghara and Tafilalet, with significant drawbacks on people and their environment. Poverty in El Maghara is one of the major drivers that initiated a somber string of events, deeply endowed in people history, reflecting on their conception and sometimes to their tolerance and relationship with officials. Reports of clashes between inhabitants of El Maghara and police forces are considered signs of the strained relationship between Bedouin and governance, mainly stirred up by poverty and massive unemployment.

Inferior services and lack of infrastructure have alienated development and investment potentials in the El Maghara and Tafilalet. Women in the two locations are probably the most vulnerable to poverty as their share of hardship is much higher than that of men. Collection of edible plants, fetching water, and travelling long distances with grazing livestock are extra hardships that women experience and have to endure.

Box 1.1 Bedouin Protest Against Government, Sinai, Egypt

Frequent clashes between police forces and some militant Bedouin groups were reported in 2007, and a number of senior police officers, soldiers, and Bedouin were reported killed. Bedouin protested their mistreatment at the hands of the government and their inferior living conditions. They demanded the economic development of the Sinai Peninsula, which they say has been historically neglected by the government, as well as more employment opportunities for the local population. "Central Sinai is among the poorest areas in the world, with rampant unemployment and few basic services available." http://ipsnews.net/news.asp?idnews=38209.

A high rate of illiteracy was recorded in both El Maghara and Tafilalet, with illiteracy being higher in women than in men. With the prevailing poverty, inhabitants tend to involve their children in any type of income earning activities rather than sending them to schools that would require extra expenses that would place extra burdens on the parents. In addition, deficiency of schools in the vicinity discourages parents from sending their children to distant schools, especially in bad weather, a frequent incidence in some assessment areas such as El Maghara. The poor quality of education in the few available schools is also behind the high rate of illiteracy, especially in El Maghara. The situation is much better in Asir, due to generous government spending on education and schools.

Primary School Children, El Maghara, Sinai

In Tafilalet, there are some informal literacy programs and initiatives to raise awareness regarding the protection of the environment. In addition, some occasional

Table 1.2 Health Conditions, El Maghara, Sinai

Age Group	Common Diseases	Causes
Infants under one year of age	Eye infections Common cold diseases	Bad hygiene and erroneous mother's traditions Lack of medical care Exposure to weather changes Bad housing
Children above 2 years of age and up to school age	Amoebiasis and other intestinal parasites which need a stool analysis	Bad hygiene
Adult group	Renal colic	Excessive use of fat in cooking Excessive consumption of tea Heavy smoking in case of men Consumption of saline water Hyper acidity

Source: UNEP, 2010

Awareness Raising and Training Session, Tafilalet, Morocco
Source: UNEP, 2009

and sporadic actions to raise awareness of environmental issues are undertaken by certain voluntary groups. Otherwise, the general trend is mostly dominated by high illiteracy and a significant lack of awareness and mobilization of players for the rational management of natural resources, that creates a sub-optimization of resource allocation.

1.2.4 Assessment Needs

The Arab MA aimed, among other things, to reveal the flaws in the environmental setting, and conceptual understanding of environmental integrity in some of the Arab countries.

It also aimed to raise awareness, and promote technical capabilities among a wide sector of researchers in the area of ecosystem assessment. The selection of Egypt, Morocco and Saudi Arabia was based on the diversity embedded in the locations, nature, and the contents of the environmental attributes of the three countries. With Morocco located in the far west of North Africa (El Maghreb) and Saudi Arabia located in the centre spot of West Asia (El Mashriq), Egypt is a link, where Sinai is a physical bridge, ensuring the continuity and connectivity between the two distinct poles of the Arab region, El Mashriq and El Maghreb, Asia and Africa.

The Arab region is endowed with a diverse environmental and ecological setting, with thriving examples of integration of people and their environment. The area has always been a congenial media for a unique richness of local knowledge that bears the blueprints of a well recognized civilization, as

well as a distinguished array of ecosystems that provide a number of special services. The Arab Millennium Assessment portrays the dominant ecosystems in the region, namely drylands, agriculture, marine, oasis, and mountainous ecosystems.

Each of the three assessments studied has a definitive set of objectives. For instance, Asir park assessment is a twofold: (i) to assess the impacts of degradation of Asir park on ecosystems, and (ii) to enhance community livelihood through improving the existing linkages between local authorities in the Asir region, researchers, NGOs and national development organizations.

In general, the present study is warranted by the need for a holistic understanding of the relationship between human beings and the ecosystem, and how to manage this relationship so as to ensure the durability of the benefits and services provided by the ecosystem, as well as to contribute to the evaluation of the ecosystem on a global scale.

The Arab MA also intended to generate problem-solving knowledge that facilitates action on critical issues of sustainable development and protection of environment through the design of institutional arrangements that foster the generation, collection, analysis, diffusion, and use of scientific knowledge for the sustainable use of ecosystems. With such overarching goals in mind, each of the assessments also had other special objectives. For example, in El Maghara, a basic objective of the assessment was to uncover the magnitude of damage

Asir Mountains, Saudi Arabia

Traditional Agriculture, a Main Activity at Tafilalet, Morocco
Source: UNEP, 2009

inflicted on the environment, and to expose the suffering of the people in the area, with the ultimate hope of alleviating their suffering and improving their conditions. While in Tafilalet, one main objective of the assessment was to seek funding to implement an action plan to improve general conditions of the oasis.

The Arab MA has had an impact on the global and regional level. The Global Millennium Assessment report has used the materials originated from the MA sub-global assessment in a number of cases, with special reference to community assessment, dryland ecosystems and the relationship between local knowledge and human well-being. At the regional level, information and findings of the MA, whether on global or sub-global levels were incorporated in a number of reports, including the *Environmental Outlook of the Arab Region*, (UNEP, CEDARE and LAS 2010) and other national state of the environment reports. The strong plea the El Maghara assessment has sent about the gross mismanagement of Sheikh Hemid wood, one of the major ecological features

Sheikh Hemid, One of the Main Shrines in Sinai

of the assessment area, was met with due interest. The plea has already invoked a new diligent attitude from decision-makers, and the possibility of including the wood into a conservatory has gained good momentum and support.

1.2.5 Stakeholder Engagement and User Groups

Unlike conventional scientific endeavours, ecosystem assessments are a composite structure made of assorted efforts, in which a wide spectrum of stakeholders, from different backgrounds are involved. Bearing in mind that an ecosystem assessment trajectory is to improve the quality of life, through a better environment, there is a role for each party to play towards that end.

Local inhabitants, decision-makers at various tiers, scientists, NGOs and other pressure groups, and laymen equally have the same footage in an ecosystem assessment. Nevertheless, the role of the local inhabitants is always the most overarching and the most explicit. Local inhabitants are the factual driving force that determines the scenario of events, the goals, and the approach to reach that goal.

The three assessments of the Arab MA have had a strong reliance on local inhabitants who bear the real burdens, and are inextricably linked to the generic conditions of their surrounding environment. Information driven from stakeholders at all levels is the backbone of assessment construct and the nuclei that scientists and others may delineate on. The significant role of local inhabitants is most evident in narrating the scenarios, in each of the three assessments. Stakeholders, with special reference to local inhabitants of the assessment provide the bricks of a scenario, and their participation is a basic foundation in the construction of viable scenarios. Apart from local inhabitants, a diverse group of users is already served by each assessment. Stakeholders are a decisive factor for the success of an ecosystem assessment, and the success of any assessment is intimately related to stakeholders' involvement and active participation.

In the Asir assessment, stakeholder involvement during the study was ensured by: (i) closely coordinating with the office of Abha's Governor (ii) involving all concerned government ministries and agencies such as the Ministries of Agriculture, Water, Presidency of Meteorology and Environment (PME), National Commission for Wildlife Conservation and Development (NCWCD), and Educational Institutions/Universities (iii) contacting members of the farming community and nomads and explaining to them the objectives of the study. The results of the study were discussed in a workshop and conveyed to the decision-makers in a meeting.

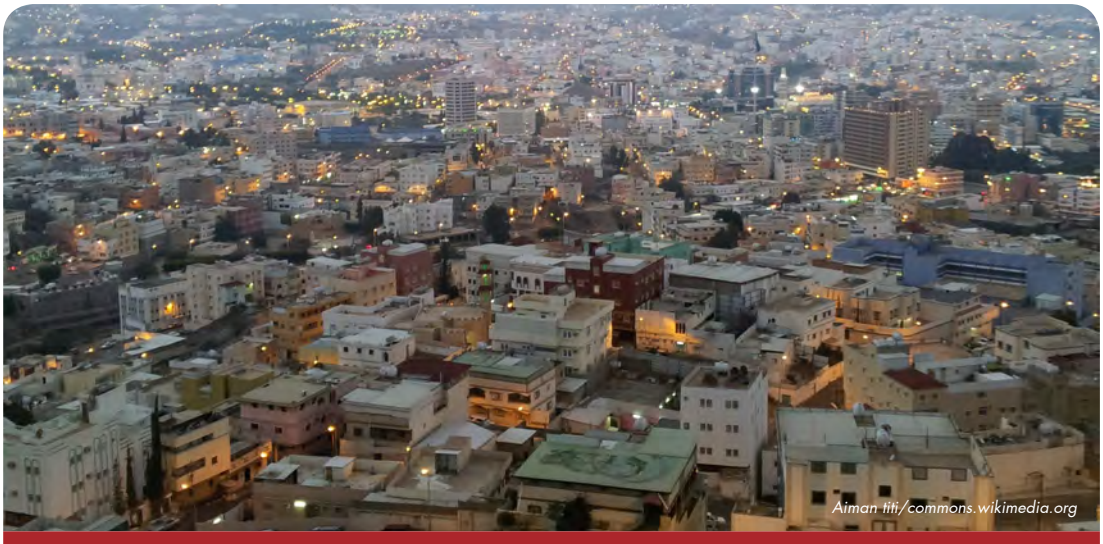
The assessment will be of particular interest to the following primary beneficiaries:

- Pastoralists whose animals graze the park area.
- Farmers involved in agriculture in ANP.
- Tourists that visit the Asir National Park.

- Local agencies such as the Asir Governorate.
- Ministry of Agriculture who produced the original report on the Asir National Park.
- Presidency of Meteorology and Environment, the central environmental protection agency and lead agency in this study.
- Municipalities and local communities.
- Universities such as King Saud University and King Abdulaziz University which have conducted agricultural and environmental research in maintaining Bedouin culture and traditional way of life.
- Other government agencies including King Abdulaziz City for Science and Technology (KACST), Ministry of Water and National Commission of Wildlife Conservation and Development (NCWCD).

In Tafilalet, the analysis of the stakeholders was carried out according to the following steps:

- Identification of stakeholder groups: this step allowed the identification of the players who may have direct or indirect relations with the project, and who positively or negatively influence the project.
- Identification of interests of the project: the identification of the role or roles the player may play.
- Evaluation of importance and influence: to determine whether the concerned player is essential or not for the success of the project and whether he/she has an influence on the development of the various phases of the project. The degree of importance and influence was determined by combining a qualitative weight factor.



The City of Abha, in the Vicinity of Asir, Saudi Arabia

Meanwhile, assessment users in Tafilalet would include:

- National institutions, including the Ministry of Energy, Mines, Water & Environment, the Ministry of Agriculture and Fisheries, and others.
- Regional, provincial and local institutions: such as the Regional Agency for Irrigation and Agriculture Development of Tafilalet.
- Institutions specialized in scientific research: including main universities and higher institutes.
- International agencies: UNEP, UNESCO and others.

In El Maghara, Assessment main users were:

The Bedouin Community

Bedouins are the main inhabitants of Sinai and the focal group of the present assessment. The Bedouin need the assessment findings for many reasons, but particularly because of their need for sound ecosystem services to help address their needs for food, water, shelter, and security.

North Sinai Governorate

The North Sinai governorate is a focal stakeholder, with direct involvement in this assessment. It represents the official and logistic reference to all activities, services, and civic affairs of El Maghara. Enforcement of law and observing sound environmental conduct is embedded in governance dedication and efforts to stop industry violations of sustainability codes, protecting the environment, and providing due care to the Bedouin.

Mohamed Tawfic

El Maghara Community, Sinai

Department of Environment and Environmentalists

El Maghara embraces some of the most highly distinguished environmental assets in Sinai and Egypt at large. The significant collection of floral diversity, terrain landscapes, and historical sites are among the most renowned. The Department of Environment, along with environmentalists, are potential stakeholders. Their role in including the El Maghara area in their future conservation and maintenance plans is crucial.

Department of Agriculture

Agriculture is the main activity of most of the Bedouin in the study area. Thus, the involvement of the Department of Agriculture is important in improving agricultural conditions, such

Information Collection, Sinai Assessment

as promotion of agrodiversity, improvement of medicinal plant production, and the implementation of good water management programmes.

Department of Water Resources and Irrigation, DWRI

A central mandate of the Department of Water Resources and Irrigation is to supply the area with water for domestic use as well as for agriculture. Most of the deep wells of the area belong to the DWRI, particularly their operation, monitoring, and maintenance.

Suez Canal University

Suez Canal University is the scientific organization running the Sinai assessment project. Fostering development and prosperity in Sinai is a major objective of Suez Canal University, which is also oriented more than most to community service and environmental studies. The university's facilities in Sinai include: a) an environmental research station in South Sinai (St. Catherine); b) an environmental agriculture faculty in North Sinai (El Arish); and c) a marine science research station at Sharm El Sheikh.

1.3 GENERAL APPROACH USED BY THE ASSESSMENTS

The Arab assessments have adopted a multidisciplinary approach that addresses issues from the biophysical, technical, socio-economic, cultural, institutional, and policy perspectives. They have also stimulated interactions among researchers, policy-makers, and community leaders. Such an integrated approach ensures that all resources are studied together within the system and that socio-economic and policy issues are considered throughout. The three assessments have also been implemented in a collaborative and participatory mode involving researchers, policy-makers, and farmers, nomads and other community members. The study was designed to develop close interaction with the beneficiaries to ensure that the assessment and the responses developed were accepted by the target groups.

A number of techniques were used in each of the assessments. Geographic Information System (GIS), and Remote Sensing (RS) were the most commonly spatial analytical tools used in the three assessments. Satellite

images, and change detection were employed to compare changes in landscape and other attributes over time.

Sets of biophysical and socio-economic indicators were also used as tools for assessing the relationship between ecosystems and human well-being. Indicators were used to assess the quality of environmental attributes and services and to gauge the degradation of some of these services. In this respect, levels of heavy metal pollution, and bacterial count in groundwater samples were used to indicate water quality in the El Maghara assessment, while in Tafilalet, concentration of ammonia was monitored to reflect the quality of water and the incidence of wastewater discharge into freshwater canals. In Asir, the distribution of chlorophyll was used to measure vegetation cover.

In addition, models were used with special reference to quantitative scenarios, and to ascertain relationship and influence between driving forces.

The method adopted within the framework of this study is the same described in the conceptual framework of the Millennium Ecosystem Assessment, (MA) Global Environmental Outlook (GEO) and Environmental Outlook of the Arab Region (EAOR).

The methodology used is based on the DPSIR analytical framework (Driving forces of change - Pressures - State - Impact - Responses), developed by the European Agency for the Environment from an initial model of the Organization of Cooperation and Economic Development (PSR model: Pressure - State - Responses). It used to analyse the interactions between society

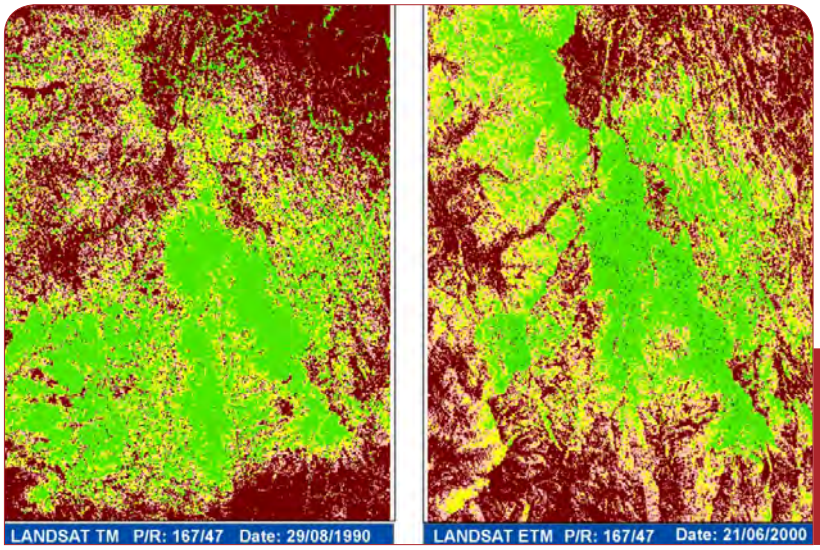


Figure 1.9 Changes in Vegetation Cover

Source: UNEP, 2010

Chlorophyll distribution in Asir study area (Chlorophyll was used to reflect vegetation cover) on 29/8/1990 and 21/6/2000

Table 1.3 Indicators and Tools for Assessing Ecosystem Components

Ecosystem Component	Indicators	Methodological Tool
Mountain: Forest/Woodland	Forested area by species Change in forested area Condition of forest areas	Historic satellite imagery with GIS and ground level verification
Mountain: Terrace Agriculture	Terraced area Condition of terraces Crop production	Satellite imagery with ground level verification Local interviews

Source: UNEP, 2010

and the environment through environmental indicators. The framework which is used in the Millennium Ecosystem Assessment allows carrying out of environmental evaluations, providing information about the elements of that are shaping the state of the environment.

Questionnaires

The conceptual framework for the MA places human well-being as the central focus for assessment. The MA conceptual framework assumes that a dynamic interaction exists between people and other parts of ecosystems.

As humans are an integral part of ecosystems, the MA pays particular attention to the linkages between ecosystem services and human well-being. In this respect, questionnaires have a central role in identifying the human needs, demands and aspirations that the assessment is addressing.

Questionnaires, mostly performed through a personal approach have been instrumental in mapping socio-economic status in the three sites alike. In all three assessments, much of the information obtained was the result of questionnaires that covered a good number of stakeholders.

In Tafilalet, the first survey, called 'Ksar' Survey, was conducted to identify habitat conglomerations, administrative locations, demographic characteristics, and existing basic infrastructure such as electricity, drinking water, sanitation, schools, and roads.The second survey, called household survey, focused on collecting information about different household socio-economic characteristics, such as household structure, production and reproduction, exploitation of natural resources, water management, the risk of sand encroachment, etc.

In Asir, four types of questionnaires, related to: 1) the marine environment; 2) the forest and mountain ecosystem; 3) terraced agricultural areas; and 4) livestock herding areas, were used. The questionnaires were distributed to thirty individuals in different

parts of the park between September and November 2006. Three questionnaires were produced and used throughout the study to map out the socio-economic profile of the population at the assessment site. A group of the assessment team experts with diverse backgrounds in medicine, psychology, sociology, economics, and environmental science were involved in the production and analyses of the questionnaires.

In El Maghara three questionnaires were conducted. The first questionnaire was designed to examine the ability of the Bedouin sample to respond and communicate with the team. It was also meant to pave the way to discuss other issues discussed in subsequent questionnaires. Because the vast majority of the Bedouin were illiterate, the study teams performing the questionnaires had to interview each person individually, explaining the question if necessary before writing down the information.

Female team members were involved in conferring with Bedouin females, who constituted about one-third of the sample. The first questionnaire dealt with basic life activities and generic social issues of the community, as it meant to establish a mutual relationship between the study team and the Bedouin. The other questionnaires that followed were more structured and targeted to ascertain more subtle and indirect information such as the quality of life, environmental awareness, local knowledge, and the role of medicinal plants in Bedouin life. A large part of the interview process was incorporated into a medical examination so that the Bedouin would be encouraged to talk and express their views.

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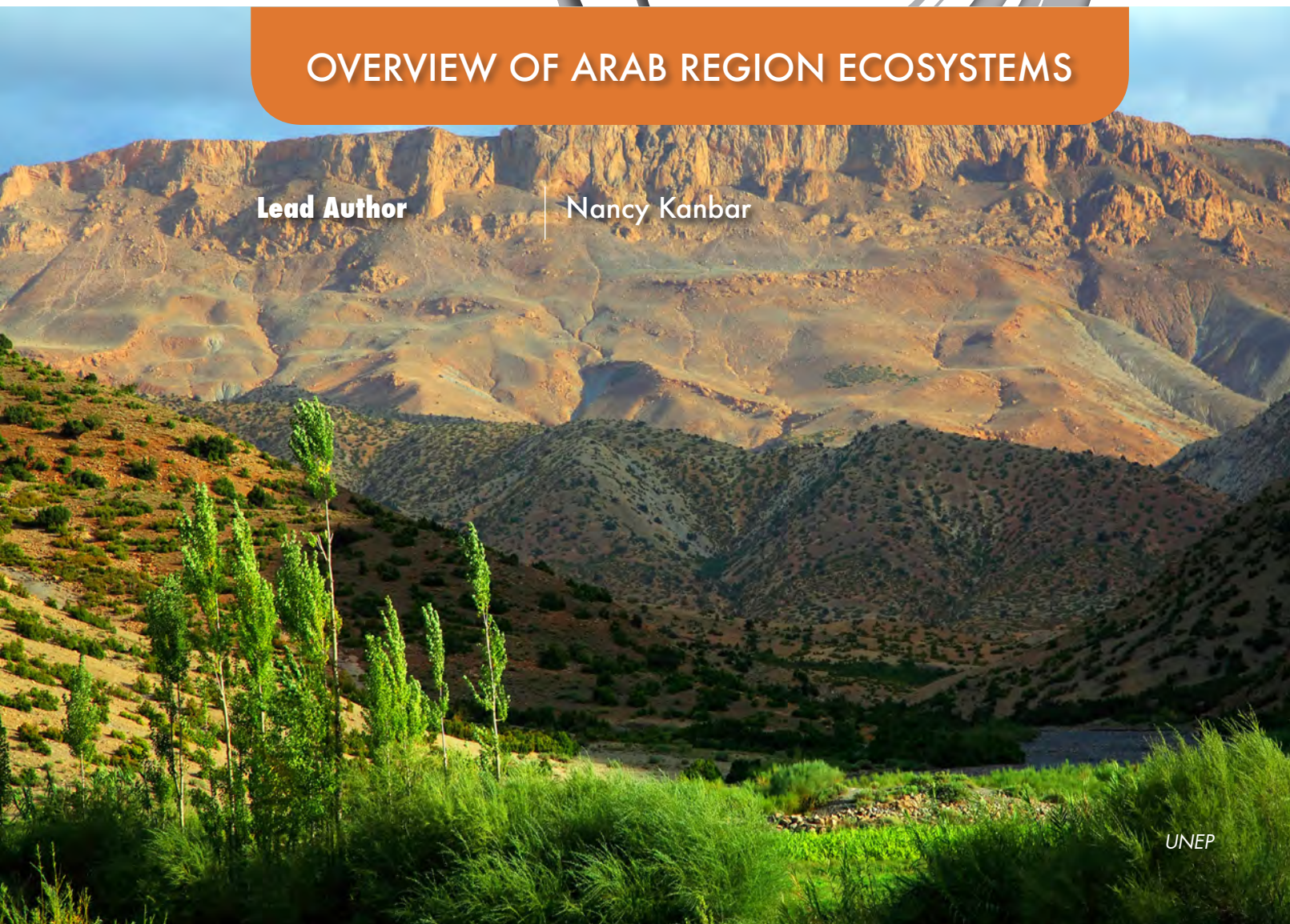
CHAPTER 2

OVERVIEW OF ARAB REGION ECOSYSTEMS

Lead Author | Nancy Kanbar



UNEP

Main Messages

The Arab region is endowed with a diverse set of ecosystems. However, this rich diversity is subject to a high degree of environmental risks.

The Arab region's ecosystems include dryland, forest, mountain, cultivated, coastal, marine and urban ecosystems. These systems are under severe pressures and challenges due to many natural events and anthropogenic activities.

Political unrest and armed conflicts can heavily contribute to ecosystem degradation.

The factors behind poor ecosystem services in many Arab countries are mostly anthropogenic, including pollution, population increase, urbanization, over - harvesting, lack of awareness and lifestyle.

Deterioration of the ecosystem can cause extreme poverty, particularly in communities where the poor depend on natural resources for nutrition, employment and income generation.

Extensive ecosystem consumption, with the subsequent resource depletion has been a major reason for the deterioration reported.

Climate change is one of the potential threats to a number of ecosystems, with special reference to dryland and coastal ecosystems. The expected drop in rainfall, as well as increase in temperatures in the Arab region will pose an extra burden on an already troubled ecosystem.

Arab countries need to develop and improve the sustainability of their ecosystems in order to conserve their services for current and future generations. In this respect, proper management and sound follow-up and maintenance programmes are considered the foremost response to help alleviate ailing ecosystem conditions.

2.1 KEY ECOSYSTEMS IN THE ARAB REGION

The Arab region refers to countries stretching from the Atlantic Ocean in the west to the Gulf in the east, and from the Mediterranean Sea in the north to the Horn of Africa and the Indian Ocean in the southeast. The Arab region covers an area of about 14.2 million km^2 with a combined population of 358 million people straddling North Africa and Western Asia. About 90 per cent of Arab land lies within arid, semi-arid and dry sub-humid areas (Abahussain and others 2002). The region consists of large arid deserts, namely the Sahara. It also contains several fertile lands, such as the Nile Valley, the High Atlas Mountains, and the Fertile Crescent which stretches from Iraq over Syria, and Lebanon and Palestine. The area comprises deep forests in Southern Arabia and Sudan.

Also, it includes key flowing rivers such as major parts of the Nile River, generally regarded as the world's longest river with a length of 6 650 km. Desert climate has ruled the majority of the Arab countries. Over time, conditions of repeated periods of drought, declining precipitation rates, irregular rainfall, heat waves and harsh winds have led to the diversity and fragility of ecosystems in these areas. Key ecosystems in the Arab region include drylands, forests, mountains, cultivated systems, and urban, as well as coastal and marine ecosystems. The following section describes these ecosystems, their characteristics and their main services.

2.1.1 Dryland Ecosystems

The World Atlas of Desertification defines drylands as areas with an aridity index value of less than 0.65 (Middleton and Thomas 1997). The UN Convention to Combat Desertification defined drylands as lands where annual precipitation is less than two-thirds of potential evapotranspiration. Dryland ecosystems are characterized by water scarcity, limited soil moisture, extreme rainfall variability, recurrent but unpredictable droughts, high temperatures, high evaporation rates, low soil fertility, high salinity, overgrazing and fires (Levy and others 2005). The water deficit of drylands limits agricultural production and has a great impact on livestock and humans. People in these areas attempt to expand agricultural production through shifting cultivation, reducing fallow periods, switching farming practices, overgrazing and cutting trees. All these practices result in greater environmental degradation.

Drylands constitute the vast majority of land in the Arab region. They dominate in areas like Saudi Arabia, the Great Sahara in North Africa and Empty Quarter in the Arabian Peninsula. Semi-arid systems are present in many areas like Aarsal, a mountainous locality (36 000 ha) in Lebanon, where nearly 5 000 ha are in serious danger of land degradation (Zurayk and others 2000). Dryland areas in general and those in the Arab region in particular are subject to land degradation, known as desertification and viewed as an expression of a persistent decline in the ability of dryland ecosystems to provide goods and

services. This reduction in land productivity in drylands is mainly caused by water and wind erosion, salinization, soil compaction and crusting, soil nutrient depletion, pollution, acidification, alkalinization, and water logging (Oldeman 1994, Lal 2001, Dregne 2002). The dryland ecosystems are often associated with misery, poverty and conflicts (ICARDA 2006).

The Khanasser Valley in Syria, Site of a Long-Term Research Project to Fight Desertification

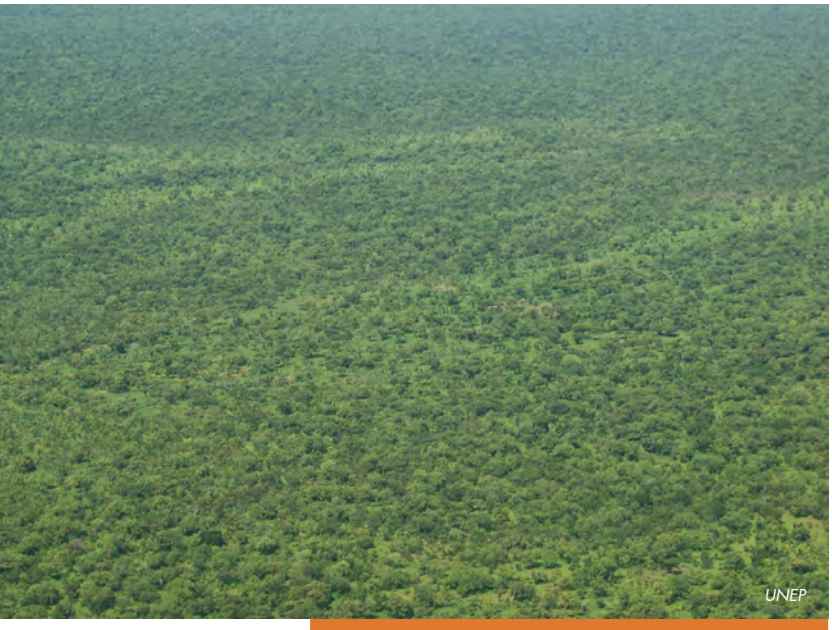
Source: ICARDA, 2006

Drylands are attractive for cultural tourism associated with historical and religious sites (such as El Maghara ecosystem), for coastal tourism (such as Mediterranean beaches), and for health-related tourism (such as the Dead Sea bordering Jordan and the West Bank). Despite harsh conditions, biodiversity and wildlife in drylands are quite high (White and others 2000); thus, they constitute major attractions for ecotourism (Oasis of Tafilalet, Morocco).

The Marsh Arab

2.1.2 Forest Ecosystems

Forest ecosystems occupy about 89.64 million hectares of land area in Arab countries (FAO 2007, Abido 2010). This represents only 7.2 per cent of total land area which is far less than the world forest cover of 30.3 per cent of total land area (UNDP 2009). It is estimated that about 83 per cent of forests in the Arab region are found in North Africa, Sudan and Somalia, with the remainder in the Mashriq countries and the Arabian Peninsula. Stretches of forest cover are found in Lebanon and Syria. The Green Mountains in Libya and the Atlas Mountains spanning from Algeria to Morocco are covered by forests (refer to table 2.1 for the most recent FAO data about forest cover in Arab countries).



Sudan Forests
Source: UNEP, 2007

Forests are central to human well-being and they have diverse ecological functions; namely, conservation of soil and water, positive effect on local climate, mitigation of global climate change, improvement of urban and peri-urban living conditions, protection of natural and cultural heritage, subsistence resources for many rural and indigenous communities, generation of employment, and recreational opportunities. Further, forests play a major role in the conservation of biodiversity as they provide habitation for about half of the world's known plant and animal species. Forest biodiversity is vital for the continued health and functioning of these ecosystems.

Table 2.1 Forest Area by Country in the Arab Region

Country	Forest area (1 000 hectares)	Per cent of total land area
Sudan	69 949 (of which 43.469 million* hectares in South Sudan)	29
Lebanon	137	13
Somalia	6 747	11
Morocco	5 131	11
Tunisia	1 006	6
United Arab Emirates	317	4
Syria Arab Republic	491	3
Iraq	825	2
Occupied Palestinian Territory	9	2
Comoros	3	2
Algeria	1 492	1
Yemen	549	1
Jordan	98	1
Bahrain	1	1
Saudi Arabia	977	not significant
Mauritania	242	not significant
Libya	217	not significant
Egypt	70	not significant
Djibouti	6	not significant
Kuwait	6	not significant
Oman	2	not significant
Qatar	0	0

**calculated by the author*
Countries are listed by decreasing per cent of forest area of total land area.
Source: FAO, 2010. Global Forests Resources Assessment (FRA 2010): Main Report

Forests are not distributed evenly across the globe. Of the top ten countries with the largest forest areas in the world, Sudan (70 million hectares of forests) is the only Arab country on the list (FAO 2010). It is important to note that the 70 million hectares of forest

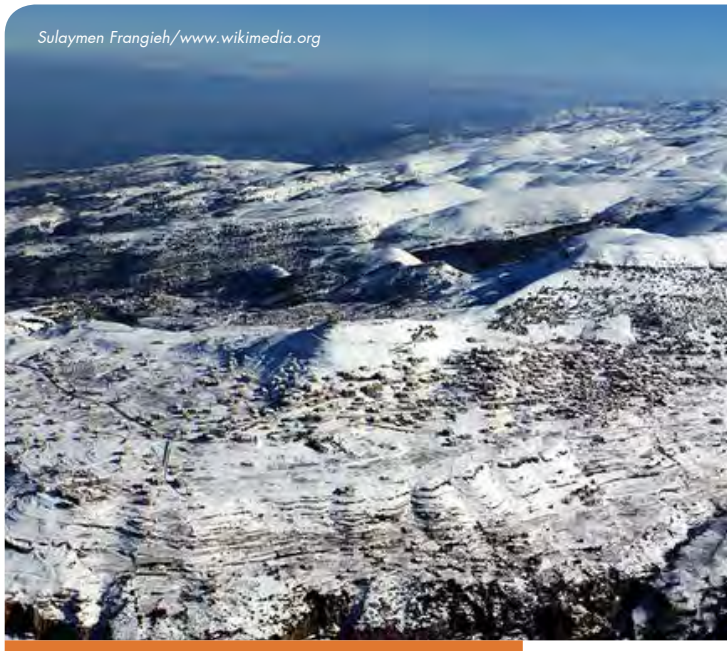
Barouk Mountain. Al-Shouf Cedar Nature Reserve, Lebanon

area for Sudan comprises the area in both the Northern and the Southern parts of the country. After periods of deadly conflict, South Sudan became an independent state on July 9, 2011 and joined the African Union on July 28, 2011.

Although forest ecosystems are relatively rare in the Arab world, forests can be found in some distinctive regions. Data from the FAO show that forest ecosystems in the Arab region are being degraded due to agricultural and urban expansion as well as fires. Despite negative trends, forests still retain the potential to meet growing human needs if managed more sustainably. Many countries have developed solid legislative, economic, and social policies for sustainable forest management. Significant progress has been made in establishing national forest programmes through participatory processes for the development and implementation of forest policies. Close to 75 per cent of the world's forests are covered by such programmes (FAO 2010).

2.1.3 Mountain Ecosystems

Mountains offer different ecosystem services, including provisioning services like supply of clean water, plant and animal production, pharmaceuticals and medicinal plants, as well as non-timber forest products. Moreover, they supply regulating and supporting services; such as biodiversity, climate regulation and soil fertility. They are also important in offering cultural services, mainly recreation and cultural diversity (Körner and Ohsawa 2005). In addition, mountains have intrinsic spiritual and aesthetic values (Daniggelis 1997, Bernbaum 1998).



Horsh Ehden Nature Reserve, Lebanon

In the Arab region, high and steep lands are spread in Yemen, Djibouti, Morocco, KSA, Oman, Iraq, and in the Eastern Mediterranean region such as Lebanon and Syria. For example, the Sarawat Mountains – also known as Sarat al-Asir or Sarat al-Hijaz – extend from the border of Jordan in the North to the Gulf of Aden in the South running through Saudi Arabia and Yemen, parallel to the western coast of the Arabian Peninsula. Elevations of this mountain chain average around 1 200 - 2 000 metres, but Sarat al-Yemen reaches heights of over 3 300 metres above sea level. The rocky formations of Sarawat Mountains contain vegetation, unlike the Atlas Mountains in Morocco. Among the cities located within the Sarawat is the Muslim Holy city of Mecca. The Atlas Mountains are a range of mountains that extend across Northern Africa, about 2 500 km through Morocco, Algeria and Tunisia. The highest peak is the Toukbal Mountain, with an elevation of 4 167 metres in southwestern Morocco. The Atlas ranges separate the Mediterranean and Atlantic coastlines from the Sahara Desert. The population of the Atlas Mountains is mainly Berber. The mountains have been home to a number of plant and animal species unique in Africa, many of which are endangered or have already become extinct.

Tunisia Atlas Mountains & Mides Canyon

Atlas Mountains

Mountain ecosystems are extremely fragile because they are subject to both natural and anthropogenic drivers of change, mainly volcanic and seismic events, flooding,

climate change, extractive industries, forest destruction, overgrazing, and inappropriate agricultural practices (Körner and Ohsawa 2005).

Mountain populations have evolved a high diversity of cultures, languages and traditional agricultural knowledge commonly promoting sustainable production systems. In general, poverty and ethnic diversity are higher in mountainous regions, and people are often more vulnerable than people elsewhere. Ninety per cent of the global mountain population lives in developing countries. It is estimated that 90 million mountain people are considered poor and vulnerable to food insecurity (Körner and Ohsawa 2005).

Siwa Oasis, Egypt

Kabylia, Algeria

2.1.4 Cultivated Ecosystems

According to the MA definition, "an area is considered cultivated if at least 30 per cent of the underlying 1x1-kilometer land cover grid cell has been classified as cropland" (Cassman and Wood 2005). About 24 per cent of the Earth's terrestrial surface is occupied by cultivated systems.

In the Arab region, cultivated systems are mainly spread in Sudan and in countries with direct exposure to the Mediterranean Sea, like Morocco, Tunisia, Syria and Egypt. In these countries, landrace varieties of wheat are cultivated. In Egypt, new technologies have been introduced in order to improve water productivity and wheat production.

In Algeria, cultivated systems are found primarily in the Kabylia fields and in oases planted with palm trees. Another example of cultivated systems is Tafilalet in Morocco, the most important oasis of the Moroccan Sahara, where wheat has evolved into different varieties under very hot conditions. This new variety of wheat was able to develop genes heat-resistant to the harsh climate of the region (ICARDA 2008). In Siwa oasis, located 50 kilometres east of the Libyan border and 560 kilometres from Cairo, dates and olives are primarily cultivated. The waste products from the olive industry have land pollution consequences (Al-Khouly 2004). In the last twenty years, Siwa Oasis suffered from population growth, development activities, overgrazing, expansion of cultivation area, and increase in industrial activities.

2.1.5 Coastal Ecosystems

Coastal ecosystems are among the most prolific, yet vulnerable, ecosystems in the world (Agardy and Alder 2005). They are highly productive, valuable to human beings, and ecologically critical. Coastal ecosystems produce more services related to human well-being than most other systems (Agardy and Alder 2005). Nonetheless, these ecosystems are experiencing rapid environmental changes. In the last centuries, human reliance on coastal systems has increased with intensified demands of growing populations and the continuous pursuit for higher productivity.

The Arab region has 22.4 thousand kilometres of coastline and 16.6 thousand kilometres of rivers, freshwater and semi-freshwater lakes (UNDP 2009). Additionally, many coastal wetlands occur in many

Cultivated Systems in Tafilalet, Morocco

countries of the region, such as in Algeria, Morocco, Lebanon and Mauritania among others.

Population expansion in urban cities along the coastline in the Arab region is causing pollution problems and growing pressures on the natural resources. Coastal areas in Arab countries are inhabited by 40 to 50 per cent of their populations (UNDP 2009). These ecosystems are experiencing serious environmental challenges, mainly due to competition for land and natural resources (UN 2010). As most urban populations and associated commercial sectors in the Arab region are concentrated along the coastline, negative impacts are felt in coastal and marine ecosystems, especially related to the fisheries sector.

The region produces some 3.8 million tonnes of fish, mostly in Morocco, Mauritania, Egypt, Yemen, and Oman (UNDP 2009). Given the high level of economic productivity of coastal ecosystems, it is not surprising that overfishing and intensive aquaculture have caused significant ecological and social challenges in these ecosystems. With increased economic activity in coastal areas, particularly urban and industrial expansion, these ecosystems are being threatened by pollution from petroleum and heavy elements (UNDP 2009). Also, the wastewater release from cities and industries as well as agricultural run-off charged with chemicals have caused the depletion of the rich biodiversity of coastal ecosystems. For instance, in Lebanon, the Nahr El-Kalb watershed is a coastal area on the Mediterranean Sea that has suffered severe pollution. Moreover, Shatt al-Arab, which is formed by the convergence of the Tigris and Euphrates rivers in Iraq, has become polluted due to the direct dumping of wastewater, industrial wastes, petroleum materials, and arms scrap after the Iraq wars.

2.1.6 Marine Ecosystems

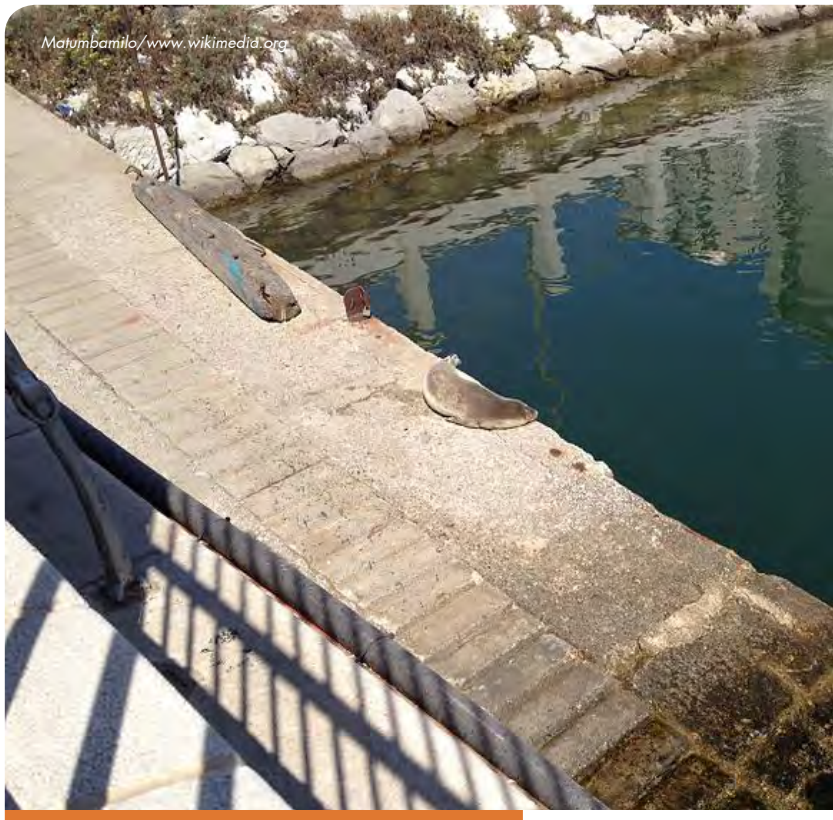
In the Arab region, marine ecosystems are found in all countries of the region, such as Egypt, Lebanon, Syria, Yemen, Sudan, Libya, Algeria, Morocco, Tunisia, Oman, KSA, and other Gulf countries. Poor coastal

Figure 2.1 Jiyeh Oil Spill, Lebanon

communities in this region depend on the fisheries sector for nutrition, employment and income generation. Additionally, several countries in the Maghreb region rely on fisheries as a major export sector (UN 2010).

Many marine ecosystems in the Arab region, especially those in the Gulf and in a number of touristic resorts in other countries, show signs of stress due to invasive species, unorganized coastal development, pollution caused by large volumes of desalination plant effluents, coastal run-off from urban areas, as well as sewage and waste disposal. Other reasons leading to the degradation of marine biodiversity are the overexploitation of fish stocks and the pollution caused by oil exploration and industrial pollution (UN 2010).

Wars and conflicts in the region have also contributed to marine pollution. An example is the bombing of storage tanks at the Jiyeh power plant in South Lebanon in July 2006, which resulted in the release of approximately 10 000 - 15 000 tonnes of fuel oil into the Mediterranean (UNEP 2007). A substantial proportion of the spilled oil sank into the water covering the seabed over an area of a few hundred metres out to the sea and affecting about 150 kilometres of Lebanon's coastline. These damages adversely impacted the country's economy, environment, and public health. Negative effects were also recorded on environmentally sensitive ecosystems like the Palm Islands Nature Reserve, on nature-based tourism like sandy beaches, as well as on the livelihoods of fishermen and communities dependent on



Mediterranean Monk Seal

marine ecosystems (UNDP 2007). A World Bank study on the economic assessment of environmental degradation due to July 2006 hostilities in Lebanon estimated the overall cost of environmental degradation between US$ 527 and 931 million averaging at US$ 729 million, or about 3.6 per cent of GDP in 2006 (World Bank 2007b).

In an effort to conserve marine ecosystems and restore marine habitats and species, Arab countries recognize that national policies such as establishing marine protected areas are important. An example for such conservation effort is the Palm

Islands Nature Reserve, a unique and integrated natural marine-island ecosystem in the Eastern Mediterranean. The ecosystem is an important site for migratory birds and it is listed as a Wetland of International Importance in the directory of Birdlife International (Evans 1994).

2.2 OVERALL CONDITIONS, TRENDS AND IMPACTS

Ideally, conditions, trends and impacts refer to past and current conditions of ecosystems and their services. Human exploitation and abuse of these services put more pressures on fragile ecosystems and can lead to serious environmental impacts. Globally, about 60 per cent of ecosystem services that are directly associated with human well-being are declining (SCBD 2006, Abido 2010). Anthropogenic and environmental forces that drive ecosystem changes, and thus changes in ecosystem services, are highly variable in various locations. Thereby, general statements of causality are hard to create and a one-to-one linkage between particular driving forces and changes in ecosystems and their services is difficult to make (Janetos and Kasperson 2005).

This section explores the major changes in ecosystem services over the last few decades and the trade-offs that have occurred as a result of the increased exploitation of those services in the three sites selected by the Arab MA. Overall conditions, trends and impacts of these ecosystems will be described and the major drivers of change that have led to the degradation of the environment in these sites will be discussed. The selected ecosystems include:

- El Maghara, Sinai Peninsula in Egypt.
- Tafilalet Oasis in the Kingdom of Morocco.
- Asir National Park in the Kingdom of Saudi Arabia.

2.2.1 El Maghara, Sinai Peninsula, Egypt

The Sinai Peninsula is a land bridge between Asia and Africa; it lies between the Mediterranean Sea to the north and the Red Sea to the south. This dryland ecosystem is characterized by the aridity of its climate and water scarcity, typical conditions in the Arab region. Sinai is distinguished by its sacred sites, such as St. Catherine's monastery, one of the oldest Christian establishments in the world, and Gebel Mousa where Moses is believed to have received the Ten Commandments.

El Maghara ecosystem in the Sinai Peninsula is known for its natural landscape, ecological landmarks, medicinal plants, biodiversity as well as its cultural and spiritual heritage. El Maghara ecosystem remains the one area in Sinai where Bedouin culture and tradition prevail. Bedouins in this region have the highest illiteracy rate in Sinai and the highest ratio of aged dependent inhabitants (UNEP 2010). Throughout history, the region was exposed to severe environmental degradation and loss of natural resources. With their indigenous knowledge and familiarity with the

harsh environmental conditions of the area, the Bedouins were able to survive the many problems they faced.

Today, El Maghara suffers from excessive environmental degradation; namely due to water scarcity, heavy pollution, resource depletion, land use changes and loss of biodiversity. Environmental degradation is considered a key factor underlying the high poverty level of local Bedouins. Climate aridity and water scarcity have severe impacts on agriculture, health, economy, education and migration in this ecosystem. With the impact of climate change, the possibility of less rainfall in drylands seems high and the situation is worsened.


Mohamed Tawfic

Bedouins of El Maghara, Sinai, Egypt
Source: UNEP, 2010

Additionally, harsh environmental conditions are caused by anthropogenic factors such as heavy industries, coal mining, overgrazing, clearing shrubs for fuelwood, and building new roads for quarrying. It is important


Mohamed Tawfic

Water Scarcity and Failing Crops in El Maghara

to highlight that El Maghara ecosystem is considered one of the most important floral centers for medicinal plants in the Middle East (Abd El-Wahab and others 2004, UNEP 2010). Unique traditional knowledge of these plants and their uses is held by the Bedouin tribes. However, severe environmental degradation has caused damage to the floral diversity of the ecosystem, affecting the welfare of the inhabitants. The natives of El Maghara area are among the poorest in Sinai. Since ecosystem services in El Maghara are a core component of human survival, it is believed that poverty in this region is partially an environmentally caused phenomenon.

Current conditions and trends of El Maghara ecosystem are highlighted. Special emphasis was laid on major services, namely floral

diversity, medicinal plants, and the provision of water and minerals. Laboratory and field observation techniques, image processing of satellite data, Geographic Information Systems (GIS) and remote sensing tools were useful in examining the ecosystem changes and the impacts caused by man-made activities. In addition, the Sinai assessment studied the socio-economic profile of the Bedouins through extensive meetings and interviews with the locals. Additionally, questionnaires were designed to map out the socio-economic conditions of the Bedouins in the various villages. The study sample targeted about 100 individuals from the assessment area. The elderly community represented a reliable source of information related to local knowledge and the use of medicinal plants (UNEP 2010). Women were knowledgeable about the floral species. The region was characterized by its relatively low population due to high out-migration of young males looking for job opportunities in other parts of Egypt.

The primary occupation of the Bedouin population is livestock grazing and agriculture. However, with the increasing water shortage problem and the severe droughts, unemployment in the region has become a serious issue. Poverty in El Maghara is not limited to the economic aspect but also includes lack of access to schools, clean water and social services (UNEP 2010). The survey attempted to rank Bedouin demands according to their importance. Results showed that 93 per cent of the Bedouins cited clean drinking water and the availability of schools as top priority issues. Their other main concerns were the availability of irrigation water for agriculture, cited by 83 per cent, and the availability of electricity, cited by 62 per cent (UNEP 2010). The high environmental degradation in El Maghara ecosystem is a key factor underlying the high poverty level and the miserable quality of life of local Bedouins who depend on environmental resources for their livelihoods.

2.2.2 The Oasis of Tafilalet, Morocco

The oasis ecosystem of Tafilalet in the Kingdom of Morocco represents another example of the arid ecosystem in the Arab region. An oasis is "an area intensively cultivated in a desert or heavily characterized by the dry climate" (UNEP 2009). The oasis is located in the Sahara in southeast Morocco. This area is selected for examination due to its natural characteristics and the human-environment interactions. Protecting the oasis was identified as a priority and the study was developed by the Environment Department of the Ministry of Land Use, Water and Environment (MATEE) through the Moroccan National Observatory of the Environment (ONEM). The assessment aims at a systematic evaluation of the current conditions, trends and impacts of the ecosystem and its services as well as their effects on well-being. It provides decision-makers with information to design sustainable plans to improve the welfare of the local population who depend on the ecosystem resources.

Historically, humans were successful in developing the oasis civilization without degrading the environment. Today, environmental degradation, driven both by natural factors and anthropogenic actions, is reflected in the deterioration of the ecosystem and its services. The current state is aggravated by widespread poverty in the region. Problems such as population growth, water shortage and pollution, arid climate, recurrent droughts, and flashfloods are major issues.

Local communities, depending on agriculture for subsistence, exerted intense pressure on limited agricultural lands. This situation created desertification, soil erosion and sand encroachment, loss of productivity, salinity, overexploitation of palm and olive trees, as well as overgrazing and deforestation that seriously threaten the ecosystem. Despite the richness of the oasis in biodiversity, many species are threatened with extinction due to the loss of natural habitats.

The diversity of the oasis is an attraction to many tourists. However, tourism in the area does not respect the natural environment.

The population of the oasis continues to grow rapidly. Population growth is accompanied by agricultural intensification and the expansion of infrastructure, which has caused intense pressures on the natural ecosystem. The population is poor and depends largely on the natural resources of the oasis, particularly agricultural lands. With high levels of unemployment, the inhabitants were forced to overuse agricultural lands to generate additional income. This situation further contributes to the ecosystem deterioration and loss of biodiversity (UNEP 2009).

Typical Fields of Traditional Agriculture, Tafilalet, Morocco

Source: UNEP, 2009

The oasis is largely characterized by limited water resources. Several factors contribute to excessive water shortages, mainly lack of and poor dam maintenance, low and irregular precipitation, poor water management, successive droughts, and unsuitable agricultural practices that threaten the sustainability of agricultural production. In addition, water quality in the oasis is polluted due to the lack of sanitation and wastewater treatment as well as waste dumping (Kelly and Mahboub 2006).

The climate of the oasis is characterized by its aridity. Recurrent droughts cause loss of agricultural productivity and desertification. Further, uncontrolled flashfloods threaten agricultural lands. In recent years, the problems caused by floods have intensified due to climate change and anthropogenic activities.

Agriculture in the oasis is generally traditional subsistence agriculture. It is practiced around water resources and it is characterized by a significant biodiversity, with local varieties, such as date producing palms and olive trees that are an income source for farmers. Currently, however, the increasing need for food has forced expansion into less fertile lands or overexploitation of existing ones. In addition, salinity, uncontrolled use of fertilizers, intense irrigation systems, and excessive pumping of groundwater have caused further loss of productivity. Additionally, sand encroachment and desertification, resulting from harsh weather conditions and anthropogenic actions, are other causes of environmental degradation, which have negative effects on the farmers' incomes (UNEP 2009).

Ministry of Energy, Mines, Water & Environment, The Kingdom of Morocco

Dates and Other Date Derivatives
Source: UNEP, 2009

The oasis of Tafilalet is classified among the main Moroccan palm areas. Palms produce dates and they are used for different purposes, such as, manufacturing doors, baskets, and ropes from their trunks and leaves. Currently, palms are suffering from overexploitation and are witnessing a sharp decline due to water shortage and desertification. Furthermore, the current date production is of poor quality, which negatively impacts their commercial values, and hence reduces the incomes of the local population. Similarly, olive trees are infested by insects that cause devastating effects threatening the sustainability of their production. Additionally, the local population generates income from animal production, such as cattle breeding, poultry and beekeeping. Though known for high productivity, beekeeping witnesses

a decrease in production mainly due to the degradation of nectar plants and bee mortality caused by pesticides overuse, drought, and diseases. Honey production, a valuable source of income, is negatively impacted (UNEP 2009).

Biodiversity in the oasis is rich in variety and in number of species available. However, many species are threatened with extinction due to the loss of natural habitats. Also, agricultural intensification and overgrazing have contributed to the loss of agrobiodiversity. The well-being of the local population, whose lives depend on wildlife and ecosystems goods and services, is affected. With their rich biodiversity, local traditions and the uniqueness of their landscape, the oasis is an attraction to many tourists. However, tourism development exerts a great pressure on natural resources, especially water. In addition, the region is known for its traditional crafts. Craftsmanship is an important source in promoting the socio-economic conditions of the local population, by creating additional incomes to the locals.

2.2.3 Asir National Park, Saudi Arabia

The assessment of Asir National Park (ANP) in the Kingdom of Saudi Arabia was undertaken with regard to the concepts of ecosystem services and human well-being (UNEP 2009). The objective was to examine the current conditions, trends and impacts of ecosystem change on humans' welfare. ANP is located in southwestern Saudi Arabia in the Asir Mountains that occupy the south part of the Sarawat Mountains, extending from Al Taif in the north to Najran in the south. ANP represents a forest ecosystem in the Arab region. It is the first park established in the Kingdom and it was opened to the public in 1981. It has been estimated that 2 - 3 million tourists visit ANP annually.

The park is spread over 45 000 hectares and it encompasses three main habitat types: sandy desert, high altitude habitat, and the marine habitat of the Red Sea. It comprises four ecosystems; including a mountain ecosystem with juniper forests, a terraced agricultural area, a grazing land, and a coastal and marine ecosystem. The forest ecosystem is the main focus of this assessment because of its vital services, such as food, conservation of soil and water, mitigation of climate change, and protection of biodiversity.

The Kingdom of Saudi Arabia extends over an estimated area of more than two million square kilometers. It is known for its dry climate and its limited natural resources. Limited rainfall and recurrent droughts contribute to the high levels of water scarcity in the Kingdom. The inhabitants of the Asir Mountains were dependent on the natural forests. In the past, a traditional system called Al Hima was put in place by the local Bedouins in order to protect the forest ecosystem. Under Al Hima, no one was allowed to access the forests without the permission of the local tribe. Literally, the word 'Hima' means 'protected area' in Arabic.

Traditional Himas were very successful in integrating land conservation and sustainable use of natural resources with human well-being. In recent decades, however, the traditional Hima system has deteriorated.

Recent studies have warned of the many threats to the forest ecosystem in Asir, which are subject to severe deterioration. These threats include poor forest management, land-use changes, urban expansion and road construction, deforestation, wood cutting, overgrazing, uncontrolled pests and diseases, pollution, drought, erosion, soil salinity, hunting, overfishing, dumping of refuse, and abuse of agrochemicals (UNEP 2009). Consequently, Juniper forests in ANP have suffered tremendously. The forest outlook study carried out for Saudi Arabia in 2004 explained that if the current forest status persists, many of the southwestern forests of the Kingdom, including the Asir region, will lose their green cover, leading to environmental and socio-economic problems (Ministry of Agriculture of Saudi Arabia 2004).

Among all natural resources, water in the Asir region has the greatest impact on people and the ecosystem. Water scarcity is a major concern for human well-being in the region. Limited and erratic rainfall is the main sources of water. Water shortage forces people in this area to rely on the utilization of groundwater and desalinated water. Not only is the water availability a problem in the region, but water quality is also of great concern. A serious problem is water pollution where discharges from wastewater treatment plants and septic tanks flow down into the Red Sea and affect the fish population and other marine biodiversity. Water pollution negatively affects all ecosystem services, such as food, agriculture, land and the fish population (UNEP 2009).

Assessment of the current conditions of the forest ecosystem in ANP has found that the area has undergone intense deterioration, which has adversely affected ecosystem services. These are likely to become exacerbated in the future as a result of many natural and anthropogenic drivers; such as population growth, urbanization, tourism pressures, agricultural expansion, road building within the forests, pollution, water scarcity, desertification and climate change. The Kingdom of Saudi Arabia, aware of these threats, is trying to enhance remediation efforts for a sustainable use of natural resources. However, despite the ongoing attempts to develop cost-effective conservation practices, the forest ecosystem degradation in ANP continues to take place at a fast pace.

2.3 LINKAGE TO GLOBAL ECOSYSTEMS

The MA is considered one of the most large-scale efforts to date that assesses ecosystem change and its impacts on human well-being. In addition to the global assessment of ecosystem changes, the MA includes a set of sub-global assessments at multiple spatial scales. These assessments are novel compared to other international studies that focus on global or regional scales

alone, in that they have provided valuable insights related to the influence of scale and knowledge systems on the complex relationship between ecosystems and human well-being. As for local assessments, they emphasize the importance of relationships between ecosystem services- particularly cultural services- and drivers of change that were often not observed at global scales (Capistrano and Samper 2005). Drivers of ecosystem change act in distinct ways in various regions. Although similar drivers were existent in different studied regions, the processes through which these interacting drivers cause ecosystem change vary among the sub-global assessments.

This section is intended to outline major trends of global drivers examined in the sub-global assessments. It will draw conclusions about the connections between Arab and global ecosystems. Examples include global population growth, urbanization and resource consumption, land cover change, the extensive use of fertilizers and pesticides to intensify agricultural production, fisheries exploitation, air pollution and climate change, land degradation, water scarcity and pollution, and loss of biodiversity.

2.3.1 Land Cover Change

Population growth and urbanization have caused changes in global consumption patterns, and increased demands for food and ecosystem services; resulting in land cover change, especially conversion to cropland. Growing demands for provisioning services lead to deterioration in other ecosystem services. As forests are converted into cropped lands, the services they once provided decline. Currently, cropped areas cover approximately 30 per cent of the Earth's surface (UNEP 2005). The Arab region, dominated by drylands, shows various examples of land cover change in different countries; mainly due to agricultural intensification, overgrazing, deforestation and forest degradation, urbanization, as well as other anthropogenic activities and natural causes.

The findings of the sub-global assessments and the results of the current conditions and trends of the key ecosystems in the Arab region were consistent with global observations on land cover change (refer to section 2.2). For instance, population growth in the oasis of Tafilalet is accompanied by infrastructure works and agricultural intensification. In addition, land cover has been changed by other human activities, such as overgrazing, clearing shrubs for fuelwood, coal mining and quarrying industries (such as in El Maghara ecosystem). Land cover change comprises various processes, including urbanization and building new roads, deforestation and encroachment on natural ecosystems by agriculture (such as in Asir National Park).

2.3.2 Climate Change

Climate change is considered a major driver of ecosystem change on a global level. Continued greenhouse gas emissions at or above current rates would cause significant changes in the global climate system inducing increasingly warmer temperatures (IPCC

2007a). According to the Intergovernmental Panel on Climate Change, global mean temperature increased by 0.4°C to 0.8°C over the twentieth century (Petschel-Held and Lasco 2005). Most arid and semi-arid areas are projected to become drier with an expected increase in heavy precipitation leading to more floods and droughts (Nelson 2005). Worldwide, warmer temperatures and associated changes in the global climate have had many effects on biological systems.

In the Arab region, climate change represents an added stress that ecosystems are subjected to in this dry arid and water-scarce region. If current development activities persist, it is estimated that large increases in greenhouse gas emissions might occur during the next twenty to fifty years in the Arab region (UNEP 2009). Thus, air quality emerges as a very important environmental parameter that affects sustainable development on the regional as well as the global scale.

Emissions responsible for climate change and the impacts of this global challenge have undesirable consequences for all sectors of development. Thus, all ecosystems must be monitored and assessed for added risks from climate change. Managing climate risks and developing the resilience or adaptive capacity of the ecosystems is crucial to protect and sustain human lives and livelihoods. Countries of the Arab region need to consider their national and international policies for air emission control to manage the negative effects of climate change.

2.3.3 Land Degradation

Another global concern is land degradation in drylands known as desertification. The United Nations Convention to Combat Desertification (UNCCD) defines desertification as "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (UNCCD 1994).

Desertification is accompanied by the persistent reduction in the provisioning services by drylands (Safriel and Adeel 2005). Factors such as population increase, land-use and land cover change, and climate change are expected to contribute to an accelerated water shortage and degradation of drylands. Safriel and Adeel (2005) indicate that the water availability in drylands is projected to decline from the existing average of 1 300 cubic metres per person per year (in 2000), which is already below the threshold of 2 000 cubic metres essential for minimum human well-being. This increased water pressure will lead to a further land degradation.

In the Arab region, the per capita renewable water resources are currently estimated at 1 100 m^3 per year, compared to a global average of 8 900 m^3 per person per year. This figure is expected to drop to 547 m^3/year by 2050. Data show that fifteen of the 20 countries in the world with the lowest internal renewable freshwater supply (below the water stress threshold of 1 000 m^3) are Arab countries (IFAD 2009).

The rainfall pattern further increases the problems of low productivity, low soil moisture, and salinization in drylands. The average amount of rain received by the Arab region is estimated at 2 148 km^3 annually, of which about 50 per cent occurs in the Sudan (IFAD 2009). The oasis of Tafilalet and Asir National Park are ecosystem examples showing that extremes of natural drivers - such as rainfall fluctuations - when coupled with anthropogenic drivers - such as demographic, economic and socio-political drivers - jointly become drivers of change that push the exploitation of ecosystems, intensifying pressure on drylands and leading to further land degradation and decreased service provision (Safriel and Adeel 2005).

2.3.4 Loss of Biodiversity

Biodiversity is fundamental to the function of ecosystems. The Convention on Biological Diversity defines biodiversity as "the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part, including diversity within and among species and diversity within and among ecosystems" (UNEP 2003). This definition is broad, and the sub-global assessments tackled particular components of biodiversity. For instance, the Sinai assessment focused on medicinal plants, the Asir National Park assessment concentrated on Juniper forests, and the oasis of Tafilalet focused on palm areas.

The majority of sub-global MA reports indicate that there is a consistent trend of biodiversity loss at the global level (Pereira and others 2005). This finding is supported by the global analysis of biodiversity trends (Mace and others 2005). Many drivers were examined in the assessment of biodiversity condition in different areas of the world. Habitat loss was one of the most significant drivers, with several assessments basing their results on land cover information derived from remote sensing data (such as El Maghara). Many sub-global assessments used the conversion of natural land cover to other land uses (agricultural intensification and building of infrastructure) as an indication of the condition of biodiversity loss (Asir National Park and Oasis of Tafilalet). Degradation of ecosystems by overgrazing and overutilization of natural resources (the intensive use of medicinal plants in El Maghara as well as the exploitation of palm trees in the oasis of Tafilalet) was identified as another important driver of biodiversity loss. Some sub-global assessments cited ineffective and uncoordinated land-use planning as the main reason for the poor condition of biodiversity. For instance, in El Maghara, there is no state control over medicinal plants, thus the intensity of abuse depends on the natural availability of those plants. Other drivers highlighted in different regions around the world were wildlife hunting and introduction of invasive species that alter ecosystems, causing global extinctions of indigenous species (data are lacking about the latter driver in the Arab region).

2.4 POLICY IMPLICATIONS: ECOSYSTEM CHANGE AND HUMAN WELL-BEING

Progress towards sustainable development is vitally dependent upon sound human decision-making regarding ecosystems. With its emphasis on the human dimension of ecosystem change, this chapter can be considered as a contribution for the search for a sustainable development for the Arab region. It is the central message of this chapter to show that the resolution of environmental problems involves real changes in the behaviors and decisions of people towards their natural surroundings. Ecosystems and environmental resources are becoming overused and polluted. Empowering local communities through public awareness and community participation will provide more opportunities towards sustainable development policies. Although the role of government and regulations is needed to manage environmental problems, the role of individuals and societies is central. The link between public awareness, policy structure, and institutional framework needs to be recognized. Approaches to dealing with sustainable development issues are often complex due to information imprecision (Sage 1999). Despite this complexity, a political will as well as the will of the local populations can help bring about win-win solutions.

Finally, the chapter clearly demonstrates that human aspiration for better well-being is usually the primary factor that explains trends and impacts of ecosystem change. Nevertheless, the interactions of modern human activities with ecosystems have contributed to increasing human vulnerability and to the impact of ecosystem changes on well-being (De Guenni 2005). Proper ecosystem management remains an important tool to enhance human well-being. Climate change, access to clean water, food and energy are key factors that can impact the health, stability and security of individuals and communities.

Today, Arab countries realize the dependence of local communities on their ecosystems as well as the profound association between ecosystem conditions and development. Thus, policy makers in the Arab region are beginning to integrate environmental factors into development decisions. Despite the limitations of data in the Arab region as a whole, sufficient knowledge exists in most countries to apply sound ecosystem management practices and sustainable development strategies in order to provide opportunities for better human well-being.

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CHAPTER 3

ECOSYSTEM SERVICES

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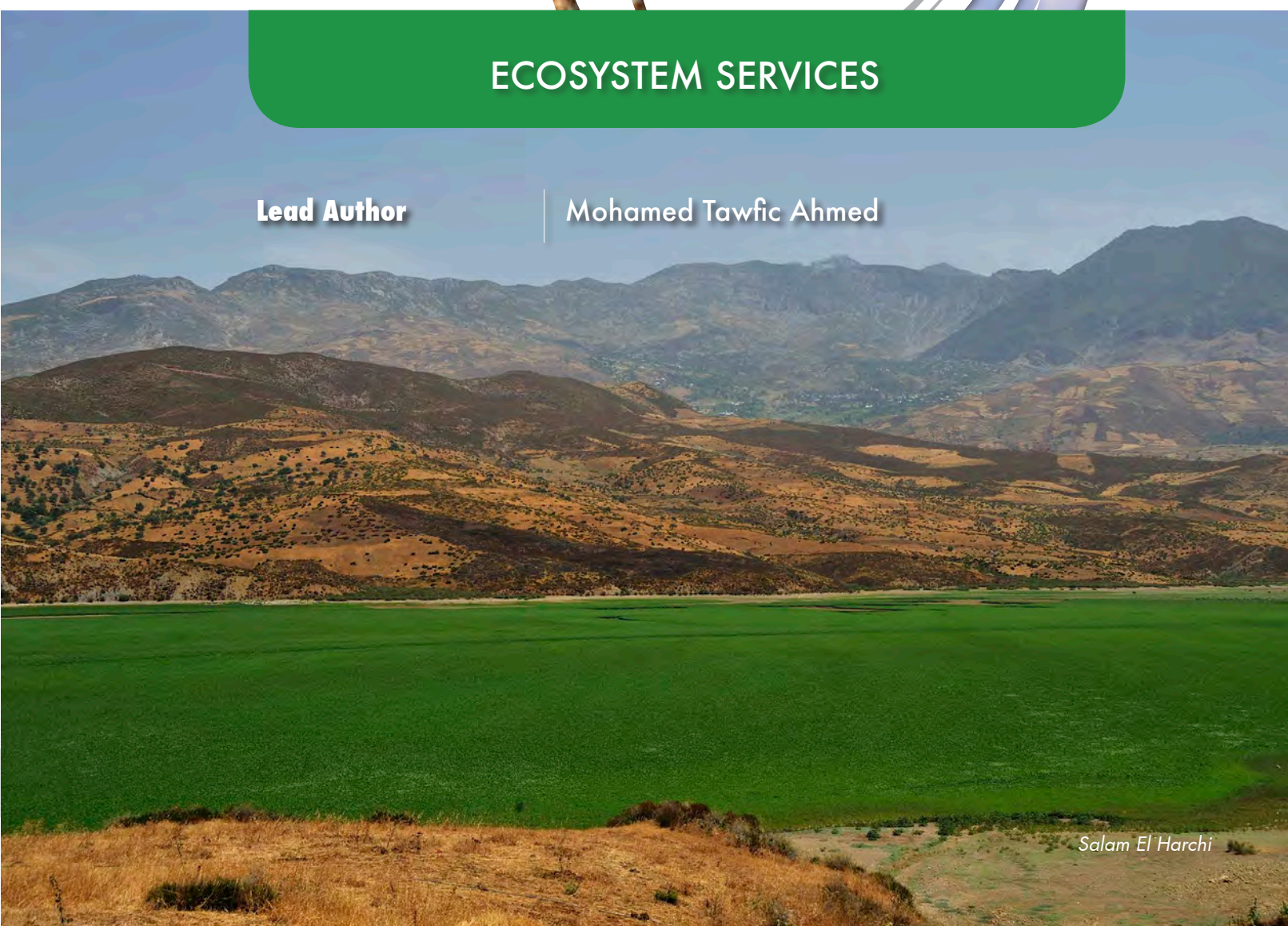


Salam El Harchi

Main Messages

Productive ecosystems provide communities with resources and options they can use as insurance in the face of natural catastrophes or social upheaval. Well-managed ecosystems reduce risks and vulnerability. Poorly managed systems can increase the risks of flood, drought, crop failure, or disease.

An ecosystem is subject to numerous externalities that might impede its ability to provide its regular service, either temporarily or permanently, depending on the nature and magnitude of that externality. Examples include any natural or human-induced factors that directly or indirectly cause a change in an ecosystem.

In each of the Arab Sub-global assessments, ecosystems provide numerous services, inherent to each. Provisioning services are the most dominant in the three assessments.

Common ecosystem services in the three assessments include water, agriculture, grazing and raising cattle, aromatic and medicinal plants and biodiversity.

The three case study areas are vulnerable with regard to water resources, as rain is the main source of water. Water scarcity is the most influential driver on ecosystem services. Both natural and anthropogenic factors impact the quantity and quality of water resources. Drought and lack of precipitation are the most natural influential drivers that limit the ecosystem's ability to provide water.

Change in land-use patterns is a major cause for a number of repercussions that affect the environment and its ability to keep on providing its regular services.

Agriculture is the most well established and inherent ecosystem service. However, intensity, quality, and profitability of agricultural practices are significantly different in each assessment. Impacts on agriculture tend to have a series of drawbacks with direct and heavy bearing on people's welfare and prosperity.

Biodiversity, in its widest scope, is the main repository of all services that an ecosystem can provide to its inhabitants. Products of biodiversity include many of the services produced by ecosystems, such as food and genetic resources. Changes in biodiversity can influence all the other services that ecosystems provide. Poverty is probably the most potential driver, with direct and deleterious impact on biodiversity. In many unprivileged communities, mostly in rural areas where the majority of people are poor, ecosystem services become life-supporting elements, and their role becomes more conspicuous.

3.1 ECOSYSTEM SERVICES, TRENDS AND CONDITIONS

Ecosystem services are the benefits people obtain from the ecosystems they live within. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The concept "ecosystem goods and services" is synonymous with ecosystem services.

Ecosystem Services Definitions

An ecosystem is "a dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit" (UNEP 2003). Ecosystems form a landscape and are connected often by streams, rivers, and wildlife. Ecosystem services represent the benefits human populations derive, directly or indirectly, from ecosystem functions (UNEP 2003, Daly and others 1997).

Humanity has always depended on the services provided by the biosphere and its ecosystems. Furthermore, the biosphere is itself the product of life on Earth. The composition of the atmosphere and soil, the cycling of elements through air and waterways, and many other ecological assets are all the result of living processes – and all are maintained and replenished by living ecosystems. The human species, while buffered against environmental immediacies by culture and technology, is ultimately fully dependent on the flow of ecosystem services. Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services, which directly affect people, as well as the supporting services that are needed to maintain the other services. Changes in these services affect human well-being through impacts on security, the basic material for a good life, health, and social and cultural relations. These constituents of well-being are, in turn, influenced by and have an influence on the freedoms and choices available to people.

The demand for ecosystem services are now so great, that trade-offs among services have become the rule. There are many indications that human demands on ecosystems will grow still greater in the coming decades. The current estimates of 3 billion more people and a quadrupling of the world economy by 2050 imply a formidable increase in demand for, and consumption of biological and physical resources, as well as escalating impacts on ecosystems and the services they provide.

This combination of ever-growing demands being placed on increasingly degraded ecosystems seriously diminishes the prospects for sustainable development. Human well-being is affected not just by gaps between ecosystem service supply and demand but also by the increased vulnerability of individuals, communities, and nations. Productive ecosystems, with their array of services, provide people and communities with resources and options they can use as

insurance in the face of natural catastrophes or social upheaval. While well-managed ecosystems reduce risks and vulnerability, poorly managed systems can exacerbate them by increasing risks of flood, drought, crop failure, or disease.

3.1.1 Ecosystem, the Relationship between People and Environment

The concept of an ecosystem provides a valuable framework for analysing and acting on the linkages between people and the environment. For that reason, the MA uses an "ecosystem approach" which has been endorsed by the Convention on Biological Diversity (CBD). The CBD states that the ecosystem approach is a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. This approach recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.

3.1.2 Drivers of Ecosystem Change

An ecosystem may be subject to a number of externalities that may impede its ability to provide its regular service, either temporarily or even permanently, depending on the nature and magnitude of that externality. The MA defines such externalities, "drivers" in the broadest possible sense: any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. The approach adopted here is to distinguish between direct and indirect drivers. A direct driver unequivocally influences ecosystem processes and therefore can be identified and measured in differing degrees of accuracy. Indirect drivers operate more diffusely, from a distance, often by altering one or more direct drivers. An indirect driver can seldom be identified through direct observation of the ecosystem; its influence is established by understanding its effect on a direct driver.

The indirect drivers of change are primarily demographic, economic, socio-political, scientific and technological, cultural and religious. The interaction of several of these drivers in turn affects the overall level of resource consumption and disparities in consumption within and between countries.

Clearly these drivers are changing. For example, population and the global economy are growing, there are major advances in information technology and biotechnology, and the world is becoming more interconnected.

Changes in these drivers are projected to increase the demand for food, fibre, clean water, and energy, which will in turn affect the direct drivers. The direct drivers are primarily physical, chemical, and biological, such as land cover change, climate change, air and water pollution, irrigation, use of fertilizers, harvesting, and the introduction of alien invasive species as discussed in previous chapters.

Changes in drivers that indirectly affect biodiversity, such as population, technology, and lifestyle, can lead to changes in drivers directly affecting biodiversity, such as the catch of fish or the application of fertilizers.

Box 3.1 Typologies of Drivers

Several typologies of drivers were considered for the Millennium Ecosystem Assessment conceptual framework – primary versus proximate, anthropogenic versus biophysical, dependent versus independent, primary versus secondary. The proximate and primary driver terminology, for example, is widely used in the land-use change and climate change literature (Turner II and others 1995, IPCC 2002).

Proximate and primary drivers are conceptually similar to direct and indirect drivers respectively, but tend to be used when analysing specific spatial processes in which the human intent (primary) is linked with actual physical actions (proximate). The explicit cross-scale linkages and inclusion of physical activities of this typology made it too complex, however, for characterizing the drivers in the Millennium Ecosystem Assessment conceptual framework. Other typologies have been developed for specific purposes and have their limitations. The distinction between direct and indirect drivers, in contrast, provides an opportunity to include highly diverse types of drivers that seem acceptable to the broadest possible community.

This leads to changes in ecosystems and the services they provide, thereby affecting human well-being. These interactions can take place at more than one scale and can cross scales. For example, an international demand for timber may lead to a regional loss of forest cover, which increases flood magnitude along a local stretch of a river. Similarly, the interactions can take place across different time scales. Different strategies and interventions can be applied at many points in this framework to enhance human well-being and conserve ecosystems.

3.2 ECOSYSTEM SERVICES IN THE ARAB ASSESSMENTS, AN OVERVIEW

In the Arab sub-global assessments, ecosystems provide numerous services, inherent to each other. Provisioning services are most dominant in the three assessments. Other types, such as cultural and regulatory services, are also present, deeply embedded in ecosystem construct. Nevertheless, the spectrum of services in each assessment tends to have some commonalities with other assessments, while maintaining some special services, as part of its inherent difference.

In the three assessments, similar ecosystem services complement inhabitants' needs of food and other materials used in daily life. In both El Maghara and Tafilalet, where poverty is a common concern, supplements from ecosystem services are the most effective way to combat poverty. In these assessments, environmental degradation, and diminishing ecosystem services are direct causes of poverty and inferior quality of life.

Water and agriculture are the most common ecosystem services in the three assessments. In Asir, forest products, fisheries, and tourism are other provisioning ecosystem services. In El Maghara, the main provisioning services

are water, agriculture, and medicinal plants. In Tafilalet, agriculture, including animal production, medicinal and aromatic plants, along with fuelwood are major ecosystem services. Cultural services have some significant presence in the three assessments, with tourism as a significant service in Asir, and Tafilalet, while in El Maghara Sheikh Hemid, one of the religious shrines in Sinai is a major cultural and religious landmark of Bedouin culture and heritage.

3.2.1 Water

The provision of water is probably the most valuable service provided in the three assessments alike, with rain as the main source of water, in all three.

Provision of Water is One of the Main Services in Tafilalet Ecosystem

Source: UNEP, 2009

Bedouin Ladies Fetching Water at El Maghara, Sinai, Egypt

Source: UNEP, 2010

A variety of techniques are used to harvest rainfall (flash floods), including dams built to store and regulate rainwater throughout. Local knowledge is highly manifested in the management of such scarce and sporadic rainfall, using locally devised and developed methods.

Water from flash floods, in addition to being the main source to replenish exhausted stock of groundwater, is also used for agriculture, ridding the soil of salt content, while improving soil fertility and productivity. However, flash floods can turn destructive causing some serious damage.

Flash floods are also a major source of irrigation in the three sites where inhabitants seed their land and wait for the flash floods to come. Alternatively, inhabitants may allow flash floods to pass over their land, and then soon after plant their crops on wet land.

Destruction Caused by Flash Floods, Tafilalet, Morocco
Source: UNEP, 2009

Destruction Caused by Flash Floods, Sinai, Egypt
Source: UNEP, 2010

Wells, the main sources for potable water are shallow in Asir, but rather deep in ElMaghara. Groundwater quality differs in the three sites. In Asir, water quality is sufficiently good for human consumption, with an average TDS (Total Dissolved Solids) ranging between 350 - 1080 ppm, with a tendency of increased salinity towards the Red sea.

In El Maghara, the quality of groundwater is often not good enough for human consumption, and Bedouin depend on storing rainfall in deep ground storage sites. Bedouin also buy fresh water from nearby village centres, where fresh tap water is available.

In Tafilalet, 'Khettarat', a technique developed some centuries ago, is a common system of abstraction of groundwater. Khettarat was invented in Iran and was introduced into the Maghreb by Arabs during their conquests.

Various Irrigation Methods, Tafilalet, Morocco
Source: UNEP, 2009

Khettarat in Tafilalet, Morocco

Source: UNEP, 2009

The management and maintenance of 'Khettarats' are made by traditional groups of water rights holders. Maintenance consists mainly of a flushing of the earth and sand accumulated in the gallery of 'Khettarat' and on the well walls.

Water Scarcity and Drought Spills

The Middle East and North Africa regions have witnessed prolonged harsh spells of drought for some time, with some unfavourable repercussions.

In Tafilalet, prolonged drought was reported during the last century and the beginning of this century (Benmohammadi and others 2000, Kabiri and others 2003).

The province of Errachidia, where Tafilalet is located, is largely characterized by limited water resources, low and irregular precipitation and successive droughts, creating a sensitive water balance that may cope with growing demand. Similar drought spells were also observed in El Maghara, Sinai with some significant impacts on all walks of life, including food production, health, and socio-economic fabric.

In Asir, groundwater abstracted from upper parts of Baba valley is estimated to be 5.5 million m^3 per year, while groundwater extraction from upper parts of Hala valley is estimated at 11 million m^3 annually. Downstream, near the shore, water abstraction from Baba and Hala valleys used in agriculture is estimated to be 47 million m^3 per year. In Asir, water desalination is also carried out to supplement groundwater, with Shuqaip desalination plant producing

Table 3.1 Areas, Lengths and Annual Discharges of Wadi Basins in Asir

Wadi Basin	Area of Basin (Km^2)	Length of Wadi, Km	Annual Discharge (million m^3)
Hala	4 783	145	1 610
Atood	1 551	55	320
Baba	2 665	105	1 180
Beesh	5 164	145	2 350
Total	**14 163**	**450**	**5 460**

Source: UNEP, 2010

120 000 m^3 per day, with a second phase expected to produce 212 000 m^3 per day. Desalination of brackish well water is sporadically practiced in El Maghara, but at a very minor level.

Signs of Drought, El Maghara, Sinai
Source: UNEP, 2010

Potable water consumption in the three assessments is a function of availability and suitability. In the Asir assessment, potable water consumption in the governorates of Abha, Mahayel and Rejal Al-Ma is 103 million m^3, 33 million m^3 and 3.1 million m^3 annually respectively, from sources such as groundwater wells, desalination plants and dams. The consumption rate per person is 250 litres in Abha city while in other small cities it is slightly lower, at 200 litres per day. In rural villages, each inhabitant consumes 100 litres per day on average. This would count for all water resources in the area that include water provided through groundwater, desalination, and dams.

Oughrour, One of the Traditional Methods of Irrigation Tafilalet, Morocco
Source: UNEP, 2009

In El Maghara, there is great disparity in current per capita water availability for each watershed in the area. Wadi Mezara has over 4 000 m^3 per person per year. While the average for both Wadi El-Khariq and Wadi El-Fatah watersheds are under 1 000 m^3 per person per year, and that for Wadi El-Massajid is about 1 756 m^3 per person per year (UNEP 2010).

In Tafilalet heavy pressures on groundwater resulted in the decline of water supplies and even their disappearance in some cases. In some cases, wells dried up and were eventually abandoned, or became places to dump waste or even septic tanks that pollute groundwater.

Impact on Water, Quality and Quantity

Water is the elixir of life; all other ecosystem services are directly related to the quantity

and quality of water. Among all the ecosystem resources, water has the greatest impact on people and the environment as neither can exist without its availability. Too much water in the form of floods can also be as problematic as not enough water. Not only is the quantity of water of concern to decision-makers, but quality of water as well. Water pollution can adversely affect practically all other ecosystem services.

In the three Arab sub-global assessments, water resources are subjected to both natural and anthropogenic impacts that influence water quantity and quality. Drought and lack of precipitation are the most natural influential drivers that limit ecosystem ability to provide water in the three assessments. It is even expected that climate change and global warming may increase the intensity of water shortage in the three assessments alike. Arab countries, including Egypt, Morocco and Saudi Arabia, are among the world's dry regions with the least global water per capita, at about 1 000 m^3 (UNEP, CEDARE and LAS 2010). All predictions are that climate change will reduce the overall amount of rainfall by at least 20 per cent, increase variability (droughts and floods), make it harder to manage the rain that does fall, and increase evaporation through higher temperatures.

Rapid population growth is bound to affect water availability to a drastic extent, with per capita set to drop to half by 2050. Development of the tourism industry is emerging as one of the driving forces with notable impact on water availability, with special reference to Tafilalet and Asir.

Desalination is a Major Source of Water in Saudi Arabia

Water Pollution

In Asir, El Maghara and Tafilalet, water pollution is a potential limiting factor that adds up, and exacerbates water scarcity problems. In El Maghara, the various industrial and extractive activities are one of the main reasons for the inferior quality of water. Coal processing wastewater and dewatering processes also involve the emission of heavy metals and other organic pollutants. Wastewater and dewatering flows are disposed of around the mine, allowing contaminants to leach to groundwater causing potential damage to water quality. Water samples collected from various wells in the assessment area were analysed to monitor concentrations of heavy metals and other anionic constituents. The results (see Table 3.2) indicate the presence of a wide spectrum of contaminants in almost all water samples.

Microbial Contamination

Another and equally serious source of pollution is microbial contamination of groundwater in the El Maghara area. Samples from main wells in the assessment area were analysed for their microbial load. Results indicate hazardous levels of microbial contamination in almost all water samples tested. The Bedouin store their water supply in open tanks, exposed to dust and air, with almost no sanitary precautions.

In Tafilalet, discharge of municipal wastewater is the main source of water pollution. The province of Errachidia, where Tafilalet is located, is characterized by the lack of sanitation and wastewater treatment. The liquid discharges from urban centres are directly discharged into rivers, which have a low capacity of natural purification especially during the periods of low water level. The results of tests carried out by the RDH 2003 - 2004 (Mahboub and Kelly 2006) indicate that 22 per cent of measured points (surface water) are beyond the standards required for ammonia. The most affected sites (more than 8 mg/l of ammonia) are located around the largest cities in the region; Goulmima, Errachidia and Rissani – in the ponds of Ghèris and Ziz. Further up from these places water has a better quality (0.1 mg/l of ammonia).

In Asir, water pollution caused by wastewater discharge from Abha and Al-Birk wastewater treatment plants and septic tanks flow down the wadi into the Red Sea and adversely affects the fish population. Water pollution can adversely affect practically all other ecosystem services. Examples of services negatively impacted include water itself, food, agriculture, land and the fish population.

Excessive amounts of fertilizers and pesticides can seep into the ground, mix with shallow aquifers and ultimately render water unsuitable for drinking purposes. When such chemicals (persistent organic pollutants (POPs)) mix with run-off water and are discharged into the sea, fish populations suffer. In addition, floods can erode the topsoil, removing essential nutrients for crop production.

Table 3.2 Residues of some Heavy Metals in Water Samples in some Wells, El Maghara

Sr.No.	Well Name	Manganese ppm	Iron ppm	Nickel ppm	Copper ppm	Cobalt ppm	Lead ppm
1	Bir 5	0.06	n.d	0.4	0.06	1.43	0.26
2	Bir 12	0.06	0.22	0.4	n.d	0.71	0.26
3	El Feteh 1	0.06	0.15	n.d	n.d	n.d	n.d
4	El Feteh 1	n.d	n.d	n.d	n.d	n.d	n.d
5	El Masoura	n.d	n.d	n.d	n.d	n.d	n.d
6	Bir Raghwi	0.09	0.22	n.d	n.d	n.d	n.d
7	Coal Mine (Wadi Massajed)	0.09	0.19	n.d	n.d	n.d	n.d
8	Coal Mine (Wadi Safa)	0.09	0.76	0.4	n.d	1.79	0.4
9	Bir Unwerib	0.06	n.d	n.d	n.d	n.d	n.d
10	Bir El Maghara	0.12	n.d	0.8	n.d	n.d	n.d
11	Bir El-Hodod	0.06	n.d	0.8	n.d	n.d	n.d
12	Cistern *(Haraba)*	0.32	0.72	n.d	n.d	n.d	n.d
13	Bir El-Malahi	0.09	n.d	n.d	n.d	n.d	n.d
14	Bir El-Masoutia	0.09	0.31	n.d	n.d	n.d	n.d

Source: Ahmed, M.T. and others, 2010

Table 3.3 Levels of Bacterial Contamination of Water Samples Taken from some Haraba in Central Sinai

Sample Name	TVB cfu/ml	FC cfu/ml	FS cfu/100 ml
Mazarea Harraba	1 600	Nil	Nil
El Menissi harrab	1 900	1	Nil
Karama Dam	2 500	160	Nil
Egyptian Standard	1 100	Nil	Nil

TVB = total viable bacteria; CFU = colony forming unit; FC = faecal coliform; FS = faecal streptococci
Source:Ahmed, M.T. and others, 2010

Impact of Drivers on Water

The three assessments have shown clearly that change in land-use pattern is a major driver for a number of repercussions that have affected the environment and its ability to keep on providing its regular services. The three assessment reports have portrayed a number of cases, in which changes in land-use pattern have caused some potential damage to major ecosystem services and attributes.

For example, in the Asir assessment, road construction is one of the most apparent manifestations of land-use change, with some significant influence on water conditions. The construction of roads is indispensable for community development and prosperity. However, it is also considered responsible for an alteration in the natural set-up of land resources, with some implications on groundwater movement patterns.

Local inhabitants of Asir predict that land-use changes will continue to take place; for example, forest areas will be cleared and replaced by croplands, because of the economic advantage of crops over forest products. Forests have an instrumental role over cropland in that they protect soil from erosion by transforming intense rainfall into a more gentle rainfall.

Land-use change in Asir, caused by the expansion of urban centres as a result of migration of populations toward urban centres is another pressure on forest areas as the land for expansion comes from forests. This also leads to increased demand for agricultural products which results in the expansion of agricultural activities, converting forest areas into agricultural land.

In El Maghara, the unlawful construction of alleys by gravel contractors is one of the main drivers that affect the full exploitation of flash floods.

In El Maghara, flash floods constitute a prominent component of fresh water that the Bedouins use in their daily lives, and for growing their crops. The Bedouin of El Maghara, know through intuition and long experience, the route that flash floods will take to reach them from the highlands down to the downstream valleys where they live and grow their crops. As the season of flash floods approaches, they start checking these paths, removing all obstacles that may

Road Construction, Obstructing Flash Flood Reaching the Bedouin in Sinai

Source: UNEP, 2010

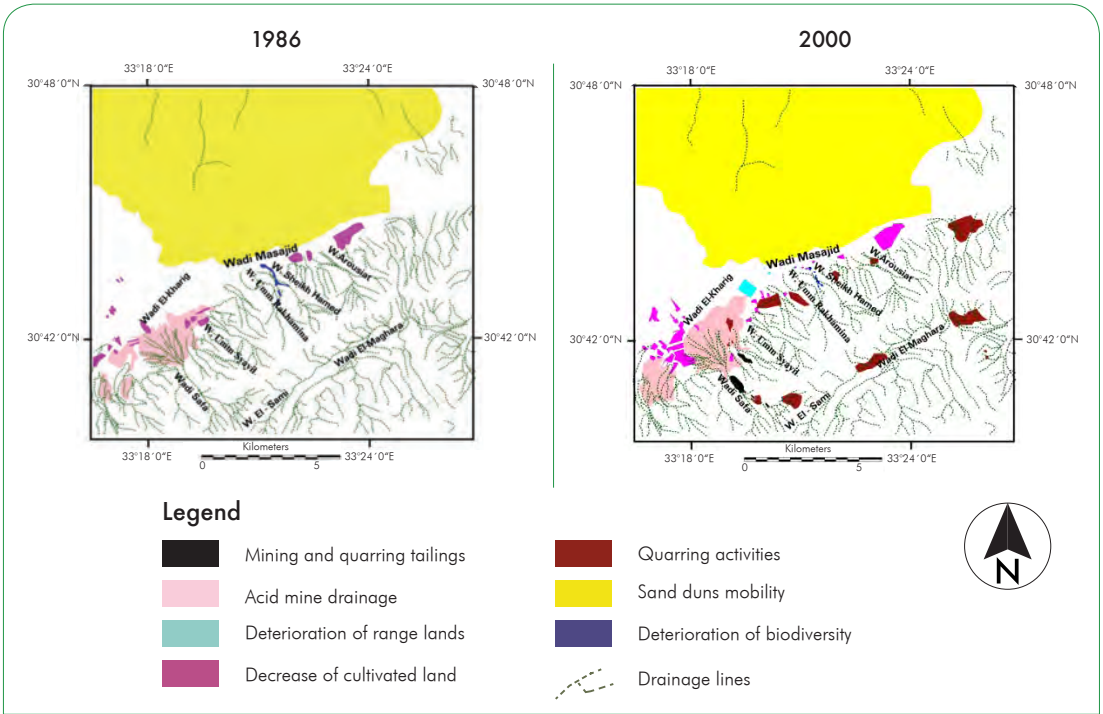


Figure 3.1 Land-use Pattern in El Maghara Area, 1986 and 2000
Source: UNEP, 2010

obstruct the floods to ensure a high harvest. With the large increase in demand for stone and marble, quarry contractors have constructed new alleys and roads to reach highland sites, that were never used before. The Bedouin claim that most of these newly built roads are intercepting flash flood supply, dispersing water and causing the loss of a large potential source of water.

3.2.2 Agriculture

Agriculture is the most well-established and inherent ecosystem service in the three assessments, though intensity, quality, and profitability of agricultural practices are significantly different in each assessment.

In Asir, agriculture seems to be a well-established ecosystem service, with wide practice and advanced technology. Terrace agriculture on mountains and slopes area is most common. Agriculture is also practiced in the plains towards the Red Sea.

Most of the farms at higher altitude areas are terraced. They depend on rain as well as irrigation from groundwater. Main crops grown in the area are wheat, millet, sorghum, barley, as well as some maize and sesame. Due to the migration of inhabitants from rural areas to urban zones in order to gain access to jobs, education and better opportunities, large

areas of farms are left fallow or are rented to others. Generally, these farms grow two crops per year.

In El Maghara, agricultural practice is modest in comparison to Asir and Tafilalet. The chronic shortage of water is a potential factor affecting agriculture and related activities in El Maghara. As a result, agriculture is sporadic, restricted to areas where rainfall is likely to take place, or in the vicinity of wells, depending on water salinity and suitability for agriculture. The main crops grown in the area are olives, peaches, cantaloupe, barley and almonds. There are no reliable figures on agricultural productivity, but, considering the prevailing conditions, one would expect a very low production rate. The potential for agriculture is reasonable, however, if a source of water is ensured. Research conducted by the Desert Research Centre indicated the ability to grow a number of economic crops such as nuts, spices, and fruits. Olives are a staple food in the area and olive oil is widely used.

Bedouin of Sinai Selling their Agricultural Products in a Nearby Market

Source: UNEP, 2010

The intercropping system practiced by the Bedouin is a part of agrodiversity. They use barley with olive trees and cantaloupe for intercropping. Barley can tolerate water salinity and can be used as fodder for camels. The intercropping system enables the Bedouin to protect their lands from degradation and erosion. In addition, it improves water use efficiency and increases productivity. Intercropping is also a way of reducing risks, in case the main crop fails to grow for any reason, especially with the prevailing hardship of the area.

In Tafilalet, agriculture is a central service, representing 68 per cent of economic activity. Traditional, conventional agriculture is prevalent, especially around rivers, and near water resources.

Tafilalet has two farming types: the extensive and the intensive farming systems. The extensive farming type is practiced by nomads and transhumants leading their herds of sheep and goats in the mountains and plains in search of pasture. However, because the climate of the region is marked by long periods of drought and high dryness, pastures are characterized by a predominance of spontaneous and thin vegetation. Intensive farming, on the other hand, is primarily concerned with cattle and sheep. Alfalfa is the main source of food.

Agriculture in Tafilalet exhibits significant biodiversity, with local varieties adapted to the natural conditions. It offers a vast number of agricultural products, such as date, olive, apple and almond trees, cereals, fodder (alfalfa), and market garden productions. Date palm production constitutes the most dominant and is the backbone of oasis agriculture.

Dates are used for consumption, marketing and animal feed (waste of dates and dates of low commercial value). Olive trees are the second largest crop after dates. Similar to El Maghara, intercropping is largely practiced in Tafilalet, as crops are often combined on the same plot. They constitute an additional income source for farmers.

Impacts of Drivers on Agriculture

With agriculture being the main service providing food to the local inhabitants, impacts on agriculture tend to have a series of drawbacks with direct and heavy bearing on human well-being and prosperity. In the three assessments, the main drivers of agriculture are either natural or anthropogenic.

Water Scarcity

Water scarcity is the most influential driver, with the strongest impact on agriculture and agricultural productivity in the three assessments. Water scarcity is also an indirect driver for a number of repercussions that trickle down in various forms. Young inhabitants tend to leave the assessment sites, moving to other places where reasonable income can be ensured. Water shortage, therefore, has affected the age structure of the Bedouin, with the highest ratio being elderly, in comparison to other age groups. Water shortage also has economic repercussions. Cash flow is very limited, as grazing and agriculture, the most important activities in the area, are badly hit by long-lasting droughts.

In Tafilalet, when agricultural lands became incapable of ensuring a sufficient supply of goods and services for the local people, there was an intense immigration to Europe.

Money brought by these immigrants led to a major transformation in the lifestyle of the population. Indeed, it led to the desertion of traditional houses, 'Ksours', built in adobe

Soil With Salt Deposits, a Manifestation of Drought in Tafilalet

Source: UNEP, 2009

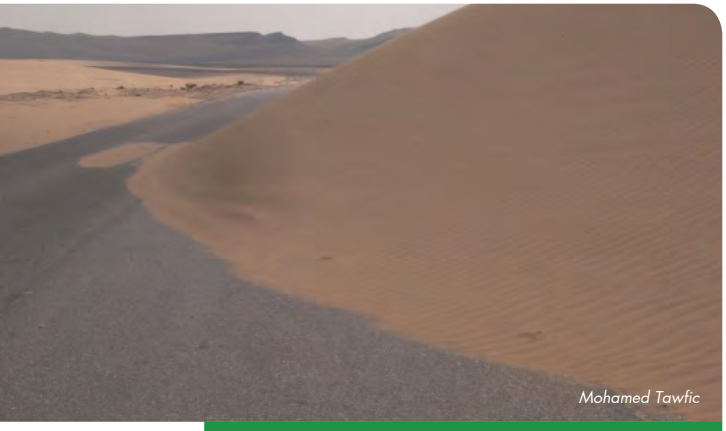
soil, to move into new houses built in reinforced concrete in the outskirts of 'Ksours', on agricultural lands. The abandonment of farming by young people, who are attracted by the urban lifestyle and other more promising horizons, are further reasons for immigration.

Sand Encroachment

The phenomenon of sand encroachment, resulting from harsh weather conditions and anthropogenic practices are considered the final stage of the process of physical and biological degradation of the environment.

Wind action can be classified into two main classes: a mobilized sand encroachment from outside the villages, and a mobilized sand encroachment from the villages and farmlands at the edge of the desert.

Change in soil quality and loss of vegetative cover are main causes for sand encroachment recorded in El Maghara. Enhanced images show extensive and large amounts of sand accumulations and encroachment covering large areas. Roads, especially during winter, are often covered with massive volumes of moving sand, hampering the use of roads and posing serious risks to travelers.



The Main Road Of El Maghara Area Covered With Moving Sand

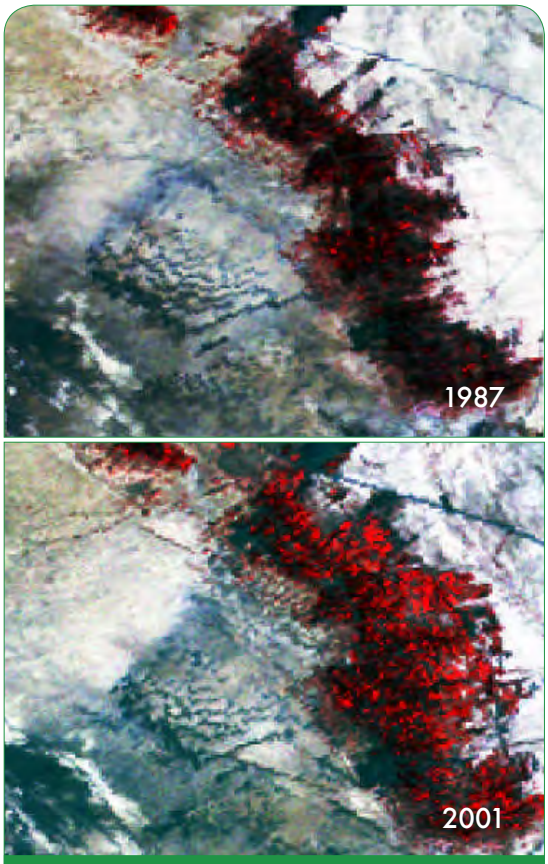


Figure 3.2 Sand Dunes Movement in Tafilalet, Morocco

Source: UNEP, 2009

Moving sand has serious impacts on infrastructure and interrupts the mobility of the already meager public transportation buses serving the area. In El Maghara, sand movement impedes the small trucks Bedouin use to move around, exacerbating their sense of isolation and remoteness.

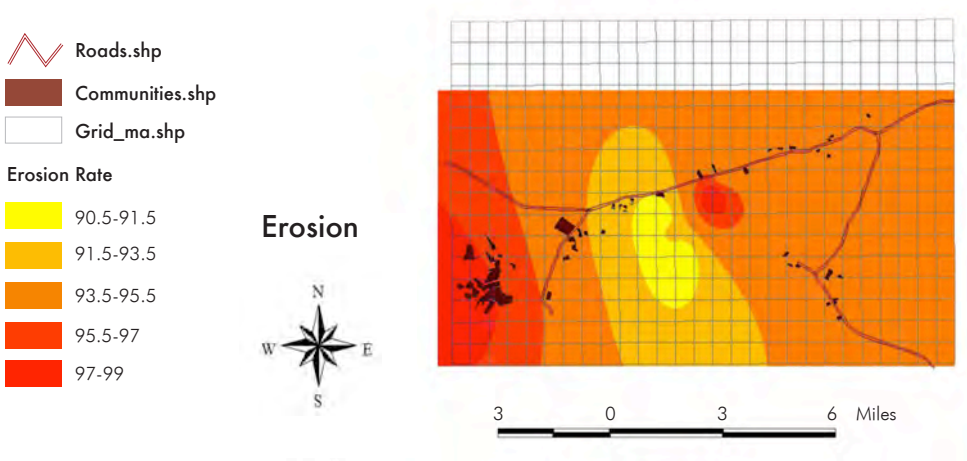


Figure 3.3 Erosion Map, El Maghara, Sinai, Egypt
Source: UNEP, 2009

Water and Wind Erosion

Water erosion threatens agricultural lands. Indeed, flood waters undermine the banks and remove agricultural lands, but also deposit large quantities of sand and cause siltation of irrigation canals. In El Maghara, blowing wind dismantles scarps, deepens hollows, and erodes exposed rock. These eroded particulates are emitted into the atmosphere as dust, or accumulate in the form of sand sheets and dunes, or are left behind as coarse lag deposits.

Figure 3.3 indicates the erosion rate at El Maghara, showing a relatively high rate of erosion around the area where most of the gravel and sand extraction processes take place.

Diseases and Insect Pests

In Tafilalet, plant diseases are potentially harmful, affecting the production of many agricultural crops, with particular reference to date palms that become infected with Bayoud, a plant pathogen.

The incidence of Bayoud is high in areas with abundant supply of water. Thus, the site of Meski is one of the most infested places. The impact of Bayoud varies on different species of dates. 'Boufegous' is the most susceptible variety, with an infestation ratio of about 70 per cent. Such high susceptibility is attributed to the thinner skin of this variety in comparison to other varieties.

In addition, a number of insect pests are causing considerable damage to main crops, especially olive trees, one of the main crops of Tafilalet. Major insect pests are:

- The bark beetle of olive trees (neroun) Phloetribus scarabeioides, Coleoptera. This insect causes devastating effects by

digging tunnels in tree trunks, especially after the weakening of trees due to drought.

- Olive tree cochineal insect (Saissetia oleae olive Homopères, Coccidae). The insect, characterized by black hemispherical shells, can cover all parts of the tree.
- Olive tree flies (Dacus olea Gmal, Diptera, Tryptidae). This fly pierces young fruit to lay its eggs. The larvae feed on the pulp of olives.

Bayoud Infecting Date Palms, Tafilalet, Morocco
Source: UNEP, 2009

3.2.3 Grazing and Raising Cattle

Grazing is the single largest land-use pattern in drylands, including the three MA sites. In Sinai, grazing is primarily an activity of women, with almost no involvement of men. Women have developed a good sense of recognition for various types of herbs that animals feed on, with a remarkable ability to distinguish toxic and harmful weeds.

Grazing provides a long list of supporting services that contribute to the well-being of Bedouin, and supports their presence in the Sinai's harsh arid ecosystem:

- Meat and milk, the primary production of grazing, supply Bedouin needs for protein. Camels provide the primary source of transport.
- Organic manure is an important livestock product.
- Bedouin construct their shelters from animal skins.
- Animal wool is used as the primary material to produce a variety of household an farming tools.
- Wool is also the backbone of some handicraft industries, such as rugs, and it can also be used in bedding and clothing.
- In orchards, sheep are often used to control weeds and thus constitute a profit-producing biological control.
- Animal grazing removes older, less productive plant species and stimulates regrowth of useful plants, and this in turn reduces soil erosion.

In Tafilalet, raising cattle is widely practiced. The number of cattle is estimated at about 30 000 heads, consisting mostly of the local breed, which is hardy and less productive. Improved breeds are also spread mainly around the urban zone of Errachidia and Rich, and represent less than 10 per cent of the total size. Goat milk (450 000 heads) is mostly produced by the local goat called

"Beldia" that coexists with the Canary Spanish milk goat introduced to Morocco two decades ago.

3.2.4 Aromatic and Medicinal Plants

The provision of medicinal and/or aromatic plants is one of the main ecosystem services in El Maghara and Tafilalet. Local inhabitants are well versed in the utility value of many of the medicinal plants available in their vicinity. In both El Maghara and Tafilalet, a considerable number of plant species is endangered, or have even disappeared because of the overuse of rangelands, and land-use changes.

In Tafilalet, pastoral resources were managed through a locally developed, transhumance manner, known as Al Orf, or Agdal, which seem to have lost momentum as part of changing lifestyle and practices. In Asir, medicinal and aromatic plants are among the main non-wood forest products, in addition to some herbs, spices, gums, and resins.

In El Maghara one sector of the questionnaire was to ascertain the relationship between the Bedouin and the available medicinal plants. Information showed clearly that Bedouin 30 years and older are intimately familiar with the use of medicinal plants. This age group's interest in using medicinal plants is 73 per cent higher than those below this age. Those in the younger generation might have the same strong belief in medicinal plants, but they also believe that these plants on their own may not be good enough to treat many diseases

A Bedouin from El Maghara Identifies One of the Threatened Medicinal Plants

Source: UNEP, 2010

and that there is a real need to supplement their use with commercial pharmaceutical products.

The Tafilalet report indicated that the Acacia seyal ('Amrade') which used to be abundant in the mountainous areas, is currently endangered, and approaching extinction. The shrub possesses many medical uses. Most of the medical values are related to Arabic gum formed near the trunk. In addition, the population uses its sap as an anti-asthmatic, and its seed as a medicament against stomachaches. Similarly, fruits of the Olea eurapaea (oleaster, 'Tiwinight', 'Azemour') shrub were extensively used, until recently, as a medicament against kidney stones and injuries. This species has virtually disappeared in the region.

3.2.5 Biodiversity

Biodiversity, in its widest scope, is the main repository of all services that an ecosystem can provide to its inhabitants, as well as beyond. Biodiversity is the variability among living organisms from all sources. Diversity is a structural feature of ecosystems, and the variability among ecosystems is an element of biodiversity. Products of biodiversity include many of the services produced by ecosystems such as food and genetic resources. Changes in biodiversity can influence all the other services ecosystems provide. Throughout history, human communities have relied directly on biodiversity to provide food and medicinal products. In poor communities, the role of biodiversity is even more apparent, with a substantial contribution in combating poverty.

Biomass Collection, Tafilalet, Morocco
Source: UNEP, 2009

Biodiversity maintains critical and key processes such as carbon storage, nutrient cycling, plant species diversity, soil fertility, soil erosion, nutrient uptake by plants, formation of soil organic matter, nitrogen fixation, biodegradation of dead plant and animal materials, reduction of hazardous waste, production of organic acids, and control of plant and insect populations through natural biocontrol.

Despite the major role played by biodiversity in the three assessments, some major fears to its fabric have been commonly stated. Signs of species disappearance, reports of alien species, massive mismanagement practices, habitat fragmentation, and negligence have been well documented in the three assessments.

In Asir region, many people supplement their income through the processing, consumption and marketing of non-wood forest products. The main non-wood forest products in Saudi Arabia include medicinal and aromatic plants, herbs and spices, gums, resins, tannins, mushrooms, honey, fruits and nuts. In some cases, fodder is also considered a non-wood forest product as a large number of livestock depend on it from forests and woodlands. In fact, non-wood forest products are more valuable than wood products in Saudi Arabia.

In the past, fuelwood and charcoal production were carried out according to the traditional way. Trees were cut, dried and sold in fuelwood markets without any consideration of the associated damage of forestry resources. In 1977, the Forest and Rangelands Act was issued by the government of Saudi Arabia. The Act established the principles and regulations

concerning the exploitation methods of any of the public or village forests. Violations and penalties were clearly instated. The executive regulations for the Forest and Rangelands Act were issued. They explained the methods for forest exploitation and transportation of products according to specific models of licensing relative to fuelwood collection and transportation, and charcoal making activities and transportation.

In Asir, inhabitants of rural villages and resettlement areas are most affected by deterioration incurred in forest areas, as they rely on many of the forest products, such as fuelwood, animal grazing, by-products including fruits, seeds, medicines, and honey. Forests also have other environmental roles and fringe benefits that include environment conservation, improvement of soil and water systems and the associated increase in productivity of other agricultural crops. Forests also ensure economic benefits by providing job opportunities in educational operations and guard duties. Trees were and still are very important in nutrition, essentially providing fodder for wild and domestic animals that in turn transform this vegetal material into meat and milk for human consumption. Trees also provide an environment for grazing, plant growth and shelter and shade for wild animals. Forests are also considered direct sources of food, providing various fruits for human consumption such as Sidr, Ziziphus spp., pistachio Pistachia spp., olive Olea spp. and others.

In addition, forests play a key role in the development of tourism in the area, as forests represent the natural resources upon which environmental tourism depends. In fact, environmental tourism is one of the fastest

Rich Plant Diversity in Asir, Saudi Arabia

growing sectors of this decade. Through tourism, the awareness of nationals is raised regarding the role of forests, the importance of conservation, and the potential generation of job opportunities for locals in forest regions.

The indirect benefits of forests are particularly important as they are fundamental to the conservation of the natural environment through the following:

- Conservation of plant cover that helps in soil fixation by the roots and improved aeration.
- Decreasing velocity of rainwater flow, soil surface and the mountain slopes which prevents soil sliding and erosion.
- Decreasing wind speed and sand creeping process.
- Decreasing temperature and water loss through evapo-transpiration.
- Providing organic materials that build the soil and increase its fertility.
- Providing fodder for domestic and wild animals.
- Improvement of the local climate and increase of crop productivity.
- Providing parks and tourism sites.
- Decreasing environmental pollution through the absorption of harmful gases including carbon dioxide, and reducing sound pollution.
- Clearing of the weather that contributes in the condensation of clouds, and increases the chances of rainfall, especially in high altitude regions.
- Conservation of wildlife by providing suitable shield and safe refuge for animals during their normal migration.
- Production of honey, medicinal substances, and tanning material.

Plant coverage in the El Maghara area and in Sinai at large is a prominent component of Bedouin life and well-being. Plant coverage constitutes a major source of food, beverage, animal feed, raw material for building houses, and medicinal plants. Plants are also used to produce some household and agriculture tools such as ropes, plates, and many other products.

A Bedouin's Home and Household Tools Made of Local Plants, El Maghara, Sinai

Source: UNEP, 2010

The oasis of Tafilalet is endowed with a rich and varied folklore, reflecting the strength of the oral culture, still very much alive, which consists of a popular heritage and a means to communicate the local culture. Biodiversity richness allows the development of nature-based tourism activities such as hiking or riding, sport fishing and nature exploring (fauna, flora and landmarks are still intact and virgin).

Impact of Drivers on Biodiversity

Biodiversity, a subtle web of organisms of various size and nature, is closely connected with a number of in and out flows, and influx mechanisms. Impacts on a distant segment of the web might be of significant influence on the performance of the whole web, though not necessarily recognized. In the three assessments biodiversity is impacted by aridity, poverty, urbanization and tourism.

Impact of Aridity on Acacia Wood in El Maghara

The harsh environmental conditions caused by severe aridity, coupled with other potential man-made impacts have caused damage to the floral and faunal diversity of the area. Frequent meetings with the Bedouin indicate that a number of the plants they use in their daily life have disappeared, or are becoming very rare. At the same time, some other species that they never knew have become frequent, and sometimes cause problems for their crops. This view was not only expressed by the people of El Maghara, but also by

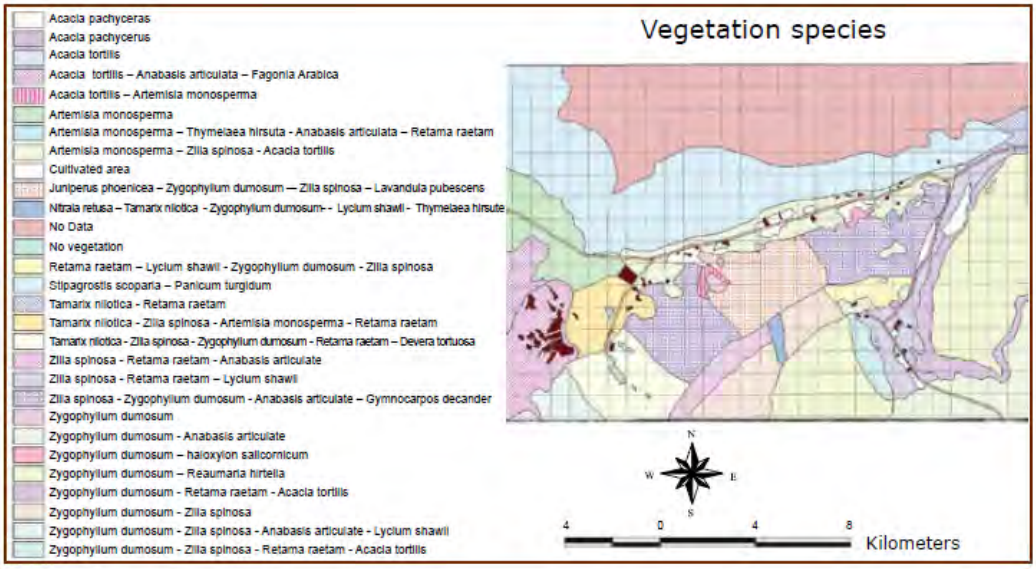


Figure 3.4 El Maghara's Plant Diversity in 2006

Source: UNEP, 2010

Acacia Wood at Sheikh Hemid, One of the Main Ecological Features of El Maghara Area
Source: UNEP, 2010

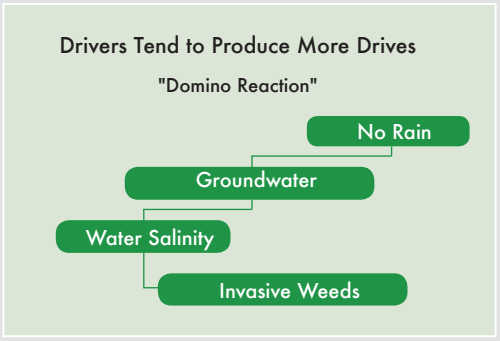
other Bedouin in other parts of Sinai. Impact of quarrying activities in El Maghara was particularly strong on Sheikh Hemid acacia wood.

The acacia wood is one of the main landmarks in Sinai, with its historic, biological, and folkloric value. Quarrying work was ruthlessly performed around the trees, resulting in serious irreparable damage to a vast number. The Acacia is one of the most popular trees in Sinai. It provides a stable browse for camels and goats, its forage available throughout most of the dry season when other sources are scarce. The dense acacia wood makes very good fuelwood that burns slowly and produces little smoke when dry.

Damage Inflicted on Acacia Trees
Source: UNEP, 2010

Box 3.2 Mesembrayanthemum Crystallinum

Drivers and indirect drivers: a case study illustrating a domino reaction. One feature identified in the present study is the introduction of some alien species in Sinai, including Mesembrayanthemum Crystallinum, a pest weed that infests orchards and crops in Sinai, causing serious economic damage. Bedouin report that this potential invasive weed started to spread out a few years ago. They also add that the weed showed up in areas fed with groundwater, where salinity is high, then started to infest other parts of Sinai.



One explanation for the massive spread of crystallinum is the significant drop in rainfall within the last few years that forced Bedouin to depend on groundwater in their agriculture, despite its high salinity. Because Mesembrayanthemum Crystallinum has high tolerance for high salinity, it was able to survive and even flourish under these conditions, and become a potential pest weed.

Mesembrayanthemum Crystallinum: An Invasive Species in Sinai

Source: UNEP, 2010

Impact of Poverty and Change in Lifestyle, on Biodiversity

Poverty is probably the most potential driver, with direct and deleterious impact on biodiversity, with special reference to El Maghara and Tafilalet. The relationship between poverty and the environment, and between poor people and natural resources, is complex and has been the subject of extensive debate.

Poor people are often impoverished by an austere resource base, and thus forced by their circumstances to degrade the environment even further (World Commission on Environment and Development 1987, Durning 1989, Cleaver and Schreiber 1994, Ekbom and Bojo 1999). Poverty

reduction is becoming a global issue. In many unprivileged communities, mostly in rural areas where the majority of people are poor, ecosystem services become life-supporting elements, and their role becomes more conspicuous. A World Bank report (see Figure 3.5) indicated that in low-income countries natural resources account for an estimated 28 per cent of the capital stock, whereas for high-income countries this figure is only 2 per cent.

Impact of Urbanization on Biodiversity in Asir

The gradual development of roads, and the expansion of towns is affecting both forest and agriculture ecosystems. The clearing of forests and agricultural land for construction of roads, houses, and industry, reduces forests' ability to absorb heavy rainfall, thus creating greater amounts of run-off. Changes to agricultural production introduce additional services and means of income for the local population, thus reducing dependence on agriculture and increasing dependence on imported goods and services.

With growing urbanization, an increase in air pollution will begin to negatively impact agriculture (producing poor soil composition), and may possibly create health complications for the local population. The forest ecosystem in Asir will be affected by the expansion of urban centres, roads, and land conversion to cropland.

The local population will be less dependent on forest materials and products for income because of a growing demand for new services in the urban centres, which will lead to less investment in the maintenance and management of forests. The younger generation will be less interested in forest-related careers, which will result in a lack of local forestry specialists in the future. Due to the relatively high level of rainfall in forested areas, much of the current forests will be converted to agricultural land. Since forests in ANP are home to most of the diverse plant and animal wildlife, biodiversity will be lost.

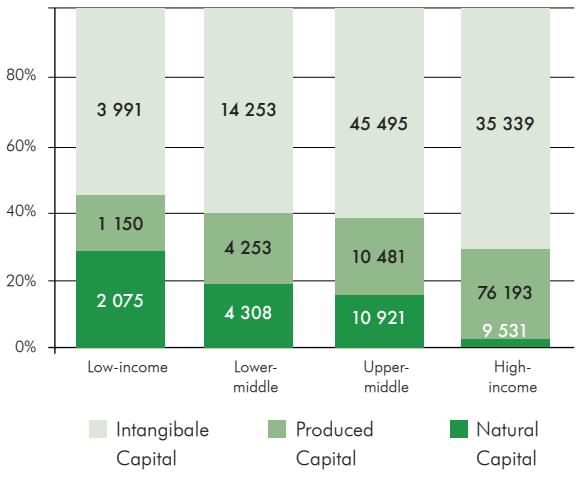


Figure 3.5 Proportion of Capital Stocks In-country in Different Income Groups

Source: World Bank, 2007

Impact of Tourism on Biodiversity

In Tafilalet, biodiversity, often endemic and remarkable, is quite unique in variety and number, characterized by cultural and architectural diversities. This richness and

Impact of Dredging and Filling Activities on Mangroves, Around Asir
Source: UNEP, 2010

diversity allow the development of nature-based tourism activities such as hiking or riding, sportive fishing, nature exploring (fauna, flora and landmarks are still intact and virgin).

However, much of this heritage is threatened with extinction mainly because of direct or indirect human actions. Deterioration of natural habitats is mainly due to overexploitation. Accordingly, the number of species, animals or plants is declining due to the increase and acceleration of the extinction rate of species and destruction of their habitats. The impacts of this degradation will be reflected negatively on human well-being by reducing the quantity and quality of goods and services provided by the ecosystem and on the functioning of the ecosystem.

Tourism development exerts pressures on natural resource. Hotels' infrastructure and the development of upscale hotels necessitate the exploitation of the resources to meet the demands and requirements of customers, who often exceed the supply and the limits of the environment.

In Asir, tourism is expected to increase within the next few years and the number of tourist visitors to the mountainous area of the Asir National Park will reach a rate that is at least equal to the population growth rate generally, estimated to be in the vicinity of 2.5 per cent. With no control, the increased number of visitors will result in an increase in the rate of environmental degradation of the Park, which is a major determinant factor, affecting biodiversity.

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CHAPTER 4

SOCIO-ECONOMIC CONTEXT IN THE ASSESSMENT SITES

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Main Messages

The three study areas are unique in characteristics in terms of nature, culture and richness of natural resources. Despite this fact, these areas are considered to be the most vulnerable among the areas of the region for their marginalisation. The inhabitants of such areas are still following inherited traditions in their daily life activities and dealing with challenging issues, depending on existing natural resources for their livelihoods as well as for income generation.

Arab countries have depended on their natural resources for economic development for centuries. Since the onset of industrialization, inhabitants of the Arab region have known the economic value of natural resources. This caused a change of perception from that of resources used for living and development to that of resources that could be used to achieve prosperity.

Economic growth became a target for most of the Arab region, which is simply an increase in the production and consumption of goods and services. If the current economic growth ratio is not well managed, neither environmental resources will be able to be used sustainably, nor can human welfare assurance be achieved.

Ecological Footprint can be used as a tool for assessment and better decision making. It also summarizes overall resource trends, and is a cost-effective policy tool for weighing policy options.

There are social and economic drivers which formulate the socio-economic context of each country in the Arab region. Existing social drivers in the areas negatively affect economic development in the region. These kinds of drivers are a result of lack of awareness, absence of up-to-date technologies, misunderstanding and mismanagement by inhabitants and governmental authorities regarding environmental, economic and social aspects.

Unemployment, economic sector framework, services and extreme events are drivers that formulate the patterns of the economic context in the Arab region and affect its development.

The various aspects that affect the socio-economic situation in the Arab region are according to location, culture, traditions, conflicts and political instability. One of the main common issues that affect the socio-economic context among all areas is water scarcity. Water scarcity affects the economic, social and health conditions of the inhabitants. It negatively affects the economic situation by reducing income generating opportunities, changes the communities' activity pattern and creates use and user conflicts. The demography of these areas is affected as a result of migration due to water scarcity.

4 SOCIO-ECONOMIC CONTEXT IN THE ASSESSMENT SITES

4.1 INTRODUCTION

Arab countries have always relied on their natural resources for their economic activities. The people of the Arab region have understood the economic value of natural resources from the dawn of industrialization, which caused a change in perception from that of resources used for living and development to that of resources that could be used to achieve prosperity. This perception emphasized the idea of "desires" instead of "needs" and thus gave precedence to economic growth over economic development, human welfare and the need to lessen poverty. This change in perception negatively altered people's approach towards the use of natural resources in a sustainable way. This unrestricted and unsustainable approach towards natural resources, rapid population growth and urbanization, together with lack of governmental implementation of sustainable development policies place natural resources, human well-being and economic development at risk.

The absence of integration of environmental issues in other sectors, creation of policies and implementation of suitable programmes, have led to environmental difficulties in many Arab countries, such as water scarcity, desertification, urbanization, marine life degradation, and waste management problems. Unsustainable environmental activities may have considerable effects on the economy, which depends on goods and services obtained from natural resources for its success. The link between socio-economic factors, human well-being, and the environment is evident in the Arab region.

Economic development and human well-being concentrate on improving the quality of life and not on the quantitative production of goods. Therefore, economic development becomes imperative for sustainable development as it aims to properly value the importance of nature and sustainable progress and to improve the standard of living of citizens. Economic growth is just an increase in the production and consumption of goods and services without making an allowance for social factors. Economic growth is shown by an increase in Gross Domestic Product (GDP). Economic growth is founded on the incorrect belief that the economy can keep growing while natural resources and services keep deteriorating and people keep getting poorer. The existing attitude towards environmental resources will greatly impact the environment as well as human well-being.

The Arab region is known for its vast geographic, demographic, and socio-economic diversity. It comprises many areas that are distinctive in terms of tradition, culture and natural resources. Within each country there are internal impacts on natural resources between urban and rural areas. These impacts are mainly in the overuse of highly populated urban areas to the natural resources of susceptible rural areas. The inhabitants of susceptible areas in the Arab region rely on available natural resources for their livelihoods and income generation. To understand the socio-economical context of the selected site, an overview on the socio-economic context of the Arab region should be taken into consideration. Accordingly, this chapter will discuss the drivers that formulate

the socio-economic context and environmental issues of the study areas in the light of the Arab region's social and economic drivers. It will also link the impacts of the Arab region's socio-economic drivers on the selected sites.

4.1.1 Arab Region Ecological Footprint

Great differences exist in the economic status of member countries of the Arab region, as it includes both oil-rich economies in the Gulf as well as countries that are resource-scarce in relation to population, such as Egypt, Morocco, and Yemen.

Several indicators reveal that many countries throughout the region continue to consume their natural resources at rates well beyond sustainable levels and well beyond the ability to regenerate. As a result, natural resources in most of these countries are grossly depleted.

An important indicator for the consumption and sustainability of natural resources is Ecological Footprint (EFP). Ecological Footprint provides an aggregate measure of the pressure human societies put on nature. It estimates people demand on the environment by measuring the amount of biologically productive land a population requires to produce the resources it consumes and the wastes it generates. Ecological Footprint could be a crucial tool for region situation as it allows analysts to summarize overall resource trends and is a cost-effective policy tool for weighing policy options. Accordingly, better decisions concerning a country's natural resources, demands, and priorities will be taken.

Reports have indicated that human pressure on Earth's capacity has significantly increased from 70 per cent in 1960 to 120 per cent of available biocapacity by 2000 (Wackernagel and Rees 1996; Wackernagel et al. 2002). Hence, a change in footprint over time is a genuine reflection of progress made towards sustainability.

Human consumption has grown over the past forty years, with global demand for biological capacity exceeding what the planet can supply by 25 per cent in 2003 (WWF 2008). As a result of overuse of natural stock it was stipulated that Earth would need 1.5 years to regenerate the renewable resources that humans have consumed. There is no doubt that overuse of planet natural stocks will cause undesirable repercussions that include financial difficulties, environmental degradation and threatened human future.

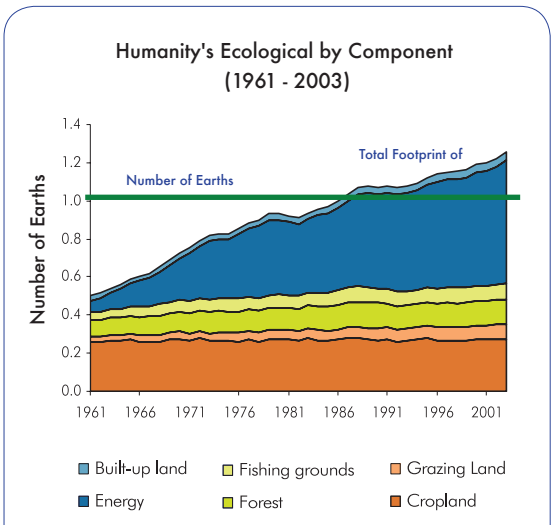

Figure 4.1 Humanity's Ecological Footprint
Source: UNEP, 2007

Box 4.1 Ecological Footprint (**EFP**)

The Ecological Footprint tracks human demand on ecosystems by adding together the equivalent areas of world average biologically productive land and water required to provide the renewable resources that people use, provide space for infrastructure, and absorb the CO2 waste that human activities produce. The Ecological Footprint tracks demand in the following categories: cropland, grazing land, forest land, fishing grounds, built-up land and carbon. The first five types of Footprint are defined in this report as Footprint of resource use.

The term 'Ecological Footprint', when not further qualified, refers to the Ecological Footprint of Consumption: the Footprint associated with the entire supply chain serving the consumption of a given population or region. The Ecological Footprint of Production, on the other hand, measures direct demand for biocapacity, regardless of whether the end products of this demand are consumed locally or are exported. Footprint of resource use in this report refers to Ecological Footprint exclusive of carbon footprint.

Biocapacity: Biocapacity measures the area of biologically productive land and water actually available to provide renewable natural resources and absorb CO2 waste.

Biocapacity deficit/surplus: Biocapacity deficit is when Ecological Footprint exceeds biocapacity; biocapacity surplus is when biocapacity exceeds Ecological Footprint.

Ecological overshoot: During the 1970s, humanity as a whole passed the point at which the annual Ecological Footprint matched the Earth's annual biocapacity - that is, the Earth's human population began consuming renewable resources faster than ecosystems can regenerate them and releasing more CO2 than ecosystems can absorb. This situation on a global level is called "ecological overshoot", and has continued since then.

Global hectare (gha): Both the Ecological Footprint (which represents demand for resources) and biocapacity (which represents the availability of resources) are expressed in units called global hectares (gha), with 1 gha representing the productive capacity of 1 hectare of land at world average productivity.

The Ecological Footprint of numerous Arab countries is above the global average - with two Arab countries among the top five per capita consumers of natural resources at a global level. In 2006, it was reported that the UAE had one of the highest per capita Footprints in the world, mounting to five times higher than the global per capita. Recently, the UAE launched a national initiative, Al Basama al Beeiya (Ecological Footprint) that involved multiple stakeholders and aimed to reduce the country's footprint. The initiative involved multiple stakeholders across the nation to work towards developing important guidelines for a more resource-conscious and resource-efficient government and society.

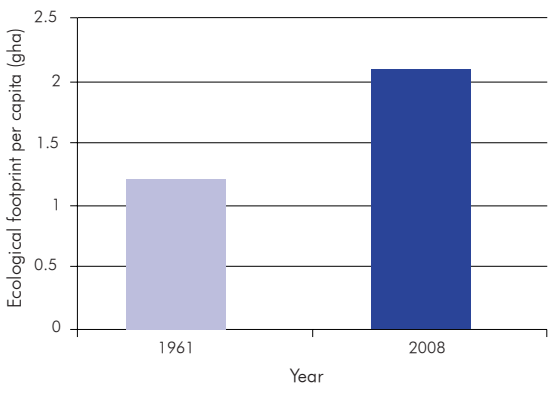

Figure 4.2 Ecological Footprint per Capita (gha) in 22 Arab Countries

Source: AFED, 2012

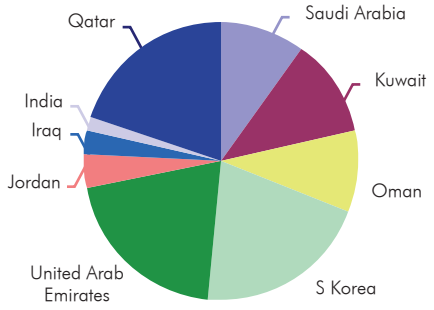

Figure 4.3 Ecological Footprint of Saudi Arabia in Comparison to some Selected Countries

Source: Tawfic, 2010

Footprints of individual Arab nations vary considerably, depending on the pressure people exert on their environment, as well as the magnitude of biocapacity for each of these countries. Prevailing patterns of consumption in these countries are major contributors that shape Footprint.

For example, The Ecological Footprint of Saudi Arabia is more than twice the average world Ecological Footprint, and also much higher than the global average biocapacity available per person (1.8 gha/per capita). However, Saudi Arabia has a favorable EFP in comparison to neighbouring Gulf countries, where the EFP of the United Arab Emirates and Qatar are 10.7, and 10.5, respectively (Tawfic 2010) (see Figure 4.3).

Ecological Footprint and Poverty

In any country ecological deficit, especially in cropland, is more likely to affect people with low level income than those with high level income. Wealthy people would be able to afford to buy imported foodstuff and other goods that low income group could not afford to purchase. It has been always the case that low income communities are more dependent on local biocapacity to meet their needs; consequently, they are more impacted with any ecosystem flaws. Developing countries like Egypt have less biocapacity per capita than they consume, especially in highly populated nations. With the growing trend of increasing food prices, Egypt may face some serious problems meeting its people needs.

Adjusting for its grazing land, forest and fishery yields, which are lower than corresponding global averages, and its cropland yield, which

is higher than the global average, Egypt has a biocapacity of 50.4 million global hectares (gha). This is less than its total Ecological Footprint of 163 million gha. Egypt has been operating with an ecological deficit prior to 1961. Cropland footprint is the highest of Egypt's Ecological Footprint, despite its apparent reduction in recent years. This shows the high demand and consumption level of agricultural and farming products. Moreover, considering the current information on cropland ecological footprint (0.63), and comparing it with cropland biocapacity (0.43) it is quite obvious that Egyptian crops alone cannot suffice feeding the country. This also applies to fish ground. However, comparing cropland footprint (the major constituent of Egypt's footprint) with cropland biocapacity and keeping in mind the high population growth rate, there is a need to appreciate Egypt's efforts to maintain a reasonable balance between cropland footprint and biocapacity.

Ecological Footprint deficit in Saudi Arabia would have various undesirable manifestations, but would not affect local Saudis much. In a high income country such as Saudi Arabia, most people can afford to buy imported food rather than totally depend on locally grown crops. Saudi cropland ecological footprint is the second fastest growing next to carbon footprint, with a growing alarming deficit.

Adjusting for its cropland and grazing, which are much higher than Asia average, forests and fishery, which are lower than Asia average, carbon footprint which is higher, and built up land, which is equal to Asia average, Saudi biocapacity is 19.76 million global hectares (gha). This is less than its Ecological Footprint of 125.97 million gha. Saudi Arabia has been running an ecological deficit since late 1970s. The high birth rate characterized in the early 1980s, coupled with increasing population of foreign workers are possible reasons for this deficit.

4.2 OVERVIEW OF THE SOCIO-ECONOMIC SITUATION

There are social and economic drivers which formulate the socio-economic context in the Arab region and case study areas. As for the area's unique nature and location; culture and traditions play an important role in the manner these areas manage their resources. However, through the analysis of the sub-global assessments of the study areas it was found that water scarcity is a dominant factor among the study areas that has a direct impact on the socio-economic situation. It negatively impacts the economic situation by limiting income generating opportunities, changes in the functioning pattern of communities and the creation of use and user conflicts.

4.2.1 Social Context of the Study Areas

The social context of the study areas is frequently linked to traditional and native knowledge. Traditional knowledge usually supports sustainable management of natural resources. This could be due to the centuries old appreciation of the environment and its natural resources. Prior to the advent of the holy religions inhabitants used to worship

natural resources as a symbol of life. For example, one of the most important questions resurrection after death during the Pharaoh's times: Did it pollute the Nile? Consequently, these beliefs allowed them to conserve what gave them life. They may have aspired to achieve a good standard of living rather than economic profit.

In the case study areas, natural resources were managed through customary rules. In the Arabian Peninsula where the environment is characterized by aridity and uncertainty, collaboration over communal resources became vital to safeguarding the livelihoods of its inhabitants. For example in Saudi Arabia, for more than fourteen hundred years, customary rules known as Al Hima involved sustainable use of natural resources by local tribes in remote and rural areas. The forests of Saudi Arabia were protected by Al Hima by which certain tribes had control over a certain part of the forest, and no one was allowed to access the forested areas without the consent of the local clan or tribal leaders.

In Tafilalet, Morocco, surface water and groundwater are the two sources of water used for domestic and agricultural uses. In the past, customary rules known as "water rights" safeguarded water resources. Traditional housing in these areas is of a simple design and mostly made out of materials from the local environment. However, in the present day there has been a rise in modern housing development techniques and designs. This has had negative impacts on the ecosystem of the area. In Tafilalet, there are urban areas where housing is known as "Ksours", inhabited by different ethnic groups living together in harmony. Rural areas consist of rural housing units and traditional Moroccan houses which are the main types of housing found in rural areas.

Inhabitants of the study areas usually live in tribal communities that are led by tribal sheikhs or heads that make all the important decisions concerning tribal matters. In contrast, present day decisions are now being taken over by local governance authoritarians and participation of the area's local inhabitants in development decisions is usually absent. In this context it is hard to achieve sustainable development when the needs, ideas and ambitions of local societies are not reflected in the the planning and execution of development projects.

4.2.2 Social Drivers

Existing social drivers in the Arab region negatively affect economic development. Lack of awareness, absence of up-to-date technologies, misunderstanding and mismanagement by both inhabitants and governmental authorities towards environmental, economic and social aspects have caused the emergence of these kinds of drivers.

4.2.2.1 Population Growth and Densities

Population growth and density in the region have an impact on numerous environmental and economic issues. Despite the steady decrease in fertility rates in the region (UNEP 2003), the current population growth rate,

projections show that the Arab population will reach 598.5 million by 2050 (6.5 per cent of the world population) (Gelil, I. A. 2011).

With the high population growth rates, expansion of new settlements will take place leading to rapid urbanization. Urbanization will negatively affect available natural resources. Accordingly, this will affect industries that are dependent on natural resources to fulfil people's needs as well as economic targets.

Population densities in the Arab region have different measures than population growth. Many of the Arab countries can face very high population growth rates with very low population densities as it measures population per unit area.

Population density creates localized pressures on natural resources and environmental damage. Pressures on natural resources will increase consumption of non-renewable resources, stress on rural lands, and fresh water. It increases the production of wastes and pollutants.

High population densities have been detected in the study areas especially in Tafilalet and ANP. In Tafilalet, the population of the watersheds area continues to grow at a significant pace. This population was only 484 298 in 1994, giving an average total annual increase rate, compared to the population of 1994, of 0.60% (1.998% in cities and -0.06% in the rural areas) (UNEP 2009). The average fertility rate in the watershed equals 3%.

Table 4.1 Land Area and Population Densities in Arab Countries

	Land Area (sq. km)	Population Density (People per sq. km of Land Areas)		
Country	2010	1990	2000	2010
Jordan	89 342	35	56	68
UAE	83 600	20	37	99
Bahrain	707	703	975	1 858
Tunisia	155 566	50	61	68
Algeria	2 381 741	10	13	15
Dijibouti	23 200	19	29	40
Saudi Arabia	2 000 000	--	10	12
Sudan	2 505 805	10	12	17
Syria	185 180	68	88	111
Somalia	637 657	10	15	17
Iraq	435 052	43	52	77
Oman	309 500	7	8	11
OPT	--	--	--	--
Qatar	11 427	34	50	149
Comoros	2 236	195	247	309
Kuwait	17 818	116	123	215
Lebanon	10 452	255	360	384
Libya	1 775 500	2	3	4
Egypt	1 009 450	53	64	78
Morocco	710 850	37	40	45
Mauritania	1 030 700	2	3	3
Yemen	555 000	21	33	42

Source: AMF, 2011

The oasis is under pressure to meet the requirements of several areas in Morocco, as well as the requirements of its own inhabitants. This is attributable to the increase in population density in the areas, as well as in the cities leading to increased food requirements. Need for food generates pressure on the agricultural system and necessitates expansion into less fertile lands or over-exploitation of existing agricultural lands. Productivity loss, less income and the risk to lose local crop varieties may oblige farmers to abandon the agricultural activity.

Abha governorate is part of Asir National Park (ANP) with a total population of 317 159 in a ratio of 70 per cent urban to 30 per cent rural. The population, throughout the Kingdom of Saudi Arabia including the ANP, is increasing at a rate of 2.5 per cent annually. In addition to the permanent population, ANP hosts 2 to 3 million visitors annually in the summer, in which the park has to fulfill their needs (UNEP 2010). Nevertheless, any increase in population, even temporarily, creates added demands for food, water, and housing and therefore builds added pressure on an already fragile and sensitive land. High population densities in ANP have led to land encroachment.

If the unplanned growing urbanization continues, an increase in air pollution will begin to negatively affect agriculture (producing poor soil composition) and could perhaps cause health complications for inhabitants.

If economic growth were to be equitably distributed, the actual improvement of living standards would be minimal, since economic growth rates were roughly equal to population growth rates. High population growth rates create demands on the market, speeding up the growth of goods production. With the growth of these economic activities, a high demand on natural resources will occur. This demand cannot be fulfilled with rapid urbanization that causes natural resource decline. This has caused many investors to search for natural resources in marginalized/rural areas that suffer lack

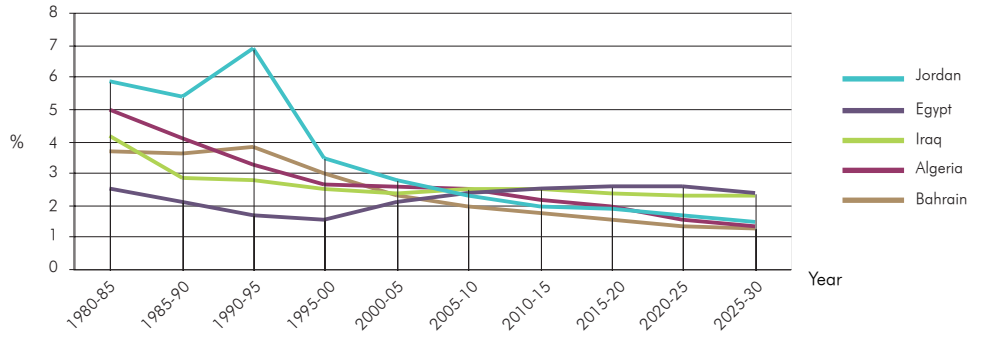

Figure 4.4 Growth Rate of Urban Population in some Arab Countries, 1980-2030
Source: UNEP, CEDARE and LAS 2010

of services and high poverty rates. This paradigm has been evolving without any focus on environmental management and environmental sustainability. The latter has increased rural-urban migration rates for better living, which has increased the vulnerability of the socio-economic situation in such areas.

Therefore, urban populations throughout the region continue to grow, and natural resources in marginalized/rural areas continue to be extracted and taken. There will be increased impoverishment in urban and rural communities, creating even greater concern for human well-being and environmental sustainability (UNEP, CEDARE and LAS 2010).

4.2.2.2 Poverty

According to the UNDP, poverty is identified as when opportunities and choices most basic to human survival and development are denied. Thus, a person is not free to lead a long, healthy, and creative life and is denied access to a decent standard of living, freedom, dignity, self-respect as well as the respect of others. From a human development perspective, poverty means more than the lack of what is necessary for material well-being. Poverty is also a product of inequality, in terms of income, wealth and natural resource distribution.

Poverty and environmental degradation and social services are very much interrelated, with the study area's poorest communities intimately dependent on natural resources for their livelihood and well-being. Solving the problem so that poor communities can benefit adequately from these resources in the long-term will require them to practice sustainable management of resources. However, poor inhabitants are rarely in a position of power concerning the management of, access to, or ownership and control of resources. Thus, they are more vulnerable to environmental change and economic fluctuations. Lack of services is also a contributor to the existing poverty in the study areas. It is argued that poverty in El Maghara is not restricted to the economic dimension but goes far beyond to include inaccessibility to schools, clean water, and social services (UNEP 2010). Thus, both urban and rural areas suffer from poverty in the Arab region. Rural areas are often impoverished due to marginalization and decentralization, which translates into a lack of access to services, such as proper education and healthcare, decent housing, water, power, and job opportunities. The urban poor are a mixture of immigrants, migrants, refugees and internally displaced persons who live in shantytowns with little or no access to the city's services.

4.2.2.3 Education

Illiteracy rates are directly linked to population growth, and play an important role in the lack of citizens' awareness of important environmental issues. Increased population rates have decreased educational opportunities and quality. With rapid population growth, and poor capacities of educational bodies, many Arab countries have failed to offer suitable educational

opportunities that fulfil ambitions or meet market needs. The quality of such services offered, particularly for low-income and poor families, are insufficient and inappropriate.

Achieving universal primary education is a goal of both the MDGs and the Arab Ministerial Declaration. With the exception of lesser-developed countries (LDCs), most Arab countries are likely to meet the goal of universal primary enrolment by 2015. The LDCs in the Arab region, however, are highly unlikely to meet this goal since nearly half of primary school age children were not enrolled in 2002. This sub-regional difference is exemplified by the fact that of the 7.5 million out-of-school children in the region, two-thirds live in LDCs (UNEP, CEDARE and LAS 2010).

Despite efforts undertaken by Arab countries to increase literacy rates, rural vulnerable areas have high illiteracy rates. This is due to lack of services, marginality and economic situations which have forced many families to have their children drop out of school in order to help increase income rather than sending them to distant schools. This indicates the extreme poverty rates in such areas.

Education in the case study areas varies and is greatly affected by several factors, including gender inequality, the economical situation, governmental plans and accessibility to educational services. In order to promote education, the government of Saudi Arabia has implemented a plan to support and advance education at the elementary, intermediate and high school levels as well as training institutes and universities in the ANP area, where illiteracy rates are high. This is a clear case of how availability of governmental plans and equitable funds helped develop education in the area.

The government of Saudi Arabia implemented this plan as a result of rural-to-urban migration by inhabitants in order to get an education and improve their livelihoods. Rural-to-urban migration has brought about the abandonment of numerous traditional occupations, such as agriculture, with sizeable areas of farms left fallow or rented to others. Inhabitants of the area have affirmed the government's significant efforts in continuing to improve educational facilities. An increase in the number of educational institutions and the number of teaching staff and students entering these institutions was detected.

The illiteracy rates in Tafilalet and El Maghara are significant. In Tafilalet, the lack of suitable governmental plans, marginality of the area and the economic situation have had a negative impact on the educational situation in the oasis. The illiteracy rate, calculated for persons aged 10 and over, is 41 per cent, and is quite significantly higher among women (55 per cent) than men (26 per cent) (UNEP 2009).

In El Maghara, there is inadequate governmental involvement when it comes to educational services. There are no local preparatory schools and students have to travel to distant schools, the nearest being almost 20 kilometres away, making it very difficult for parents to cover the cost of travel.

Table 4.2 Illiteracy Rate in the Arab Countries

	Illiteracy Rate (%)											
	Adults (People Ages 15 and Above)						Youths (People Ages 15 - 24)					
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
	1990			2008			1990			2008		
Jordan	10.0	27.9	18.5	3.7	10.8	7.2	2.1	4.7	3.3	1.0	0.9	1.0
UAE	28.8	29.4	29.0	9.7	11.3	10.2	18.3	11.4	15.3	1.7	3.9	2.6
Bahrain	13.2	25.4	17.9	8.3	10.6	9.2	3.8	5.0	4.4	0.2	0.3	0.3
Tunisia	28.4	53.5	40.9	13.6	30.4	19.4	7.2	24.8	15.9	1.9	4.2	3.2
Algeria	35.7	58.7	47.1	15.6	29.0	22.3	13.9	31.9	22.7	5.8	9.4	7.5
Dijibouti	33.2	60.3	47.0	20.1	38.6	29.7	17.8	35.8	26.8	9.0	15.1	12.1
Saudi Arabia	17.4	36.3	25.3	8.2	17.0	12.4	6.5	21.2	13.4	1.6	3.8	2.7
Sudan	40.0	68.5	54.2	21.0	40.4	30.7	24.4	46.0	35.0	11.4	18.3	14.8
Syria	18.2	52.5	35.2	9.3	23.4	16.2	7.8	33.1	20.1	4.4	7.5	5.9
Somalia	--	--	--	--	--	--	--	--	--	--	--	--
Iraq	48.7	80.3	64.3	14.0	30.8	22.4	43.6	75.1	59.0	15.5	19.8	17.6
Oman	32.7	61.7	45.3	10.0	19.1	13.3	4.6	24.6	14.4	2.4	2.4	2.4
OPT	--	--	--	2.8	8.9	5.8	--	--	--	0.7	1.0	0.8
Qatar	22.6	24.0	23.0	3.5	4.6	3.7	11.7	7.0	9.7	0.9	1.0	0.8
Comoros	--	--	--	20.3	31.3	25.8	--	--	--	14.2	15.3	14.7
Kuwait	20.7	27.4	23.3	5.0	7.7	6.0	12.1	12.8	12.5	1.6	1.5	1.6
Lebanon	11.7	26.9	19.7	5.6	10.2	7.9	4.5	11.4	7.9	1.6	0.9	1.3
Libya	17.2	48.9	31.9	5.1	18.7	11.6	1.1	17.3	9.0	0.1	0.3	0.2
Egypt	39.6	66.4	52.9	25.4	42.2	33.6	29.1	49.0	38.7	12.1	18.3	15.1
Morocco	47.3	75.1	61.3	28.1	50.8	39.7	32.0	58.0	44.7	15.2	31.6	23.4
Mauritania	53.7	76.1	65.2	35.9	50.5	43.2	44.5	63.9	54.2	29.5	36.6	33.0
Yemen	44.8	87.1	67.3	21.1	57.2	39.1	26.5	75.0	50.0	4.9	30.0	17.1

Source: AMF, 2011

Table 4.3 Number of Male and Female Educational Institutions and Students in ANP

	Rejal Al-Ma Governorate	Mahayel Governorate	Abha Governorate
University	None	None	King Khalid University
University Students	None	None	10 180
Number of Colleges	None	None	10
Male Schools			
Elementary	18	NA	72
Intermediate	17	NA	58
High School	09	NA	25
Training Schools/Technical Institutes	NA	NA	04 (2 293 students)
Female Schools			
Elementary	05	NA	43
Intermediate	09	NA	30
High School	05	NA	24
Training Schools/Technical Institutes	01	NA	02 (169 students)
Students (Male)			
Elementary	3 224	21 064	
Intermediate	1 942	5 386	9 234
High School	1 519	2 628	7 237
Students (Female)			
Elementary	NA	10 455	15 710
Intermediate	NA	4 166	6 728
High School	NA	3 151	6 009

Source: UNEP, 2010

In addition, it may also be dangerous to allow young children to travel such distances by themselves. The government does make available dormitories for students, but parents do not usually opt to allow their children to make use of these facilities.

The need to promote environmental awareness in both areas of study is limited to a few infrequent measures. Inhabitants have very little knowledge and awareness when it comes to natural phenomena, such as the hazards of sand encroachment on

infrastructure, agricultural lands, housing units and their effect on human health. This lack of education creates an obstacle to the fight against environmental issues. In addition, the remoteness of these areas makes it difficult to provide transport, communication and other services.

4.2.2.4 Gender Equity

In the study areas, women are more dependent on resources in their daily household activities than men are. However, most often they have less access to these resources which consequently affects their activities and the satisfaction of their family's needs. Most of the women in the Arab region cannot address these problems as they rarely have a chance to participate in the decision making process due to cultural aspects, especially women in rural areas. Therefore, "women's well-being is less easily attained, and their vulnerability to environmental stress and change is in many cases higher" (UNEP 2007).

Two clear indicators of gender inequality are education and employment, both of which demonstrate a gender gap throughout the region. Hence, women still suffer from gender inequality at various levels and in almost all sectors. Gender inequality significantly affects the ability of women - and society - to use resources sustainably and efficiently.

With regards to education, the region has witnessed the adoption of national policies promoting equal access to education for boys and girls in schools and higher education. Although progress has been evident, there remains a critical need for further promotion, particularly in certain sub-regions. According to the Gender Parity Index (GPI), school enrolment at the Arab region level, measured by the girls-to-boys school enrolment ratio has substantially increased at all levels of education from 1991 to 2005 (UNEP, CEDARE and LAS 2010). However, gender parity in enrolment at the primary and secondary levels has yet to be achieved, and large disparity between sub-regions and individual countries persist.

In the study areas where poverty rates are detected to be high, illiteracy rates are significantly high among males and females, but the percentage is higher in females. High percentage of illiteracy is due to economic and social reasons, as well as lack of educational facilities. The lack of adequate educational facilities, forces parents to send their children to distant schools. These inhabitants also have very low incomes which make it difficult for them to pay for their children to go to school, thus children drop out of school in order to work and support their families. The opportunity to be educated is usually given to boys more than girls for cultural and traditional reasons; girls usually stay at home to help their mothers in daily activities. For example in El Maghara, there is considerable disparity between the attendance for boys and girls, as well as a disparity between the percentage of those who attend primary school and secondary school. Twenty three per cent of boys

Table 4.4 Enrollments in Primary, Secondary and Higher Education

	Guide to Gender Equality in Education					
	Primary Education		Secondary Education		Higher Education	
	1990	2008	1990	2008	1990	2008
Jordan	1.01	1.01	1.04	1.04	...	1.11
U.A.E	0.97	0.99	1.14	1.03	3.00	2.05
Bahrain	1.00	0.98	1.03	1.04	1.40	2.45
Tunisia	0.89	0.98	0.79	1.08	0.70	1.49
Algeria	0.85	0.94	0.80	1.07	0.53	1.40
Djibouti	0.71	0.88	0.65	0.70	0.50	0.68
Saudi Arabia	0.90	0.96	0.87	0.85	0.93	1.65
Sudan	0.75	0.88	0.78	0.91	1.00	0.92
Syria	0.90	0.96	0.73	0.98	0.64	--
Somalia	0.52	0.55	0.53	0.46	--	--
Iraq	0.85	0.82	0.64	0.66	...	0.59
Oman	0.91	1.01	0.78	0.97	1.00	1.15
OPT	--	1.00	--	1.07	--	1.23
Qatar	0.94	0.99	1.10	1.46	2.87	6.10
Comoros	0.70	0.92	--	0.75	0.18	0.77
Kuwait	0.95	0.98	0.98	1.04	1.78	2.33
Lebanon	0.96	0.97	1.07	1.11	0.93	1.23
Libya	0.94	0.95	1.03	1.17	0.83	1.09
Egypt	0.85	0.95	0.81	0.92	0.55	0.88
Morocco	0.69	0.90	0.73	0.86	0.62	0.89
Mauritania	0.74	1.07	0.47	0.88	0.16	0.37
Yemen	0.40	0.80	0.21	0.48	0.29	0.42

Source: AMF, 2011

attend primary school and only 3 per cent attend high school. Four per cent of girls attend primary school, however almost all drop out of school at a very early age due to cultural restrictions. El Hassana precinct, where El Maghara is situated, has the second highest rate of students dropping out of school and the second highest illiteracy rate in Sinai. It was found that 56 per cent of men were illiterate, while 24 per cent can manage to read and write but have no certificate of completion of any stage of education. Only 20 per cent of men have a primary school certificate. Among women, 90 per cent were illiterate (UNEP 2010).

The lack of education in females is greatly affecting the environment, as females in the Arab region are more interactive with natural resources than men. This reflects the importance of education in females, as they are the ones that can teach environmental ethics, behaviour and practices to new generations.

Employment

In some countries of the Arab region women are more involved in the agricultural sector than men are, particularly in the Arab LDCs. In other countries where agriculture is not a significant contributor to GDP women usually don't work or are more involved in the services sector. Generally, female unemployment rates in the region in non-agricultural labour markets have been a consequence of a "combination of factors that include low educational, low conventional perceptions on the role of the different members of society, and employment regulations that implicitly create a bias against women" (UN 2007).

In 2005, Egypt showed that males made up 28 per cent of the labour force in agriculture, while females made up 39 per cent of the labour force in agriculture. In Morocco, male to female employment in agriculture, was 39 per cent to 57 per cent (FAO 2006). Women working in the agricultural sector either work for low pay or without pay especially if agriculture is a family business. In all cases they are not insured and have no societal protection.

In countries where agriculture is not a significant contributor to GDP, female employment is different. For example, GCC countries have very low rates of female employment due to the fact that the oil industry is not deemed suitable for women, whereas in the more diversified economies, where economies rely more heavily on the service sector, higher rates of female employment are observed (UN 2005). It is important to add that women have less access than men to microcredit facilities, thus rendering it even harder for women to earn their own source of income (CEDARE et al. 2001).

4.2.2.5 Health

The health situation in the Arab region differs according to the economic situation and the capacity and plans of countries to solve any health generating issues. Some health issues in Arab countries are linked to the quality and quantity maintenance of natural

resource based services for healthy living, such as quality of drinking water, sanitation services and leakages, quality and quantity of food availability for adequate nutritional levels, and needed water quantity for proper hygiene. Furthermore, it is linked to the quality and quantity of medical facilities, as these services should be equally distributed throughout the country and should be able to treat any emerging diseases. Poverty, low-levels of social services and lack of health protection affect the health of many inhabitants of the study areas.

The Arab region is facing the prospect of severe water scarcity unless rapid and effective measures are taken to address the problem. Water scarcity is a restraint to economic development, food production, and human health and well being. Shortage of water and the decline of its quality have had a varied impact on the health conditions of both humans and the ecosystem as a result of lack of hygiene, the spread of waterborne disease, loss of biodiversity and contamination of agricultural products.

In El Maghara, analysis of samples of drinking water collected from various wells and dikes confirmed the poor quality of this water. Mining and gravel extraction industries have affected the quality of water in the nearby wells to a serious extent. Investigations showed the presence of heavy metals and pathogenic micro-organisms in the commonly used wells in the region. One of the main sources of drinking water in the area is from flash floods, and this water has also been polluted by materials that litter the course of the flash floods. Additional health problems were mainly due to polluted water, lack of hygiene, water salinity, poor nutrition, and exposure to the sun. It was also found that anemia was the most common disease.

Water scarcity and drought have also impacted the health of the environment. In Tafilalet Bayoud disease had impacted the date-producing palms, particularly the noble variety of palms which are known for their commercial quality. Regions with relatively more water resources show a higher impact of the disease. According to the ORMVA/TF, 3 per cent of date-producing palms die out every year as a result of Bayoud, with more than two-thirds of the date palms heritage in Tafilalet lost in one century.

Tree health is also affected by insects that form shields and white encrustation that interfere with the process of photosynthesis and thus impede tree growth. All of the palm groves in the area are diseased. Olive trees affected by insects, particularly after the deteriorating effect of drought, are greatly damaged. Some diseases may also affect beehives, leading to deterioration in honey production. These diseases greatly decrease the yield in production and thus impact the health as well as the income of inhabitants.

Inadequate government monitoring and programmes for these areas, lack of proper medical services and facilities, as well as treatment for trees has greatly increased environmental and human health problems. In ANP, primary health care centers have been set up in cities as well as in villages and

are steadily increasing in number. The total number of health care centers in the Asir region has increased 18 per cent from 2001 to 2005, an increase from 213 to 251 health care centers (UNEP 2010).

4.2.3 Economic Context of the Study Areas

In the Arab region, economic development has historically been tied to domestic natural resources. One can even trace the rise and fall of certain civilizations in the region with sustainable - or unsustainable - environmental management. It is essential to recognize that economies are still defined by their GDP, which is the total market value of all final goods and services produced in a country in a given year. The Arab region's economy is supported by its environmental assists and services at 2.5 per cent to 4.8 per cent of GDP (UNEP, CEDARE and LAS 2010). The direct economic cost of environmental degradation in the region is enormous, and might affect the GDP and exceed the annual economic growth rate. This is due to ecosystem fragility, rapid population coupled with development policies that do not consider the capacity of the local environment, and the continued use of obsolete manufacturing techniques. In this way the economic development in Arab countries is totally affected by the degradation of natural resources that depend on it.

Human well-being is dependent upon ecosystems and ecosystem services in the case study areas. Extreme events and uncontrolled economic activities have had profound and irreversible effects on the use of indigenous natural resources and on the environment in general. Ecosystem services make up an essential part of the economy in the case study areas, thus deterioration of natural resources is linked to the poverty that can be found; particularly in El Maghara and Tafilalet. Inadequate governance and the extreme changes that have occurred in the nature of natural sources have led to the damage of features essential to the quality of life: water pollution, land degradation, floral and faunal species depletion, and the emergence of alien species causing considerable damage.

Use of natural resources to reach economic targets has increased their degradation. This has negatively impacted the needs of inhabitants, increasing the level of inequalities. Degradation of natural resources, such as soil erosion, use of ground water for commercial purposes, desertification, and wood cutting for trade, and overgrazing can be observed in the case study areas. This decreases local know-how by limiting available work opportunities in the agricultural and livestock-herding sectors, which is one of the reasons for urban migration.

Reliance on economic growth strategies and policies without taking into consideration social, cultural and environmental aspects has not been successful. This had led to the disparity between rich and the poor. Green economy and sustainable development are essential to improve the social, economic and environmental situation.

4.2.4 Economic Drivers

Unemployment, types of economic activities, and extreme events are drivers that formulate the patterns of economic context in the study areas. Therefore, it is crucial to understand the work patterns of these drivers in the region to better assess economic mechanisms and their nature.

4.2.4.1 Employment

High unemployment rates in the Arab Region make it difficult to maintain economic progress and alleviate poverty. Unemployment hinders economic growth and poverty alleviation (UN 2005). Unemployment in Arab countries impacts young people and women. In fact, Arab countries registered the highest unemployment rate in the world for young people between the ages of 15 to 24, which is estimated to be 48 per cent (AMF 2011).

In 2009, more than 20 per cent of the youth labor force in the region was unable to find a job, which constituted more than half of total unemployment, and impacted women more than men. There is a significant increase in unemployment, considering that the labour force increases 3.5 per cent per year due to the growth in population, creating an even greater number of unemployed youth. According to the Joint Arab Economic Report 2011, first-time job seekers entering the labour market made up about 70 per cent of total unemployment in Arab countries for which data is available. The high unemployment density either among young people or job seekers who have never worked, or university graduates who made up about one quarter of the total unemployed in Arab countries, is strongly linked to the inability of the labour market to absorb new entrants. Arab countries urgently need to boost growth that leads to job creation and to link education outputs with changing needs of the labour market, as well as supporting youth employment programmes.

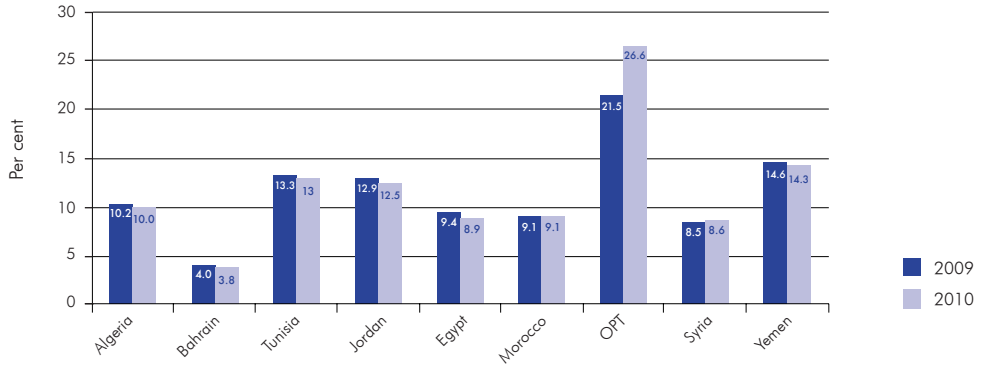

Figure 4.5 Unemployment Rates in Selected Arab Countries (2009-2010)
Source: AMF, 2011

Agriculture and grazing are traditional and recognized means of employment in the case study areas, but there are also less informal endeavours such as craftsmanship as well as illegal activities. Unemployment rates have risen as a result of the degradation of resources and the marginalization of such areas, greatly reducing employment prospects in agriculture and craftsmanship.

Generally, the region has the highest share of working poverty, where families work but find themselves still locked into poverty with employment deficits, small wages and wealth inequities. In the case study areas, earnings are usually low for activities for which payment is received. Moreover, degradation of natural resources increases income disparities and decreases employment rates and local know-how. For example, the excessive use of water will result in its shortage, and as a result income generating activities dependent on water will not be able to support the same number of people it once did.

Unemployment is one of the most adverse issues in the case study areas, with unemployment being higher for women than for men. Women are responsible for reproductive work, such as housework, care of children and the elderly as well as productive work, such as agriculture and farming, which is usually not paid.

It is essential to encourage and raise awareness to green economy, generate green employment opportunities and implement sustainable development plans and programmes.

4.2.4.2 Economic Sectors

Economic sectors in the Arab region are diverse. Most of the Arab region's GDP is increasingly dependent on the industrial sector, which is based on extraction of exhaustible natural resources. The extractive industries have steadily grown from constituting 63 per cent of the industrial sector in 1999 to 81 per cent in 2006. The unsustainable increase in

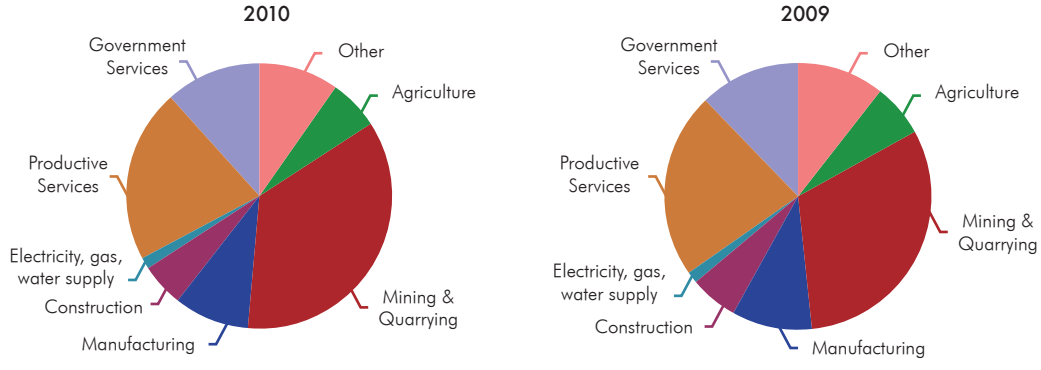

Figure 4.6 Structure of Arab Gross Domestic Product by Main Economic Activity
Source: AMF, 2011

the extractive industries will negatively affect the amount of non-renewable resources and will affect country GPD in the long-term.

Traditional and inherited economic activities are the most persistent in the case study areas. The economic sectors of these areas mainly depend on natural resources, as well as on their distinctive settings and cultures to promote tourism.

Extractive and Manufacture Industries

There is a dramatic rise in the percentage of contributions to GDP by the total of extractive and manufacture industries in most Arab countries. Extractive industries exceed manufacturing industries as a share of total industrial exports, especially in economies that focus on mining and quarrying as their main economic activities. More diversified economies in the region manufacturing industry exports are more significant than those for mining and quarrying. The mining and quarrying industries in Arab economies are not used in a sustainable manner to ensure reliability within this industry, for example, mining and quarrying - as with oil and natural gas - are dependent on non-renewable resources. Thus, it is important to both re-invest the monies earned from this sector into renewable resources, particularly human resources, and to ensure that this industry abides by environmental standards in the extraction of resources, and in the rehabilitation of lands.

Extractive industries in the region generate revenue and create job opportunities. However, despite these advantages resources are indiscriminately consumed, which may lead to decline and deterioration of these areas. In general, industrialization increases environmental degradation, increases the consumption and mismanagement of natural resources, such as land and water, and raises levels of air pollution. In addition, the proper management and treatment of industrial waste is still missing in much of the region (CEDARE et al. 2001).

Sustainable resource management is crucial to maintain the sustainability of the extractive industries. Short-term and long-term economic and environmental plans for the Arab region should be of a particular consideration, whether the flow of monies from sanction operations will be reinvested into the local and national economy, or whether they will be siphoned out to foreign corporations, increasing inequalities.

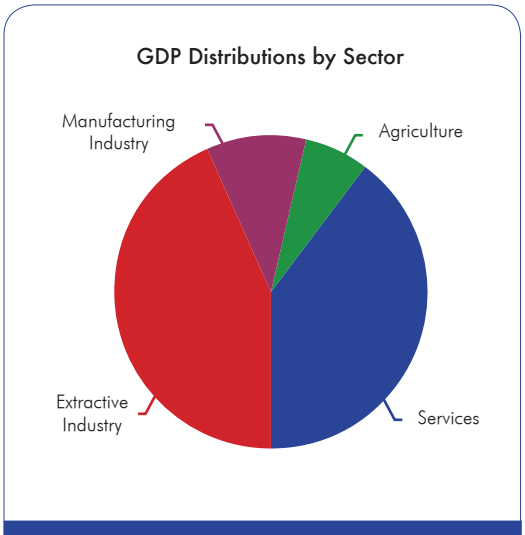

Figure 4.7 GDP Distributions by Sector in the Arab Region, 2006

Source: LAS 2007

Table 4.5 Percentage share of Extractive and Manufacturing Industries in GDP for Selected Arab Countries (2003 and 2006)

	Extractive Industries % of GDP		Manufacturing Industries % of GDP		Total Industry % of GDP	
	2003	2006	2003	2006	2003	2006
Jordan	2.7	2.6	14.0	17.6	16.7	20.2
UAE	32.0	37.1	13.6	12.1	45.6	49.2
Bahrain	25.2	26.5	10.9	12.3	36.1	38.8
Tunisia	3.6	5.4	18.2	16.9	21.7	22.3
Algeria	36.1	45.9	6.6	4.1	42.7	50.0
Djibouti	0.5	0.5	2.3	2.3	2.8	2.8
KSA	38.1	50.1	10.1	9.4	48.2	59.6
Sudan	8.0	11.5	5.6	7.5	13.5	19.0
Syria	19.5	26.3	4.3	10.2	23.7	36.5
Iraq	19.5	76.7	4.3	2.0	23.7	78.6
Oman	42.0	48.6	8.3	10.4	50.2	59.0
Qatar	57.6	61.9	6.9	7.3	64.4	69.2
Lebanon	-	-	9.1	9.1	9.1	9.1
Libya	57.5	71.9	4.2	2.2	61.7	74.1
Egypt	8.1	14.5	18.3	16.0	26.4	30.5
Morocco	1.6	1.7	18.2	15.8	19.8	17.5
Mauritania	11.0	34.3	7.8	3.3	18.9	37.6
Yemen	31.6	33.9	4.8	6.5	36.4	40.4
Total		**40.0**		**9.5**		**49.5**

Source: LAS, 2007

Existence and types of extractive and manufacturing industries in the study areas depend on dominant economic activities. Their impacts on the study areas vary according to the variation of extracted resource. For example, in Saudi Arabia extraction of gas for fuel is a part of the country's plan to decrease in wood cutting. This trend will continue to replace wood and charcoal because of its ease and availability,

according to the local inhabitants. This will have positive impacts on forest cover, biodiversity, and food availability for herding animals and humans. In contrast, over use and extraction of oil and gas in an unsustainable manner will lead to its decline as they are dependent on non-renewable resources and will affect the economical situation of small villages in the areas for its high prices.

El Maghara area is rich with mineral deposits. Rock diversity and coal seams had allowed many industrial and mining activities in the area; extractive industries had negatively impacted the area's ecosystem. Exploitation and development mining works were executed under government supervision for 20 years since the early 1980s. The low grade coal ore, coupled with the high cost of production and extraction processing and poor management, were main reasons for the big losses incurred that eventually ended up by closing the mine. The closing of the coal mine caused many Bedouin to lose their jobs. Industries, such as sand and gravel extraction, provide a few jobs for Bedouin, but the lack of jobs has forced many inhabitants to migrate to other parts of Egypt. This has resulted in increased loads and stress on city centers, infrastructure and has greatly affected the demographic distribution of the population.

In the light of the previous examples, extractive and manufacturing industries developments plans should be carried out through a sustainable and green economy perspective to ensure the stability of the socio-economic situation vulnerable societies and fragile ecosystems.

Agriculture

Agriculture is a primary rural activity and an important sector in most Arab economies as a contributor to gross domestic product (GDP). Contribution of agriculture to the economy and its role varies from one country to another according to the variations in arable land and water resources. It also plays an important role in providing food security, employment, and as a main source of income generation and livelihood for the majority of the rural population.

Agriculture in the Arab region is affected by many factors, including internal migration, unsustainable agricultural activities and climate change. Migration from rural to urban areas in Arab countries in search of adequate services and standard of living has increased, causing a decline in agricultural labour in the total workforce. Lack of diversification in rural economies, coupled with weak links between agriculture and related industrial activities, such as small scale food processing and agro-industries, have impeded expansion of employment opportunities that would support livelihood in rural areas.

Unsustainable agricultural activities might lead to degradation of quality and quantity of agricultural products. It considerably degrades land and water sources in the region, in which their availability is the

Table 4.6 Agricultural Gross Domestic Product and per Capita Agricultural Income in some of the Arab Countries (2000, 2005, 2009 & 2010)

	Agricultural Gross Domestic Product (US $ million)				Agricultural per Capita Income (US dollars)				Per cent of Agriculture in Total GDP			
Country	2000	2005	2009	2010	2000	2005	2009	2010	2000	2005	2009	2010
Jordan	171	347	648	791	35	63	108	129	2.0	2.8	2.6	2.7
Algeria	4 600	7 927	12 820	13 644	151	241	364	381	8.4	7.7	9.2	9.0
Saudi Arabia	9 326	10 208	11 045	11 204	458	438	414	406	4.9	3.2	2.9	2.6
Sudan	4 796	11 608	18 675	22 754	154	328	465	546	35.8	33.0	32.0	31.4
Syria	4 667	5 907	12 241	12 015	286	326	608	583	24.6	20.7	22.7	20.4
Iraq	1 206	3 438	5 219	7 294	50	123	163	218	5.8	9.5	5.4	6.0
Lebanon	1 077	1 148	1 707	1 963	286	295	428	489	6.2	5.3	4.9	5.0
Egypt	15 474	12 517	24 501	29 135	242	177	319	370	15.5	14.0	13.0	13.3
Morocco	4 908	7 847	13 081	12 641	172	260	415	396	13.3	13.2	14.4	13.4

Source: AMF, 2011

main asset for healthy and sustainable agriculture. Unsustainable practices increase desertification in the region. This includes inefficient irrigation practices, overgrazing, uncontrolled agriculture, logging for fuel, and the mismanagement of water resources. With regards to water for irrigation, irrigation methods and low cost of water are reasons behind the deterioration of water resource in the region. Several Arab countries still rely on traditional irrigation methods that typically cause considerable water loss and limited uniformity in water distribution. Water diverted and used for irrigation often causes environmental externalities and degrades natural resources. There are externalities due to over-extraction or contamination of common-pool resources such as lakes and underground sources (Malik 2008). The costs of these externalities are usually not taken into account while determining the cost of irrigation water.

In most countries of the Arab region, costs for irrigation water comprise only a fairly small percentage of operation and maintenance expenses. Arab countries have made subsidized water available to farmers through public financing (Malik 2008). This policy has resulted in highly subsidized irrigated agriculture, where low water prices have contributed to the extension of irrigated areas, increases in agricultural water demand, and the misallocation of the resource among users and uses. Low-

cost recovery and poor maintenance have caused infrastructure deterioration, and poor water distribution efficiency, and irrigation performance (Malik 2008). The rise in water use across all sectors has impacted water designated for agricultural uses.

Agriculture is highly exposed to climate change since it depends directly on climatic conditions, which might impact the quality and types of agricultural products. Land quality is affected and desertification may occur due to arid climate, land use change, and over extraction of water. Climate change negative impacts on water availability accompanied by increased water requirements and the existing water shortage in the region will greatly reduce agricultural development. This creates challenges to food security and job opportunities.

Agriculture plays a major role in the economy of the case study areas. The most important agricultural products are dates, olives, apples, cereals, and vegetables.

Table 4.7 Agricultural Employment in Selected Arab Countries

	Employment As a Percentage of Total Population		Employment (Annual Growth Rate) (%)	Employment by Agricultural Sector (%)	
Country	1995	2009	1995-2009	1995	2009
Jordan	28.1	45.0	5.9	13.0	8.8
UAE	55.6	65.7	6.3	6.2	5.2
Tunisia	25.1	35.4	3.6	26.5	16.2
Algeria	30.3	40.4	3.8	25.4	13.1
Saudi Arabia	34.9	33.9	4.0	6.3	4.1
Sudan	39.7	39.3	2.7	65.4	44.0
Syria	30.8	38.0	4.1	30.5	13.9
Oman	36.2	39.3	3.5	41.2	20.7
Lebanon	30.2	40.4	3.1	5.2	2.2
Libya	31.4	30.0	2.9	8.1	4.9
Egypt	29.1	33.0	1.3	33.4	26.5
Morocco	39.4	46.1	2.4	40.2	36.8
Yemen	29.9	34.0	3.7	55.3	36.8

Source: AMF, 2011

Inhabitants of the forested areas in Asir National Park depend on trade, farming and grazing for their livelihood. Terrace agriculture on mountains and slopes in the ANP area is customary. Inhabitants in the Asir region supplement their income through the processing, consumption and marketing of non-wood forest products. The main non-wood forest products include medicinal and aromatic plants, herbs and spices, gums, resins, tannins, mushrooms, honey, fruits and nuts. In addition, fodder is also considered a non-wood forest product as livestock depend on it.

The natural vegetal cover of ANP is presently in danger and vulnerable to degradation as a result of damaging climatic factors and anthropogenic causes. This danger is caused by indiscriminate cutting down of trees, exhaustive pasturing, fire, disease, tree senescence and weak natural regeneration. The deterioration of natural resources such as soil, water and wildlife will persist if suitable measures are not taken.

In Tafilalet, agriculture is the core of the oasis identity, represents 68% of the economic activity, constituting, thus, the backbone of the local economy. It is practiced by the majority of the rural population, although its output is low due to the unfavorable weather conditions and the limitedness of useful agricultural land. The gross income of the agricultural production is about 20 000 DH / house / year, 72% of which consists of dates, 10% of wheat, 7% of olive, 5% of barley, 4% of maize and 1% of alfalfa . Production costs represent 11% of the gross income.

It offers a vast number of agricultural products including fruit production (date producing palms, olive, apple and almond trees, etc.), cereals, fodder (alfalfa), market garden productions and the date palms production which constitute the most dominant speculation. The marketing of these products are the main source of income source for the farmers.

Agriculture is characterized by the limitation of space marked by the lack of expansion possibilities of agricultural activity outside the oases and the plots' division. The agricultural area of the oases is reduced to 0.86 ha per farmer with an average of 5 plots. This modification resulted in the reduction of the lucrative value of the Utilized Agriculture Area (UAA), generally followed by the progressive impoverishment of farmers.

The state of agricultural and rearing production is marked by the decline of the services they provide. The main causes are the 'Bayoud' disease, water scarcity (due to human actions and to the context of structural drought), demography, the intensification and expansion of agriculture, poverty and change in human behaviors. Olive trees are the second arboricultural species after date producing palms. However, olive industry in the region is characterized by low productivity and relatively low oil quality, if compared to the international standards. The causes, among others, are linked to the plants' advanced age, the non-mastery of the optimal period of olive harvesting, the traditional process of oil extraction, low olive recovering, etc.

The rapid population increase in the recent years and the precarious economic situation, generated a strong pressure on natural resources. This pressure affected agriculture through the excessive water pumping from groundwater. Wasting this already scarce resource is even more serious because it is often used to irrigate agricultural speculation with very low economic productivity, using traditional irrigation methods which significantly help wasting water resources.

This results in degradation of soil, dryness of palms and overexploitation of water resources, with consequent loss of agricultural productivity and agro-biodiversity. In addition to water scarcity, viruses, such as 'Bayoud' seriously threaten the future of the entire ecosystem oasis of Tafilalet.

Fishing

The fishing sector is one of the most important economic sectors in some countries of the Arab region, such as Morocco, Tunisia, Mauritania, and Oman. This sector offers considerable employment opportunities and income, as well as foreign earnings and revenue to these countries. However, these resources are decreasing due to coastal and marine degradation, overfishing, and increased ship traffic (UNEP 2003). As a result, many fishery resources continue to be degraded, and the effects of degradation are generally expanding, despite efforts to control them. The extinction of a species, particularly a keystone species, can ripple through a food web and affect a wide range of other organisms. Consequently, there is a great need to implement stronger and more effective fisheries management.

In the study areas, fishing represents one of the most important and vital economic activities. Most inhabitants along the small coastal towns and villages of Saudi Arabia are fishermen. It is a traditional means of livelihood and has been handed down from one generation to the next. In Asir province, there are six major boat harbours: *Al-Birk, Al-Qahmah, Omog, Al-Moajez, Al-Nohod, and Dhahban*. These harbours have a total of 565 small boats; 341 are used for fishing and the rest are used for entertainment (UNEP 2010).

A decrease in the number of fisheries has been observed in the Asir Region as a result of water pollution. Fish populations have been negatively impacted due to discharges from the Abha and Al-Birk wastewater treatment plants and septic tank flow down the wadi into the Red Sea. In addition, overfishing and coastal degradation have impacted the quantity and diversity of fishes in the sea, which has also occurred in Tafilalet. This decrease in the number of fisheries has had a direct effect on the livelihoods of many fishermen. Many young fishermen have been forced to abandon their fishing jobs in order to try to find other employment opportunities.

Tourism

Tourism is a potential venue to boost economics and improve the quality of life in the case study areas. These areas are known

for their history, culture, natural richness, forests and harbours. The numerous wadis and exotic terrains are most appealing assets that can support a flourishing safari business and tourism industry if properly vented. This richness and diversity also allows the development of nature-based tourism activities such as hiking or riding, sportive fishing, nature exploring (fauna, flora and landmarks are still intact and virgin). However, the development of Tafilalet and El Maghara is largely ignored by their respective governments. These areas are losing their unique heritage and history that should be preserved as a means to generate employment opportunities and improve the economic and social situation of the areas. In contrast, in Asir National Park the development plans for tourism in the area have had negative impacts on natural resources and led to land degradation. Sustainability concepts, such as eco-tourism, rural tourism and green cities, therefore need to be incorporated into development plans in order to create win-win solutions.

4.3 NATURAL DRIVERS

Predicted climate change and natural disasters will make it difficult to reduce poverty and greatly affect any socioeconomic gains, as these events result in loss, degradation and spread of disease, which affect both humans and the environment. Climate change and natural disaster events play a key role in the migration of populations. People are forced to leave their homes in search of food, work and a way out of poverty. There is concern that as a result of environmental degradation millions of people will be displaced, leading to the formation of informal settlements in urban areas, such as slums and shantytowns.

Natural Disasters

Recurrent natural disasters occur throughout the Arab region as a result of changing geologies and increasing climate variations. The region is likely to experience higher temperatures, sea level rise, changing rainfall patterns, drought, desertification and increased climate variability. The 2010 Environment Outlook Report for the Arab region states that more than 37 million Arab people were affected and more than 20 billion dollars were lost between 1980 and 2008 due to natural disasters (LAS 2010). There is clear evidence that disasters have persistent, long-term impacts on poverty trends and human development (LAS 2010).

The Arab Strategy for Risk Reduction 2020 emphasizes the geological hazards that areas of the Arab region frequently experience, including earthquakes, volcanoes, landslides, tsunamis, floods, extreme temperature events, drought, sand storms, wildfires and cyclones. For example, the 2003 earthquake in Algeria, the 2007 Cyclone Gunu in Oman, the 2008 floods in Hadramoot, Yemen and the 2009 floods in Morocco among others, serve as a few stark reminders of emerging risk and frequent disaster trends in the region (LAS 2010).

Natural disasters are a challenge that Arab countries must be prepared for, particularly Morocco, which is vulnerable to economic

threats resulting from various types of natural disasters. It is estimated that the most serious of these could cause damages of up to 30 per cent of GDP, and affect 30 per cent of the population.

Climate Change

As one of the most vulnerable regions in the world to predicted climate change impacts, the Arab region faces many challenges. Climate change exacerbates and threatens to overburden areas and regions that are already fragile as a result of inadequate agricultural production, water scarcity, high groundwater salinity, spread of infectious diseases, threatened food security and biodiversity loss.

Climate change has increased the frequency and intensity of extreme events that already take place in the region. Flash floods, drought, and sea level rise are all events in the region that could be exacerbated by climate change. The rise in sea level as a consequence of climate change is expected to affect many of the densely populated coastal zones in the region. A one metre rise in sea level would affect an estimated 3.2 per cent of the Arab region's population.

The increased occurrence of these events has increased the deterioration of natural resources. For example, in Morocco, sand encroachment has greatly affected human well-being. This phenomenon affects human health, as well as the social and economic situation. There is an increased occurrence of eye diseases caused by particles carried by the wind. The social situation is impacted by the damage to important infrastructure, such as irrigation canals, roads, housing, as well as loss of agricultural lands. Moreover, the natural vegetal cover is currently at risk of degradation in many areas due to unfavorable climatic conditions. Economic losses as a percentage of 1.49 GDP would also be proportionally worse in the region, compared to 1.30 per cent worldwide (UNEP, CEDARE and LAS 2010). Climate change impacts in the Arab region are extensive and wide ranging, affecting many aspects of people's everyday lives.

CONCLUSION

Major achievements towards sustainable development have been realized in the Arab region since the Stockholm Conference, especially in the areas of education, health and improved standards of living. However, Arab countries continue to face many problems such as poverty, illiteracy, rapid population growth and water scarcity. The idea of sustainable development has been implemented and many efforts have been made to attain sustainability at the national and regional levels. Nevertheless, these actions have not been successful in achieving the goals of the Brundtland Report. Only the GCC countries are expected to reach the MDGs by 2015, although it is highly doubtful that this achievement will include environmental sustainability.

Arab countries depend on their natural resources for economic development for centuries. Accordingly, in order to realize

sustainable development in the region, there is a need to promote and encourage the awareness that the environment is a source of services that can improve human well-being. Issues of health, education, gender equity, and poverty need to be re-evaluated and new strategies developed that will adopt a multisectorial approach to sustainable development. Land and water resources deterioration should be better monitored, reduced, and rehabilitated. More attention needs to be given to the protection of biodiversity and coastal and marine resources. In order to attain these objectives, certain vital steps should be taken, including: stabilizing population growth and urbanization; providing equal access to social services for all social groups; ensuring the decentralization of power, building infrastructure and public services; improving access to information, education, and telecommunications; reforming the environmental governance structures; and providing equal access to environmental services for all. In order to attain these objectives a paradigm shift that understands that economic health depends on sustainability of the environment is needed.

Economic growth became a target for most of the Arab region, which is simply an increase in the production and consumption of goods and services. With the current economic growth ratio, if not well managed, environmental resources can neither be used sustainably, nor can human welfare assurance be achieved. Accordingly, governments are urged to integrate environmental issues into every sector through the adoption of sustainable development policies and programmes. Governments need to concentrate on equity at the local level by recognizing the different problems and needs of both urban and rural societies, and by increasing levels of public participation in sustainable development action plans.

Involving civil society, NGOs and the private sector would generate considerable results. Decreasing the development gap between rural and urban areas would limit rates of urbanization and its related problems of environmental degradation (CEDARE and others 2001). Sustainable development plans should also focus on decreasing the disparities at the regional, national and local levels by achieving "equity in health and resource distribution, and [respecting] the rights of citizens regardless of social, [political] or religious beliefs" (CEDARE and others 2001).

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CHAPTER 5

SCENARIOS

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Main Messages

Ecosystem deterioration in the case study areas is an outcome of a set of key drivers including governance efficiency, economic activities, and management of natural resources, accessibility, and available services.

The task of reversing the negative impacts of human induced activities and to make the transition to sustainability requires knowledge of consequences of various policy actions.

To understand the potential impacts of future actions it is important to analyze the complex social, economic and ecological process.

Analysis of future scenarios provides a structural framework for potential long-term trends.

The future state of the environment in the Arab region depends on the type of choices and actions that have or have not been taken.

Scenario Analysis is used to develop an understanding of the requirements to achieve sustainability. Exploring various future actions unveil the potential policy challenges.

Drawing future scenarios highlights the problem of ecological sustainability, recommends strategies, better transitions and leads to the understanding of the implications of each action.

Assessment of the driving forces has shown that in all scenarios economic activities will increase, increasing the chances for job opportunities and declining poverty rates. This decline varies according to the governance efficiency in implementation of laws and capability to solve issues. In the presence of economic activities, scenarios that are ruled by inefficient governance show a further degradation in natural resources, especially water, land and biodiversity. Social sustainability and human welfare only exists in scenarios with high governance efficiency and considerate investors.

5.1 INTRODUCTION TO SCENARIOS, AND DEALING WITH UNCERTAINTY

Scenarios are effective tools for evaluating environmental potential problems and suggesting best policies to resolve them. They provide a structured approach to address uncertainties and complexity of environmental systems. Scenarios can describe how the future may unfold, based on a coherent and consistent set of assumptions about key driving forces, their relationships, and their implications for ecosystems (UNEP 2005a). Scenarios also serve different purposes, such as support of scientific investigation and research, education, collaborative learning processes and decision processes and strategic planning.

Based on the Sub-Global Millennium Ecosystem Assessment reports, this chapter synthesizes the future scenarios of the three case study reports located in El Maghara, Egypt; Tafilalet, Morocco; and Asir National Park, Saudi Arabia.

The assessment aims to meet the needs of users and stakeholders in the areas in which they were undertaken. The areas are common in their richness of biodiversity and unique ecosystems that should qualify them to be declared as protected areas. However, due to uncontrolled anthropogenic activities, they have undergone changes and transitions that have affected their environmental integrity and well-being.

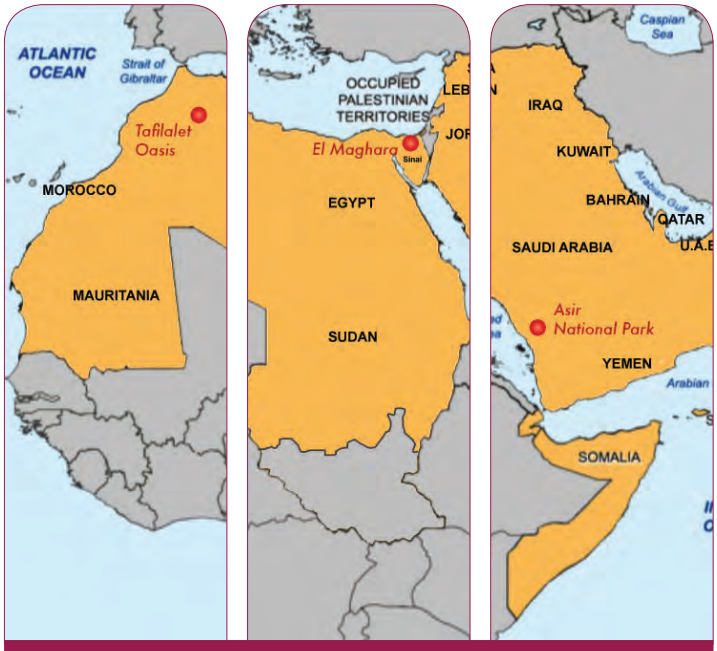

Figure 5.1 Locations of Assessments Sites

Source: Adapted from UNEP, 2010

5.2 METHODOLOGY USED FOR DEVELOPING THE SCENARIOS

The scenario process in the three case studies has provided an insight into the uncertainties that may be affecting the environmental setting and human well-being. In this case, scenarios were used as tools that decision-makers can use to set strategies, measure and look for opportunities, as well as allowing the key stakeholders and affected groups of the areas to express their views, hopes and misgivings. Issues have been clarified through the analysis of each case study per se, in a timeframe of 25 years.

5.2.1 Identification Of Key Drivers

The DPSIR analytical framework (see Table 5.1) has been applied for each case study based on scenarios depicted in each case study report. This was followed by a process of synthesizing the three case studies in order to establish the common issues and driving forces at the sites. This process was a key step in monitoring the possible relationship between issues, driving forces, pressures and impacts.

Through DPSIR analysis, the formulation of a scenario assumption matrix has been developed. This in turn has helped the evolution of the storyline for each scenario.

After narrating the storylines of each case study scenario, common issues, pressures and impacts have been gathered, marked and synthesized to give an overall vision on the situation of each scenario and the forces affecting it, giving possibilities and strategies in case of problem existence.

5.2.1.1 Key Driving Forces

1. Governance Efficiency

According to the UNDP definition, governance is: "The exercise of economic, political, and administrative authority to manage a country's affairs at all levels. It comprises mechanisms, processes, and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences".

According to the latter, poor governance is one of the main reasons behind the deterioration of environmental assets in any ecosystem. Poor governance has a negative impact on the social and economic situation of the study area and its inhabitants.

Government efforts to improve the quality of life for inhabitants in the study areas have been inefficient. Conflicts usually exist between inhabitants and existing set

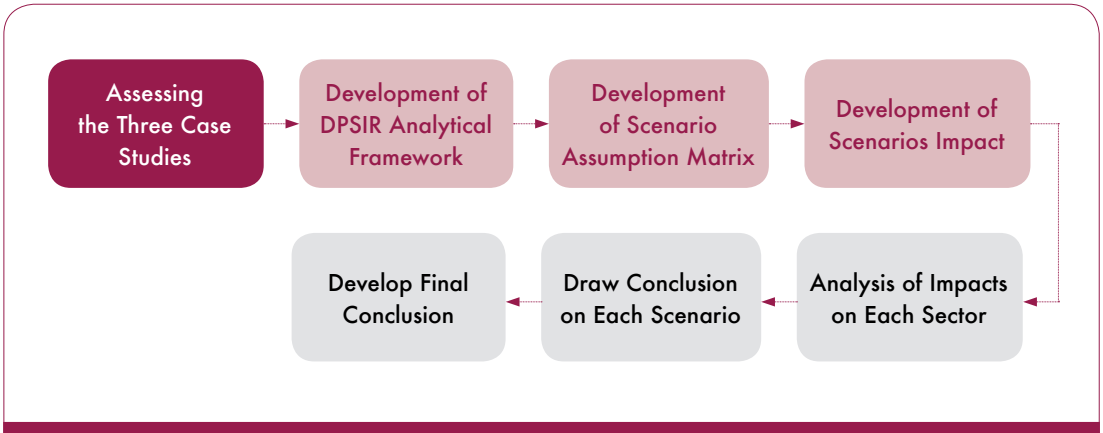

Figure 5.2 Developing Case Study Scenarios

of policies, as inhabitants usually accuse governance of allowing activities that destroy the environment and vulnerable natural resources, such as through quarrying, mining, massive land-use change and landscape fragmentation.

Inhabitants also blame governance for inadequate services and utilities that are far below their needs.

2. Economic Activities

The three assessments alike are endowed with considerable richness of natural resources that create real potential for development and investment. Following the trends of economic growth, intensive economic activities, in addition to social needs, might cause rapid urbanization and expansion of city patterns. The spread of such activities and the excessive extraction of

Table 5.1 Sample of DSPIR Method

Theme	Issues	Driving Forces	Pressure	State	Impact	Response
Human Activities	Extraction Activities Industrial Activities	• Poor Governance • Illiteracy • Mining and Quarrying activities • Unemployment • Uncontrolled human activities	• Resource depletion • Land degradation • Excessive waste	• Land change patterns • Solid waste random disposal (industrial waste)	• Heavy pollution • Habitat fragmentation • Biodiversity losses • Pollution • Land encroachment • High pollution rates • Biodiversity loss • Water shortage	
Social Services	Public Services Infrastructure	• Poor governance • Remoteness	• Lack of sanitation • Lack of potable water services • Inaccessibility of schools	• Poverty	• Promoted illiteracy rate • Negative health impact • Water shortage	
Water Availability	Water Scarcity	• Uncontrolled human activities • Nature of climate	• Depletion of water resources	• Lack of precipitation	• Negative health impact	

natural resources has exceeded regenerating rates and caused considerable damage to ecosystem integrity and the environmental setting. Major changes have taken place in the landscape and land topography.

3. Natural Resources

Environmental degradation is one of the core issues that mark the three assessments alike. It entails a number of attributes that include soil degradation, land-use change, water pollution, loss of biodiversity, and landscape fragmentation. Environmental degradation has a strong bearing on the quality of life of the inhabitants and contributes significantly to poverty, poor health and pollution problems.

a. Water resource

Water shortage is the main cause of the inferior quality of life in the area, with a profound effect on poverty, health, unemployment, and migration. Some of the study areas have witnessed a significant drop in rainfall in the last ten years. Much of the flashfloods that used to recharge groundwater is diverted to scattered pathways as a result of land-use change by gravel contractors constructing new roads and alleys to reach distinct rock sites. According to predicted climate change scenarios, it is expected that precipitation will be affected even further within the next few years, giving rise to a more complicated situation.

b. Land resource

The assessments show that land-use policies are not adequately enforced. The impact of loose land-use policies is strongly identified in the assessment areas. The growing demand for building materials such as gravel, stones, and marble has turned parts of the areas into open fields for quarries and mines. Construction of new roads is one other major manifestation of land-use change with many drawbacks.

With such massive violation of land-use plans, the landscape has been fragmented and dissected, with serious effects on biodiversity and other environmental richness. Inhabitants put the blame for the loss of flashfloods that used to recharge their water storage units and irrigate their fields on these changes in the landscape.

4. Remoteness

The assessment areas are mostly located in isolated remote areas. Transportation services are limited, irregular, and unreliable for the inhabitants use, with no telecommunication services available. Due to the nature of the climate, sandstorms often cover the existing roads with sand, making travel between the areas of study and other areas risky. Analysis show that remoteness contributes to the current social and economic situation of the inhabitants of the study areas.

5. Services and Human Well-being

Availability of basic services varied from one area to another, based on the financial capabilities of the country. With the exception of Asir in Saudi Arabia, the assessments of El Maghara and Tafilalet had a substantially inferior set of services. The basic services offered and their level greatly impacts the

economic and social situation and the attitude of inhabitants toward the surrounding environment and natural resources. Most of the basic services that are missing in such areas consist of electricity, water supply, health services, transportation and telecommunication. The poor service in the assessment areas is a determining factor shaping many of the scenario findings.

6. Education

The level of education varies from one area of study to another. Location, transportation and services offered to serve education are some of the factors that influence the level of education enrollment in the area. Nevertheless, it was mostly noticed that there was a high rate of illiteracy in the three assessments, with different ratios between men and women. It was also noticed that the level of education and awareness among the inhabitants had very strong impacts on natural resources and how they managed the surrounding environment. In some of the areas it was noticed that due to the cultural and economic situation of the inhabitants, girls were not allowed to attend schools after a certain age. Illiteracy among women is a crucial contributing factor to the mismanagement of natural resources, as women are the ones that most deal with natural resources in their daily activities, as well as being the future mothers to new generations.

7. Employment

The remoteness, poor infrastructure and mobilization of natural resources and economic activities by investors in some of the study areas have impeded efforts to promote economic development. Employment opportunities are hence very limited. The high rate of unemployment recorded in the assessment areas is a key factor that influences a number of attributes, such as poverty, migration, education and others. Moreover, unemployment, lack of proper services and isolation have forced many families and young people from the local inhabitants to migrate out of the areas looking for a better life and sources of income.

5.3 STORYLINE SCENARIOS

Moving Sand/Fox Scenario (Market Forces)

Table 5.2 Moving Sand/Fox Scenario (Market Forces) Scenario Assumption Matrix

Key Driving Forces	Moving Sand/Fox Scenario
Governance Efficiency	↘
Economic Activities	↗
Natural Resources	↘
Remoteness	↘
Services and Human Well-being	↗
Education	→
Employment	↗

The moving sand scenario is characterized by poor governance dominated by market forces, in which the main target is economic development and profit, causing environmental deterioration, poor social situation and short-term economic benefits. Substantial increase in economic activities, pressure on natural resources and social situation exist with clear negative impacts.

1. Governance Efficiency

In this scenario, governance is mostly dominated by business oriented groups, with strong lobbying toward a market economy. They are strongly backed by multinational organizations that have peripheral ties with decision-makers in major entities. Representation of local community in governing bodies is low, with major predominance of investors and businessmen that have a strong presence in the business media coming from outside the area. On several occasions conflicts have erupted between local members of the governing bodies and those from outside the area, mainly the investors. Conflictive views, particularly regarding sustainability of resources and environmental integrity were flash points. While local members are more inclined toward resource sustainability, investors have a different list of priorities, with profit and business opportunities at the top.

The presence of poor governance and absence of law enforcement in the study areas, coupled with the lack of proper monitoring systems on economic activities, have led to negative impacts on the ecosystem and human welfare. This has put pressure on natural stock and on the social situation, resulting in resource degradation, social crisis and conflicts.

2. Economic Activities

As a result of the economic vulnerability that exists in the region, people are very receptive to the kind of development that gleams immediate financial incomes. The areas have a high potential for economic development in terms of their richness in natural resources, unique traditions and culture which can attract local and international investors in industrial, agricultural and tourism sectors. Despite this richness, it is difficult to maintain sustainable achievement and competence in the local and international market, particularly with new emerging economic activities and technologies. These new ideas could only work on the patterns of profit collection without considering security standards, risk precautions and threats. However, it could lead to the improvement of the economic situation in the area.

Most of the newly established industries are based on using cheap labour and exploiting abundant natural resources of the area with no respect to sustainability. In this scenario, industrial practices are not based on sound sustainable and environmental codes. Serious environmental pollution problems emerge, causing considerable damage to the surrounding environment and ultimately leading to degradation of resources.

The growing industrial and economic activities in the area help create employment opportunities for the local people. Many labourers, mostly unskilled, find employment in the newly established facilities. On the other hand, skilled labour is mainly made up of workers brought in from outside the area from other parts of the country by investors, causing more pressure on the areas.

Two of the most market driven growing economic activities are tourism and agriculture. With regards to tourism, the number of services and support available to the tourism industry increases, creating high demand on land clearing for business development. With the booming tourism industry, sustainability is not always heeded. Pressure on land, water resources, and the natural environment and landscapes take place.

Tourism projects are established with the building of major infrastructures, which will raise capital and cause an increase in population growth and urbanization. This makes these projects unsustainable because the advantages that motivated their progress and development will eventually be eliminated by the tourism itself. For example, frequent shortage of fresh water, caused by the increasing number of tourists is one of the flash points between local people and the local council. Solid waste generated from tourists and tourism activities is also another flash point that causes a lot of tension between local inhabitants, local authorities and tourism industry representatives.

Water, landscape, lifestyle, local culture, traditions and indigenous knowledge, etc. are necessary ingredients for the subsistence of tourism in these areas. If these ingredients disappear the purpose of these projects will disappear as well. With no control and poor governance, the increasing number of visitors results in an increase in the pressure on local environment and hence to an increase in the rate of environmental degradation.

The growing demand for food, coupled with the long experience of local inhabitants and the suitability of environmental conditions, favor business opportunities in this field. Businessmen introduce new inefficient technologies to agricultural practices that fulfill the local, national and international market needs with an easy and quick profit, but in an uncontrolled manner which negatively affects the environment.

The use of cheap and inefficient technology causes deterioration in the quality of agricultural products and increases health risks. Heavy reliance on pesticides and fertilizers causes high levels of groundwater pollution and serious effects on wildlife in the area. Frequent incidents of dead animals are reported, presumably after being exposed to highly toxic pesticides. Use of polluted water for irrigation has negative impacts. Most poor areas use untreated wastewater as a main component of water source; as a result, problems of soil contamination appear.

Moreover, this transition from a traditional food production system to a commercial production system requires water and

agricultural inputs to be maintained. This will certainly generate an immediate income, but will not be sustainable in the long- term, as the use of inefficient new technologies in agriculture wastes a large amount of water as well. In some cases new efficient technologies can be a good method for water conservation as was the case in Tafilalet, Morocco, where the use of traditional irrigation methods was one of the driving forces of water scarcity.

There is an exploitation of agricultural lands through the intensification of cultivation and excessive pumping of water resources, which cause soil infertility due to the increase of salt content. It has also led to the shortage of water due to excessive exploitation and use of inefficient irrigation techniques (gravity system).

3. Natural Resources

In this scenario, interest in environmental sustainability is not high on the agenda of investors. Instead, use of natural resources is governed by commercial and marketing laws.

Extensive use of groundwater results in serious salinity problems, which affect water quality and quantity. Seawater intrusion is one of the major issues in some parts of these areas, with frequent complaints from growers using this water for their crops. Signs of desertification are quite conspicuous in various parts of the study areas.

Lack of a sound enforced land-use plan has led to severe fragmentation of the ecosystem, with many drawbacks on species abundance in the area. Population densities of main endemic species dwindle, allowing a number of alien species to flourish. Industrial waste is not properly managed, with a large amount of hazardous waste infiltrating to groundwater causing alarming water pollution problems that are reflected on inhabitant health and well-being.

In this scenario, local inhabitants use natural resources to augment their nutritional needs, for domestic purposes and as medicinal material that inhabitants use as local medicine. The extensive damage to the environment and changes in land-use pattern that are caused by some industries change the floral construct of the area. A number of the local plants have nearly disappeared, while a number of alien species have flourished. The grazing industry is one of the most affected by invasive species, mostly unpalatable, and sometimes toxic. Many grazers are laid off, seeking jobs in the new facilities.

The impact inflicted on natural resources is heavily reverberated on the well-being of local inhabitants. Inhabitants tend to use ecosystem services and goods as integral components to fulfill their needs. Deterioration of these goods and services badly affects those inhabitants whose many needs are not attained.

In return, locals adapt an even harder stance toward the environment, as if they are trying to make up for the losses they encounter, and the damage to the existing natural resources becomes even greater.

Under the moving sand scenario, the demand for natural resources increases. As stated above, natural resources fulfill inhabitant needs as well as the demand for economic activities, which are most probably double the inhabitant consumption. This places natural resources in a vulnerable situation as they are also vulnerable to the climate. These natural resources are trapped by anthropogenic and natural forces.

Land and fresh water are considered the most vulnerable natural resources and are greatly affected by these activities. Expansion of economic activities raises the demand for land for new projects, food production and housing, which results in diverse negative impacts. Degradation and desertification are increasing through poor agricultural practices, overgrazing, uncontrolled land-use pattern conversions, and rapid population growth/urbanization as was the case in Asir National Park, Saudi Arabia. Economic activities have greatly accelerated urbanization, which has put pressure on forests and lands, resulting in the change of land-use patterns, and accelerated land encroachment. Land quality is deteriorating due to excessive extraction, as was the case in El Maghara, Egypt. The increase in demand of agricultural lands and products for market and domestic use influences the quality of soil as a result of intensified agricultural activities. Land is impacted naturally by events, such as droughts and flashfloods.

Water is influenced by the land-use changes created by economic activities. Construction of roads changes the underground water flow patterns that were traditionally known by the local inhabitants due to pressure from heavy trucks. The increase in economic activities leads to over-pumping of underground water which causes water shortage. Contamination of water by disposal of waste on land and water bodies also occurs. Water scarcity becomes one of the factors that might limit development in the future. The competition over water from various sectors, especially the agricultural and industrial sectors will increase. However, it will have its direct influence on the amount of potable water used for domestic use.

Deterioration of environmental assets has resulted in serious environmental impacts, such as: landscape fragmentation; loss of habitats and floral and faunal biodiversity; soil compaction as a result of heavy truck movement; air pollution from dust and other particulate matter deposited on plants; contamination of groundwater with extracted materials; and loss of flashflooding. It also affects water resources due to unlawful exploitation in some of the industrial processes, including the cooling and washing of hardware. A number of cases are reported of the solid waste generated from industry being dumped into water bodies

Housing facilities for the employees of new industries are built with no consideration to land-use pattern and environmental setting.

4. Remoteness

In this scenario remoteness of the areas will decline. Roads and all communication methods are available to serve the new

emerging activities. Regular transportation services are established to link the area with major cities and centers in the vicinity.

5. Services and Human Well-being

Services are among the major sectors that thrive in this scenario. With the growing trends of investment and industrial development, a boost in some related services is evident. Investors have laid down some medical care units in the area to provide services for those affiliated to the several industries established in the area.

Moreover, local inhabitants have an open access to these units. A number of banks have opened in the area, mainly to serve industry and investors. On the other hand, some other services are not part of this improvement boost, particularly education as it does not resonate with the interests of business and businessmen.

Economic activities will introduce new activities and technologies to the areas, which will bring about an improvement in the economic situation. This will broaden the knowledge of inhabitants and will cause a shift in perception regarding newer technologies, particularly in the younger generation.

Basic services such as clean water, sanitation, healthcare, education and job opportunities will improve as they are essential to sustain economic activities and attract investors. Transportation will be available, but accordingly air pollution and higher energy consumption rates will occur.

Deterioration of environmental assets as a result of increasing extraction of natural resources causes municipal problems, such as solid waste random disposal and sewage surfacing.

6. Education

In addition to the fact that schools are not equipped to meet current advances, pupils also frequently have to travel long distances to get to school. Also, as part of traditions and norms, families do not allow females to become educated past primary level. This results in males vastly outnumbering females in schools. Under the moving sand scenario, education will generally improve and illiteracy will decline in some of the study areas.

For example, In the case of Asir National Park, Saudi Arabia, education is an opportunity for investment. With endowments of new technologies, young people growing up in the area will be more interested in further studies overseas or in local cities, rather than become involved in the agricultural or forestry industries like their parents.

In Tafilalet, Morocco, literacy will increase with the increase in income of local people and the initiative of human development funds. Unfortunately, this is not the case in El Maghara, Egypt, where government members are businessmen that concentrate on profit and market development. Education remains an inferior priority and schools are far from meeting the growing number of pupils who still have to travel a long distance to neighboring villages.

7. Employment

Under the moving sand scenario, unemployment situation will generally decline. Employment opportunities will be available. Migrants will come to the area in search of available job opportunities. Unemployment will not be a social and economic problem. Young people will not be interested in traditional jobs and crafts, and career goals will be directed more to market demands.

Despite the high rates of employment observed in the areas; labourers are denied many of their basic rights, including proper health insurance and pension schemes.

Conclusion

Widespread environmental degradation resulting from intensified economic activities have caused severe problems, including air and water pollution, bad sanitation, unsafe disposal of solid waste and poor lands creating poverty. This has resulted in large increase in diseases. Not only are human beings affected by the environmental degradation; livestock, fish, and the whole ecosystem will be in danger as well. In contrast the spread of economic activities had increased the changes of job opportunities with a slight improvement in some social services and a decline the areas' remoteness.

Desert Tortoise (Policy Reform Scenario)

Under the desert tortoise scenario poverty and illiteracy continue to be a problem. It is expected under this scenario that application and enforcement of laws will have a slow, gradual and positive impact on the economic, social and environmental situation. Limited interventions are implemented by the governance through public awareness campaigns and education initiatives without any strong policies in place to protect ecosystem services. Nevertheless, the negative impacts will slowly decline.

Table 5.3 Desert Tortoise (Policy Reform Scenario) Scenario Assumption Matrix

Key Driving Forces	Desert Tortoise Scenario
Governance Efficiency	
Economic Activities	
Natural Resources	
Remoteness	
Services and Human Well-being	
Education	
Employment	

1. Governance Efficiency

In this scenario a large and strong representation of local inhabitants in governing bodies is unprecedented. The strong influence of local inhabitants in the

local council has significant impact on the decision making process, particularly in issues related to maintaining sustainability and environmental codes.

Governing bodies place special emphasis on local knowledge and its role in running daily life. A special committee for environmental sustainability is set by the local council to keep an eye on relevant issues including land-use patterns and natural stocks.

The council establishes some working connections with a number of national and international bodies in the field of environmental sustainability, inviting some of the head figures to visit the area seeking their guidance and support. Under the auspices of major NGOs, the local council launches a successful nationwide campaign to salvage the environment of the area, asking donors for contributions and support.

Governance is giving an outstanding example of how to go forward, with efforts to help local inhabitants attain a reasonable standard of living, strengthening environmental sustainability ethics and practices. Public awareness and resulting pressures from locals is at a sufficiently significant level that forces the government to take notice, develop capacity building and training programmes around sustainable management. Governance is playing an effective role in ensuring the participation of all sectors of the community based on equity and sharing responsibilities to encourage inhabitants to play their participatory role at area level.

2. Economic Activities

Industry is taken up by the private sector in a sustainable manner. Foreign investors are encouraged to take part to provide the necessary cash, expertise, and access to the global market for the growing industry. Governorates have taken initial steps to set and enforce the implementation of environmental laws, as a part of its reformation strategies. Industrial pollution does not come under full control – some people still manage to get away with "dirty" industries. It will take a while for people to understand that protecting the environment is not for the sake of their governorates, but for their own and future generation's sake. The local council has allocated an area as an industrial park, in which all industrial facilities are situated. The park, located on the outskirts of the area is divided into different zones, each for a particular type of industry, with strict regulations regarding emissions, waste and their management.

The governmental initiative has made a change in the attitude of industry toward the environment, and has helped them adopt sustainable production programmes, protection of biodiversity and maintained ecosystem integrity. For example, sustainable ecotourism and medicinal plants industry have been enhanced as a main source of income.

The Arab region started focusing on presenting its distinct tourist attractions in such areas. Strong regulations are applied to ensure that local travel agents provide

the best service to the tourists, good roads, and more business opportunities, taking advantage of the increasing number of visitors and holidaymakers. Nevertheless, inconsiderable acceleration in tourism increases the degradation of natural resources.

3. Natural Resources

In this scenario natural stocks are considered one of the major priorities of the governing body, who spare no efforts to maintain their sustainability and integrity. A set of laws and regulations introduced and enforced by the governing body pose a potential leverage to restore the quality of natural stocks in the study area. In order to face water scarcity and seawater intrusion, the governing body introduces a water metering system to limit irrational use of groundwater. A special quota for inhabitants is allowed based on their family size and land tenure. Governorates in the Arab region are taking initial steps towards improving water storage facilities, supervised by medical staff to ensure a reasonable quality of drinking water. Governance is making good use of the cooperation of the private sector in sponsoring the installation of some water desalination units attached to major water sources to be distributed equally to inhabitants.

Groundwater abstraction is controlled and water re-use is abandoned and is replaced with water recycling. Water use rationalization will gradually increase with the increase of law implementation and governance monitoring.

Plans are prepared for the rehabilitation of the agricultural system, which is the main water user. The water use efficiency in the agricultural sector is closely monitored. As a result, less agricultural drainage water is generated, reducing pollution to water bodies.

The council takes the initiative of building a number of small dams and water storage facilities to help harvest flashfloods. In addition, a number of specially designed structures are built as intercepting bodies to slow down flashfloods, allowing water to percolate and feed aquifers. Much of the information related to the location of dams, water storage facilities and intercepting structures is based on the views and knowledge of local inhabitants. Equally important are council efforts to prevent water pollution. In this respect, industries working in the area are selected on the basis of their environmental impacts. Industries are encouraged to adopt a cleaner production scheme to minimize their environmental impacts. Industries abiding by such sustainable codes are granted special privileges. Overgrazing is one of the practices discussed in the local council meeting and it was agreed to limit the number of herds according to the suggestions and views of local chiefs. Similarly, extractive industries are limited to licensed areas that do not have violations of land-use pattern.

Sustainable land-use patterns which bring several advantages locally are observed, including good harvesting of flashfloods and

the elimination of pollution sources, as well as sustainable use of extractive materials. Such sustainable exploitation is bound to maximize the area's reserves, adding more potential and longer exploitation. On the other hand, tourism is on the rise, bringing in more people, but with decreasing support for maintenance and management. A population increase per year results in an increase in the number of visitors and job seekers. Thus, conservatory land degradation should occur in proportion to the number of visitors to it. While no direct intervention occurs, local inhabitants tend to police themselves and visitors as well, so that negative impacts are reduced.

The governing council, with the help of some international bodies, converts large areas into protected areas. Special arrangements are made to keep a herbarium that represents major dryland floral species. The protected area and its attached herbarium have proven to be an attraction that hundreds of university students and specialists visit regularly. The protected area and the revenues generated are a major source of income that is reflected in the improvement of the infrastructure and services of the area.

Under the desert tortoise scenario, restriction and conservation of the use of natural resources has gained positive impacts. For example, Egypt's restrictions on land-use, enforced by city council is an important factor that maintains pattern, helping the Bedouin collect flashfloods to make good use of them for agricultural and domestic use.

4. Remoteness

Remoteness has declined with the improvement of transportation due to the presence of the industrial sector. On the other hand this causes an increase in air pollution levels, increase in energy and fuel consumption rates and changes land patterns, which has a direct connection with the change of underground water patterns.

Under the umbrella of sustainable industry, transportation is improved and job opportunities are created. However, it does have some negative impacts that should be considered during the industrial plans. Transportation is improving, with the increase of economic activities and tourism, which have allowed the areas to have connections between neighbours, eliminating the feeling of marginalization.

5. Services and Human Well-being

In this scenario, public services and human well-being are at the top of the governance agenda. However, with the notably limited public funds set for services, the council has favored a self reliance scheme to help improve services and the quality of life.

An agreement with industries operating in the area is made, whereby industries open their medical centres to receive local inhabitants, providing them with needed medical care free of charge. Industries also contribute in providing schools with basic materials needed for sound education, as well as providing some pupils with jobs during summer holidays.

Industries operating in the area assign some seats on their buses to serve the community traveling to nearby cities where buses travel to bring workers. This service allows local inhabitants to travel to major cities in the area, and helps the locals connect with a wider community.

As a result of the awareness campaign run by governance, the local population and those involved in preservation begin to raise awareness about degraded resources and start campaigning about natural resource erosion and natural products. Inhabitants that are affected by the deterioration start to become aware of the decline in their practices; this encourages local leaders to negotiate with the government to reinforce effective policies.

6. Education

Education plays an important role in this scenario. Education has improved through the initiation of a number of temporary schools and healthcare units that are constructed using local pre-fabricated materials until permanent buildings can be built. Inhabitants that were reluctant to send their young boys or girls to far-off schools now feel comfortable sending them to nearby schools.

The increased number of schools and pupils has raised public awareness to a great extent. Schools are used in the afternoons, after school hours, as illiteracy eradication centres, and introduce relevant subjects, such as environmental awareness, and health and safety issues. Literacy rates are expected to double, reaching a level almost similar to that achieved in the best case scenario.

The tourism industry is given special emphasis as one of the most successful fund generating industries. A one day trip programme known as Know the Desert of Your Country is marketed in the schools and universities of Egypt. Students from various parts of Egypt can come to the area for a one day visit and are introduced to the desert environment. Students can spend the day watching desert birds, visiting oases, and studying vegetative covers and wild plants.

7. Employment

The governing council starts some vocational training of local inhabitants qualifying them as rangers guiding tourists visiting the area. Small loans are provided through a special scheme to small businesses and are used by a number of young inhabitants to start small business based on local products such as medicinal plants and olive oil, as well as other small industries. The scheme opens up ample venues for employment, particularly for young women who are employed for the manufacture of home based products such as scarves and other local handcrafts. The local council has reached an agreement with industrial facilities, whereby each facility would employ a ratio of its labourers from local inhabitants. Local employees are provided with technical training and capacity building that matches the type of industry. This scheme has worked out nicely with

direct influence on employment records and community income. In addition, industries are encouraged to have venues for their products in the area, sold at special prices.

In terms of employment, the prosperity of the economy generates more employment prospects, reduces unemployment or at least keeps it from increasing. The amount of poverty will slowly and gradually decline, but will not be completely eliminated yet, and internal conflicts and instabilities calm down as living standards improve.

Conclusion

Generally, the situation will improve in some social aspects and will deteriorate in others, and this will be a result of anthropogenic activities that are in the process of being improved. Air quality has deteriorated in the areas as a result of transportation and industrial emissions. A slight improvement in access to safe drinking water and sanitation, the improvement of the economic situation and higher average family income will give a chance for more people to afford to buy medication. There is an overall improvement in the health conditions of people.

In contrast, the existing percentage of poverty will have an adverse impact on natural resources and may also lead to social problems. One of the forces that cause the persistence of poverty is population growth, which has an impact on water consumption that affects the availability of water for agriculture. This forces inhabitants to augment available water resources by overuse of groundwater. A series of problems due to groundwater overuse are observed, such as salinity, invasive species and others. Environmental awareness on the part of the inhabitants puts pressure on governance to intervene and enforce policies to solve these issues.

Dunes/Scorpion Scenario (Fortress World Scenario)

Table 5.4 Dunes/Scorpion Scenario (Fortress World Scenario) Scenario Assumption Matrix

Key Driving Forces	Dunes/Scorpion Scenario
Governance Efficiency	↘
Economic Activities	↗
Natural Resources	↘
Remoteness	→
Services and Human Well-being	↘
Education	→
Employment	→

Under the dunes scenario there are fears that the presence of inefficient governance, weak implementation, absent public participation and natural resource mobilization by investors, will lead to economic, environmental and

social problems, increasing the vulnerability of the poor. In this scenario the investors do not have a clear presence in governance, but they take full control of the political, institutional, and legal systems by paying bribes and through strong connections with authoritarians and governing bodies. This affects the inhabitants by depriving them of any rights in using their natural resources and generating profits for survival. The main focus is not on achieving sustainable economic development but on making large personal profits by tapping into natural resources for the investors own benefits without considering sustainability.

1. Governance Efficiency

Laws related to natural resource management and environmental protection are not fully implemented, resulting in overexploitation of natural resources and biodiversity losses, to the benefit of investors' own businesses and profit. The strong, mutual relationship between authoritarians and investors will leave no room for any plans for maintenance, follow-up and resource conservation to be implemented. Governance officials lose their accountability as corruption spreads among them.

The authoritarians live in protected enclaves with the investors and take full control of resources. They deprive the impoverished majority of the benefits of their own natural resources, and leave them with very few options, as well as with a sense of disappointment and isolation. This has its impact on the social and economic situation of these areas, which will increase the level of poverty and illiteracy of the inhabitants keeping them from knowing their rights.

2. Economic Activities

The investors, which are a minority, take a much larger share of the profit than the poor majority. Most of these businesses are run as monopolies for an individual's own benefits. This affects the areas and the countries' economic position, as well as incoming revenues on the national and international levels as there is no true competition in the local or global markets.

Investors do not necessarily live in the same areas as their industries, so they do not develop a sense of belonging to these areas in order to offer clean industries. People in poor areas fight for any work opportunity, irrespective of the associated risks to their health and the environment. This not only takes place at the national level, where polluting industries are moved from one area of a country to another, but also occurs across the region, as many Arab countries welcome harmful industries from foreign countries, without considering the health risks to citizens.

Industrial demands take higher priorities over agricultural and communal demands, despite the fact that agriculture consumes more water than industry. As a result, the stress on agriculture to produce more food from lower-quality land and less water, affects the quality of food and its security. It is observed that with the increase of industrial

activities the population also increases, which increases the demand for food production, land and water.

Moreover, it affects the opportunity to get food products into the national and international markets as a result of remoteness and low quality, which makes local products less competitive. For example, in Tafilalet, Morocco, the quality and quantity of produced dates decline due to 'Bayoud' disease ravaging the best varieties of dates. This puts food security and the economic situation in jeopardy.

With the introduction of western culture and ideas to the areas, and with the presence of greedy governance that does not preserve historical places and attractions, the poor realize that there is not a chance to live on subsidiary tourism-related activities. Their hopes vaporize as tourist attractions rapidly deteriorate causing a large decrease in the numbers of tourists visiting. Increased security risks, internal conflicts and instabilities also aggravate the problem.

3. Natural Resources

The lack of good governance and regulatory body follow-up and control, has allowed the expansion of activities even in the most ecologically sensitive areas. Conservation areas have been badly affected, with many trees uprooted and cut to be used for fuel. This has caused the deterioration of environmental stocks, resulting in economic and human welfare problems, such as loss of flashfloods and plant cover, abandoned agriculture, fragmentation, loss of biodiversity, land degradation and species disappearance.

Accordingly, land resources deteriorate very rapidly, particularly agricultural land due to the over-use of fertilizers, pesticides and the lack of care and interest. Moreover, rangelands suffer from overgrazing which results in loss of plant biodiversity and promotes the phenomenon of desertification and sand encroachment due to the loss of the vegetation cover.

Water resources have also been negatively affected by overexploitation. The excessive pumping of groundwater has caused blight of palm groves, which has impacted the production of palms as one of the most popular agricultural products of the Arab region. Overharvesting of groundwater is turning the groundwater saline, and is increasing seawater intrusion, causing soil degradation and introduction of some invasive species that live in saline groundwater. In addition, some rare plant species may disappear as a result of severe drought and overuse. Loss of plant cover will cause a major loss of grazing activities and products which help to improve the local economic condition.

4. Remoteness

Remoteness of the areas will slightly decline. The industrial activities owners constructed roads serving their factories with specific road patterns without considering the inhabitants needs for traveling to other cities.

5. Services and Human Well-being

Public health, basic services, human and infrastructure development are among fundamental issues neglected by the investor-controlled governments. Monopolies and privatization systems have made the price of services too high for the poor, who are therefore deprived of basic services and results in an increase in the migration rate of the locals. With regards to health, malnutrition, poor hygiene, water-borne diseases, lack of drinking water, poor sanitation and basic hygiene have deteriorated health conditions. Considering the inadequate hospital facilities and the lack of preparedness to meet such emergencies, a high possibility of communicable disease outbreak and child mortality increase seems possible. Moreover, air pollution caused by massive industrial activities in the areas is resulting in widespread pulmonary disease among the local people.

Farmers cannot afford to adopt modern technologies due to poor economic conditions. Crop production from marginal lands with low-quality water increases the production of crops that are unsafe for human consumption. The problem shows its effects as deterioration in public health and reduction in exportation of agricultural commodities.

The population growth has resulted in unorganized urbanization leading to very large numbers of people living in unhealthy accommodations without a safe water supply, sanitation, or the rest of the basic services. The deterioration of services has strong repercussions on social aspects, culture, security, and gender issues. Women have the heavy burden of managing the family's affairs under much hardship. Fetching water, plants for food, fuelwood, as well as managing grazing activities are more difficult under the circumstances.

As a result of this intolerable situation, migration of many of the inhabitants of such areas to other regions or abroad is observed. This migration contributes to the abandonment of traditional practices which results in the loss of local know-how, through lack of young people succession.

The gap between the rich and the poor widens, creating more social tension. There is an increase in the loss of cultural identity as investors increase exposure to the West and change consumption to that of a western-style culture, while the poor stick to their traditional cultures.

The lack of basic services, in addition to poor governance, has contributed to breaking social harmony and communications at the tribal level. It has also influenced relationships among tribes and between the whole tribal community and local authorities. The relationship among individuals in each tribe is strained because of the dominant hardship and harsh competition for food, water, and other resources. Unrest between tribes develops to a pan-community unrest in which tribes confront governance represented by police. This will drag the area to bleak uncertainty, with possible eruption of violence.

6. Education

The deterioration of education is increasing. Due to the small number of schools and socio-economic conditions in the areas, inhabitants stop sending their children to far-off schools, and do not allow girls to continue schooling beyond the primary level. Not allowing girls to go to school after a certain age increases the level of illiteracy within the society. Illiterate mothers fail to provide an enlightened and healthy childhood to their children. Illiteracy, as well as the number of school leavers, is increasing. Under this scenario, a growing and alarming level of illiteracy in such areas stifles all efforts to improve the quality of life and to enhance people's economic profile.

7. Employment

Investors misuse the poor as cheap labour while making large profits at the expense of deterioration of the environment and resources. Apart from those who work for the elite, the rest of the poor public live below the poverty line in increased marginalization. Professionals outside the investors closed circle can hardly find appropriate jobs.

The poor try to create job opportunities legally or illegally; they subsist on poor agricultural practices, grazing and local trading among themselves. In some cases inhabitants may even resort to growing and trafficking narcotic plants due to growing feelings of hardship and discontent. Narcotic plants bring some extra money to the area, much of which is used to buy arms for use against the police force, pushing the area to the verge of open conflict.

The spread of illegal activities on the part of some encourages drug dealers from other parts of the country, which adds more uncertainty and challenge to the area. The repercussions of poverty in all its dimensions are significant. Another example of illegal opportunities is present in Morocco.

A begging phenomenon is developing among children, which reduces the quality of tourist attractions in the region. While in Egypt the majority has succumbed to their destined fate, with their grudges and pains. However, a minority group of young Bedouin have developed a religion-based cult that allows the use of violence to address the poverty and injustice they feel.

Conclusion

In general, living conditions are precarious, but are more serious for women who are charged with the burden of production and reproduction works. The illiteracy rate in females is higher than that in males, which makes the situation for females more precarious with negative impacts on living standards, health and social life. The situation is not sustainable as the poor majority seeks to show their rejection of it. Internal conflicts spread.

The different cultures and traditions prevailing in the areas in comparison to those in all other parts of these countries have deepened the feeling of alienation and allowed a barrier between the officials and the locals, making communication difficult. Poverty is increasing in a context of non-application of laws and regulations.

Gazelle Scenario (Great Transitions Scenario)

Table 5.5 Gazelle Scenario (Great Transitions Scenario) Scenario Assumption Matrix

Key Driving Forces	Gazelle Scenario
Governance Efficiency	
Economic Activities	
Natural Resources	
Remoteness	
Services and Human Well-being	
Education	
Employment	

This scenario is an illustration of how big hopes may come true. Inhabitants, governance, environmentalists, and industrialists all have the same positive influence on critical issues, such as land degradation, water scarcity, poverty, bad services, and others. There is an economic paradigm shift from that of economic growth to the one of economic development that considers other economic sectors besides the industrial sector, such as the agricultural and tourism sectors.

1. Governance Efficiency

Equity is defined as having the same opportunities in life. To achieve this goal there is a need to have efficient governance and good services. All actors work in stimulating economic growth while maintaining environmental sustainability.

In this scenario most of the marginalized areas in the Arab region gain their welfare and rights through their representatives and governance. A newly formed government that puts special emphasis on marginalized communities with representatives of inhabitants in parliament proves its success. The government puts effort into providing good services to the area. The local council is reformulated, with new members representing all stakeholders. The council adopts policies and strategies to improve infrastructure and secure the needs of newly emerging companies and activities. Institutional reforms take place to support the newly evolving governance. Corruption of officials and employees is no longer a phenomenon. The governance operates in a transparent way. Many pieces of information that were otherwise inaccessible are made available to the public.

2. Economic Activities

The core of progress synergy is having all stakeholders striving to separate economic growth from environmental degradation, with a focus on environmental integrity through transparent policies, and switching the economic growth paradigm to one of economic development. Industry representatives donate money to start the service upgrading scheme.

Improvement of services includes the provision of clean water, electricity, schools, and communications facilities such as telephones and transportation.

Governance makes use of all aspects to diversify and boost economies, and industrialization is at the core of economic development. The presence of favourable conditions in the areas, such as skilled labour, natural resources, internal stability, consistent and transparent governments, and strategic geographic locations help to attract investors to the areas. Tourism and agriculture that were previously neglected are given a role in the economic development stage, using all their help and native knowledge.

The assessment areas have great assets for the progress of touristic activities, such as their architecture, cultures, traditions, native rituals and virgin appearances. These areas are still not affected by the technology and globalization that are highly noticed in cities. This creates a great chance for promoting eco-tourism.

Plans and strategies are formulated to ensure the conservation and development of tourism. Restoration of deteriorated and damaged historical sites is carried out with aid from specialized international organizations. Careful utilization plans are drawn up in order to ensure that these historical sites are not affected by tourist activities.

Considering tourism as an income source for the inhabitants by using the local workforce gives the locals a sense of belonging to the tourist activities and creates job opportunities. This helps in the conservation of historical places. Governance also creates strict laws and penalties against any individual who causes any destruction of these premises and protected areas.

The transition also changes perceptions regarding agriculture as being just a source of food into a profession that needs to be developed and enforced in the economic plans for these areas, particularly that these areas are specialized in special kinds of crops and agricultural products, such as palms (which are common in the three study areas), and medicinal herbs, such as in Morocco. The government works on promoting agricultural and irrigation practices. This takes place through the study of local know-how and traditional practices, making the best out of it by developing any drawbacks with the use of up-to-date efficient and effective technology. Referencing to local know-how and traditional practices gives the local inhabitants a sense of belonging to the introduced techniques and a reason for the change.

The traditional role agriculture plays changes, as farmers change from growing subsistence crops to growing cash crops. Agriculture extension is strengthened and takes a leading role in farmers adopting modern irrigation techniques, replacing chemical fertilizers and pesticides with biological types, growing new crop varieties which are more tolerant to climatic changes and pests, and economizing irrigation water use. Drainage water re-use is abandoned

for water recycling. Strong laws governing the safe use of groundwater in irrigation are introduced and enforced.

Public and private partnerships take place in this economic sector as crops grow and factories are built to accommodate and filter crops to be packed and introduced to the national market. There are future plans to introduce these crops to the international market as well. Job opportunities are created for the local inhabitants and future generations to come.

3. Natural Resources

There is exceptional attention on the environment by the governorate and inhabitants. Land and water are given the highest priorities as being the most threatened resources. Unsustainable use of these resources is gradually replaced with sustainable management procedures.

In light of this scenario, it is expected that the areas will be short of some resources. The most vital of these resources is water, the main source of life. Being aware of this reality, the areas are taking sufficient measures to ease the problem.

Integrated water resources management is the primary solution adopted. It is implemented within the necessary legislative and institutional frameworks. Mistakes are learnt from faster, leading to more efficient implementation.

Improving the quality of water bodies is systematically translated into similar improvements. The water quality of lakes and coastal areas noticeably improves leading to healthier biodiversity; in some cases, by treating water bodies through filtering systems for the removal of many waterbourne pollutants. With the help of academicians, simple and cost-effective treatment facilities are devised and approved. The whole ecosystem shows symptoms of recovery after long deterioration.

Despite increased industrial activities, industrial waste is not allowed to be disposed in water bodies. The same precautions are applied to agricultural drainage, which is reduced in quantity and improves in quality as agricultural practices improve. Waste management procedures are introduced for dealing with household and other solid waste. Sewage water is properly treated before being disposed of or used for agricultural use.

Awareness campaigns play an important role in the current scenario situation, arranged by specialists to explain how to use water without being exposed to the high risks of contracting waterbourne diseases.

Legislation and laws are designed to improve land-use and tenure situations. Strict implementation of laws takes place regarding land-use for agriculture or building purposes, to ensure food security and public accommodation. The use of land for agricultural purposes is classified according to the kinds of crops and season, in order to improve the quality and fertility of soil and the quality of products. Land tenure laws are improved and changed from the traditional

inheritance customary laws that were well known between tribes, into governmental registered lands. This gives inhabitants legal rights to land tenure and avoids land ownership disputes.

Buildings for any purpose are not permitted except in the designated areas. An urban planning scheme for the areas has been made by urban planners and engineers to divide areas according to land-use, taking into consideration different aspects of risk prevention according to sustainable development criteria.

4. Remoteness

There was a significant decline in the remoteness of the areas. The Governance along with the private sector had worked to upgrade the and improve the roads networks, transportation methods and methods of communication. These improvement plans had given the areas further economical opportunities and an upgrade to the inhabitants welfare.

5. Services and Human Well-being

Development plans for services had taken place to improve the quality of life for the inhabitants and to promote investment opportunities in the areas. Improved water supplies, sanitation, and air quality show direct impacts on public health. Houses have access to clean tap water for the first time. Sewage water is collected and treated through a biological system which makes it re-useable. The impact of utility service improvement on health and welfare is significant, and is easily reflected in the decreasing number of child deaths and good control over the spread of communicable diseases. Awareness raising campaigns for personal hygiene are held by governance and multinational organizations. These campaigns play an important role in preventing health risks especially with the high rates of illiteracy among females at different age levels.

6. Education

There is an active action from the educational public sector to improve the quality of education given to children and eradication of illiteracy in older inhabitants. Governance works on easy access to schools, as new schools are built, with major contributions and funding from government bodies and the private sector. The flourishing economy has allowed more people to educate their children. Good education and knowledge pay off in making people much more aware of their local environment. A higher technology institute has also been founded that provides training to local students in fields of interest that would benefit the area, such as tourism. The literacy rate has improved noticeably, with more girl pupils enrolled in schools. Financial incentives are provided to families allowing their girls to continue their education at the secondary-school level. The literacy rate is expected to double, reaching more than 50 per cent, as the number of schools increase and proper control on education is enforced. One of the most important impacts of improved education is in the demographics where population growth rates see significant reductions. On

the other hand, despite lower population growth rates, population sizes still remain a problem in some countries as health care improves and life expectancy increases. However, careful planning and adjustments to population structures gradually converts these large numbers of people from being a burden on society to being a useful work force.

7. Employment

The improvement of this long-neglected basic Infrastructure has made the areas become more favourable to businesses and industries. The improvement of transportation, roads and methods of communication encourages many investors to start businesses with affordable wages and creating job opportunities for the inhabitants. Inhabitants are put through training and awareness campaigns in industrial safety procedures, which promote knowledge in the workforce. Migration to better areas in search of work opportunities and better life is greatly reduced or even reversed with many people preferring to go back to their home lands.

Conclusion

Economic development cannot be achieved without internal stability and good governance. As education and public awareness improve under the great transitions scenario, people become conscious of their human rights and indeed fight for them. Step by step, bureaucracy loses ground to a true democracy in which people can decide for themselves. However, good bureaucracy is sometimes a fundamental requisite for people's welfare, and is strongly felt in a number of spheres such as in good teaching, sound extension services, health and vaccination programmes, and many others. Follow-up programmes and regular visits of key officials to the area ensure the adequate efficient and proficient performance of civil servants and government employees.

CONCLUSION

Ecosystem deterioration in the case study areas is an outcome of a set of key drivers including governance efficiency, economic activities, and management of natural resources, accessibility, and available services. Revealing the negative impacts of human induced activities and redirecting them into sustainable development paths requires knowledge of consequences of various policy actions. The latter could be achieved through analysis of potential impacts of future actions to understand the complex ecological –social –economic process that represent the main pillars of sustainable development.

The presented scenarios explored the diverse development paths that might environmentally, socially and economically impact the case study areas. Four scenarios were developed using narrative storylines and quantitative data to explore different policy approaches and their impact on the economical, social and environmental situation of the three case studies. Each scenario presented interlinkages with

numerous environmental issues; to link environment with development issues, such as water scarcity, land use change and degradation, and biodiversity loss. The chapter highlighted the need to link environment with development issues, such as extreme poverty, remoteness and human vulnerability and wellbeing.

Assessment of the Driving forces in each storyline had shown that in all scenarios the presence of economic activities will rise, increasing job opportunities, decreasing poverty and remoteness of the areas. This potential success varies according to the Governance efficiency in laws implementation and capabilities to solve issues. Analysis showed that scenarios which ruled by inefficient governance had shown a further degradation in the natural resources especially water, land and biodiversity with the presence of economical activities. Analysis of the case studies using the four hypothetical scenarios reveled that social sustainability and human welfare only exist in scenarios with high governance efficiency and considerate investments.

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CHAPTER 6

POLICY RESPONSES

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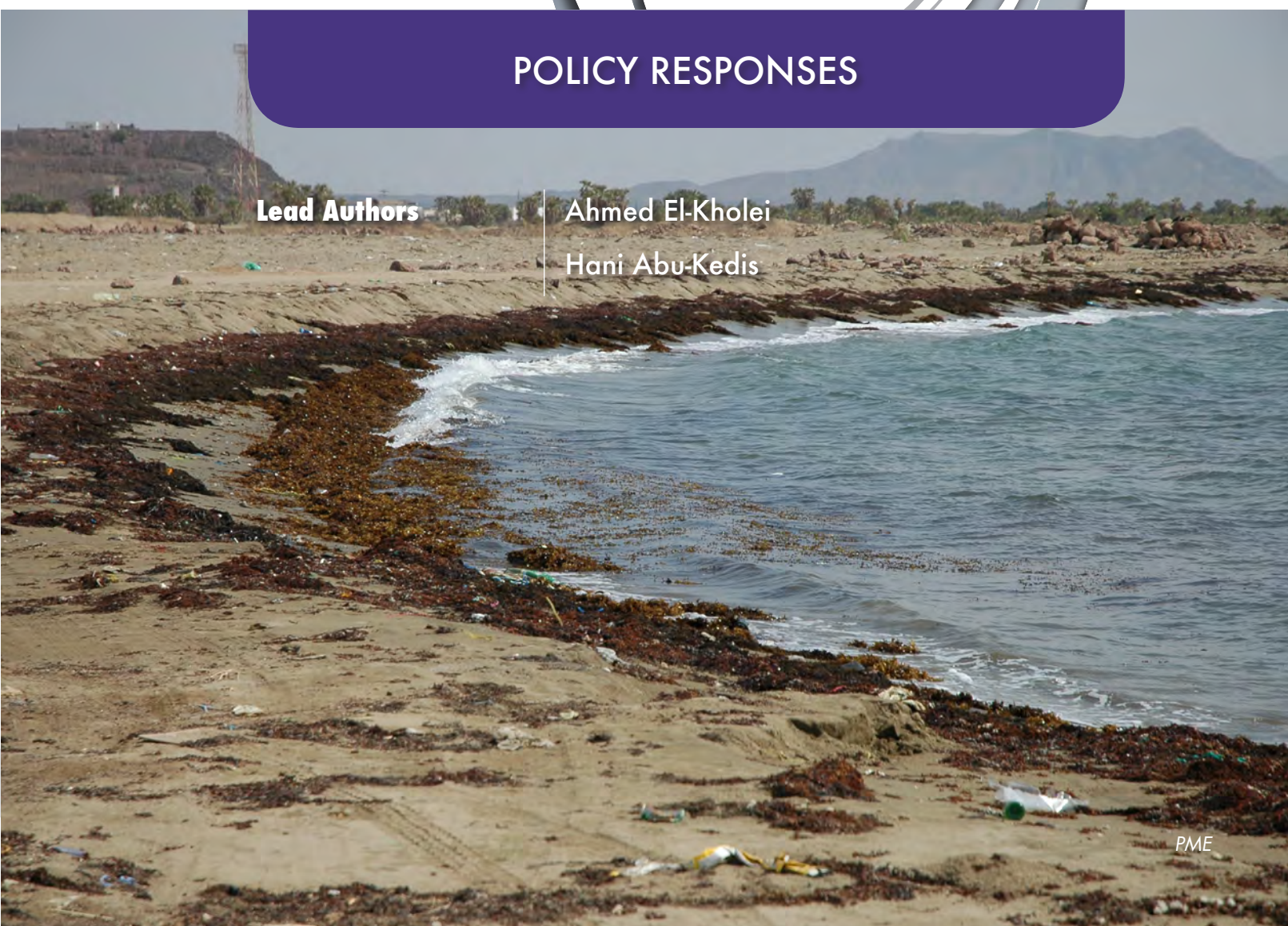

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Main Messages

The assessment indicated that the local environment of Tafilalet, ANP and El Maghara cannot sustain its development. Accordingly, there are four main categories of triggers for action: economic, social, environmental and institutional.

The economy of these areas depends on their ecosystems as they provide services that support both production and consumption. Tafilalet and El Maghara are both subject to scramble for resources. In contrast, ANP's forest and terrace agriculture, agricultural and grazing land, coastal and marine ecosystems provide and sustain the livelihoods of the locals.

Social factors constitute pressures on the local ecosystem. Poor people will continue to overexploit their environment in an attempt to support their living regardless of the future of their children.

Harsh environmental conditions accelerate the processes of impoverishment. The assessments of ANP, El Maghara and Tafilalet indicate common environmental issues. Water scarcity, hot arid climate, loss of biodiversity, drought and desertification are among the shared environmental issues and problems.

Often, problems arise within the institutional framework. Public institutions in many cases do not advertise planned action in advance in order to avoid opposition. These institutions do not consider long-term objectives; unlike sustainable development which by nature is long-term. Decision-makers at public agencies are often reluctant to consider fundamental alternatives.

The solution for the environmental sustainability of ANP, El Maghara and Tafilalet is to induce institutional transformations within which the current problems resulted. The solution rests on ecosystem awareness campaigns, empowerment of natives, capacity building and the cooperation and coordination between private sector, public sector and the inhabitants in the formulation and implementation of development plans.

Sustaining Arab ecosystems for both economic returns and social gains within the coming decade is considered a main objective. This means, first, to initiate and support economic growth without jeopardizing the environment or the society. Second, to enlighten and empower the local community to be in-charge of action plans that will allocate equitable distribution of costs and benefits of development and growth. Third, to conserve and protect the environment, and if possible, to regenerate damaged ecosystems. This is possible through planned interventions on the economic, social, environmental and institutional fronts.

Current responses in ANP, El Maghara and Tafilalet are mostly technical in nature. Governments of Egypt, Morocco and Saudi Arabia have planned and implemented a number of responses including training cadres and declaring the assessed site as a protectorate.

Proposed response actions are based on regeneration of the ecosystem; development of human resources and reformation of the institutional setup. Response actions will take place through a number of interventions that include information and monitoring measures, corrective and preventive actions, and supportive procedures to assure the successful Arab ecosystem management.

6 POLICY RESPONSES

6.1 INTRODUCTION

Responses are reactions to external and/or internal stimulus. In the field of environmental planning, there are three integrated responses:

1. **Monitoring, information generation and knowledge sharing:**
   Baseline assessments, such as the local MA assessments covered in this report monitor the improvement or deterioration of environmental conditions in any given site due to interventions or lack thereof. This requires technical capacities for monitoring the ecosystem(s), inferring the linkages between the different variables and parameters, and then computing the needed indicators. The collected data is necessary for defining the problem in terms of causes and consequences, thus supporting decision making and raising awareness.
2. **Corrective and/or preventive measures:**
   These are interventions that stakeholders have executed in an attempt to improve conditions, and/or to prevent further degradation.
3. **Supportive measures:**
   These are measures needed to sustain the two above measures. There is a wide range of supportive measures including, but not limited to, raising awareness, education and training, economic and financial instruments, institutional transformations, and command and control.

Levels and nature of responses differ, they could be international, national or local. For example, Tafilalet and ANP have a unique biological significance, and the international community regards its environmental significance. Levels could also be divided into two categories it can be either sectorial or holistic.

Reponses could be addressed through certain interventions, for example, technological, impact assessments, whether environmental, economic or social and institution transformation. Cultural problems and social preferences are potential obstacles to the implementation of such interventions. For example, technological interventions some times are associated with limited problems, such as intellectual property rights. Technology can be transferred, and adapted to fit local conditions, but cultural norms and social preferences are hard to change. Impact assessments are essential regardless of the nature of the intervention, in order to avoid any irreversible impacts. Institutional transformation, which is essential for sustainability, is also difficult to induce as it is deeply rooted in local cultures. Responses could also arise from addressing stakeholders, structure and function of environmental management, and implementation of environmental policies.

Based on the assessment presented in the earlier chapters, the question that poses itself is "What are we going to do next?". It is important to address the external context of the assessed ecosystems that influence decision making through the following:

- Interventions required to improve the situation at Tafilalet, ANP and El Maghara as a result of the assessment.
- Identifying stakeholders and relationships: Decision-makers, influencers, media, information and knowledge body, implementing body, and NGOs. Earlier chapters identified the stakeholders at Tafilalet, ANP and El Maghara.
- How to update the knowledge gathered through the assessment? This will require monitoring the ecosystems at Tafilalet, ANP and El Maghara, and preparing periodic reports to measure improvements or degradation.
- What are the opportunities? Publishing, conferences and workshops and news articles.

6.2 PROBLEMS ADDRESSED

The assessment indicated, that the local environment of Tafilalet, ANP and El Maghara cannot sustain its development. Figure 6.1 indicates, there are four main categories for action: economic, social, environmental and institutional, as follows:

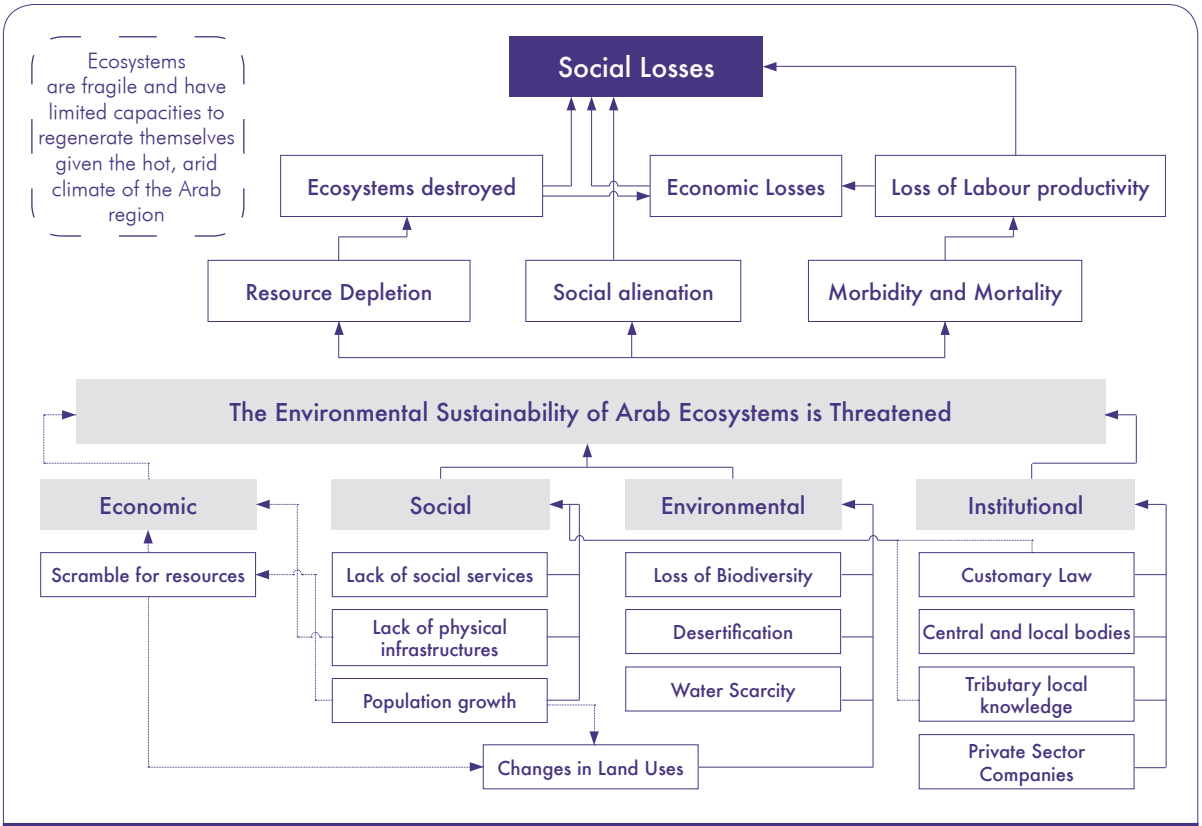

Figure 6.1 Problem Tree

Source: UNEP, 2010

6.2.1 Economic

Ecosystems provide services that support both production and consumption. Both Tafilalet and El Maghara are subject to scramble for resources. On the contrary, forest and terrace agriculture, agricultural and grazing land, coastal and marine ecosystems in ANP, Saudi Arabia, sustain the livelihoods of the locals.

In Tafilalet, Morocco, with a total area of 60 000 km^2, or nine per cent of the national territory, accommodating a population of approximately 0.81 million inhabitants, or 2.7 per cent of the national population of Morocco, their lives depend on four water sheds.[1] Meanwhile, ecosystems at Tafilalet, ANP and El Maghara are also in the interest of private sector companies, including land developers, and mining companies. In addition to economic expansion, the assessments of Tafilalet, ANP and El Maghara indicated population pressures in the form of natural population growth and the sprawl of human settlements, thus changes in land use at each site were induced, which in turn contributed to the environmental degradation of local ecosystems.

6.2.2 Social

The residents of a number of countries in the Arab region, particularly those living near ecosystems of environmental value, such as El Maghara and Tafilalet, high poverty levels. They lack physical infrastructure, such as safe drinking water, wastewater collection and treatment, as well as integrated schemes for solid waste collection and disposal. They also lack other municipal services such as, access to proper social services like educational facilities and health care units. There are a number of reasons for their state of poverty. Foremost of these reasons is the inferior quality of human resources in the study areas as a result of lack of both physical and social infrastructure. Rapid population growth, the scramble for natural resources, migration, and gender inequality are among the socio-economic drivers of environmental degradation, especially in Maghara and Tafilalet. Equally important is the view that administrators hold regarding the natives, as in the case of El Maghara, which affects decisions concerning the community and its future. The result is social alienation with its repercussions, such as losing pride in national identity, thus resisting State authority and pledging allegiance to the tribe. In the latter years , the Sinai Peninsula witnessed tensions between natives and the police force.

These social factors constitute pressures on the local ecosystem. Poor people will continue to overexploit their environment in an attempt to support their living regardless of the future of their children. They will not accept attempts to raise their awareness regarding the importance of the local ecosystem, as they hold limited confidence in their officials.

1. Millennium Ecosystem assessment (2009). Sub-Global Millennium ecosystem assessment: Morocco Millennium ecosystem assessment, Evaluation of the oasis ecosystem Tafilalet, State secretariat of the Minister of Energy, water and environment, Kingdom of Morocco

6.2.3 Environmental

The assessments of the case studies presented in earlier chapters indicate common environmental issues like, water scarcity, hot arid climate, loss of biodiversity, and drought and desertification.

These harsh environmental conditions, population growth, economic growth, the absence of law implementation and resource conservation accelerate impoverishment. The result is a number of issues of economic and social costs. For example, without protecting natural resources from pollution, and lacking health care facilities, epidemic diseases cannot be combated, and outbreak of disease is possible. This condition leads to increased rates of morbidity, which in turn affects labour productivity and income. Polluted environments without proper health care services will often lead to increased rates of mortality. If the family loses the head of the household, there are a number of social and economic burdens which occur, such as a child's dropping out of school in order to support the family, which can increase cases of child labour.

6.2.4 Institutional

Often some of the identified public institutions of the study area's problems arise within their framework and planning schemes unlike private sector companies and non-profit organizations, such as syndicates, NGOs, and CBOs. Among the elements that make the difference between these institutions is the mission and mandate of the institution itself, and as a result influences how decisions are made within the institution.

Planning is about setting ends and goals and the means to reach them. For these public bodies planning often ends vague, broad, implicit, and fragmented. Most of the decisions made within them usually are based on "political" rather than "technical" considerations. Among the reasons for this situation is that the future is often uncertain. Conditions within these public institutions – and outside it – always change; therefore, precise prediction, projection and forecasting are not always possible.

When a public institution engages with public, private or non-profit institutions the element of change is probably of particular importance. Other institutions usually try to impose change on the public institution, thus forcing it to consider serious counter-measures. Examples of this situation include, but are not limited to, controlling and management of land resources that lead to cases of adverse possession. Without clear, acknowledged, secured property rights, the land market will not be perfectly competitive. According to theories of environmental economics, environmental degradation is a sign of imperfect competition in markets.

These public institutions often do not advertise planned action in advance, in order to avoid opposition. They do not consider long-term objectives; rather are often after a "quick" fix. Sustainable development is about avoiding temporal discontinuities, such as inter-

generational discontinuities. Sustainable development by nature is long-term, while decision-makers atop the public agencies are often in pursuit of the "quick" fix, and thus will be reluctant to consider fundamental alternatives. This is probably the reason why public institutions prefer present rather than future effects and outcomes. In other words, they heavily discount the future in order to maintain the status quo. Keeping the institution running, on many occasions, is more important than fulfilling the mission and meeting the mandate. In many cases, the result of interventions turned out to be a financial burden, an economic problem, and an output that the community did not accept.

To a great extent, private sector companies are radically different. Decisions are made to maximize profit and minimize costs. For this reason decisions are based on technical considerations, as well as on political and social acceptances. Often, private sector companies have the "agility" to respond to changes within and outside the company. Private sector companies always have the shareholders, clients, competitors and collaborators, such as financial institutions, in perspective. Thus, advertising is important, and the image is crucial to test ideas, target specific groups, and so forth. Private sector companies have various solutions to deal with competitors, such as mergers and acquisitions. Private sector companies might consider re-structuring in order to survive the competition.

Non-profit organizations are flexible in reaching those less fortunate. For this reason they go beyond the State and the Market (the Private Sector Companies). In addition to considering the views of their constituents, they have to consider the interests of their sponsors.

The study areas have a unique rich culture. Most of the inhabitants of the study areas are Bedouins which have their indigenous knowledge and customary laws and regulation that should be considered by the public institution during the decision making process.

The solution for the environmental sustainability implementation of ANP, El Maghara and Tafilalet is to induce institutional transformations within the institutions where current problems resulted. The solution rests on: a) enlightening the locals about the significance of local ecosystems; b) empowering the natives to be in-charge of their future and that of their children; c) reaching a win-win agreement with private sector companies to respect local contexts including the carrying capacities of local ecosystems, and the traditions and values of the natives; and d) open central and local government to accept the views of locals as partners in development, and in the meantime, public institutions have to assume the roles of honest regulator and catalyst for local development.

6.3 OBJECTIVES

The overall objective is to sustain Arab ecosystems for both economic returns and social gains within the coming decade. This means, first, to initiate and support economic

growth without jeopardizing the environment or society. Second, as was mentioned before, is to enlighten and empower the local community to be in-charge of action plans, and thus be resilient to shocks, and gain equitable distribution of costs and benefits of development and growth. Third, to conserve and protect the environment, and if possible, to regenerate damaged ecosystems. This is possible through planned interventions on the economic, social, environmental and institutional fronts as indicated in Figure 6.2.

6.4 EXISTING RESPONSES

Most of the current responses in ANP, El Maghara and Tafilalet are technical, such as construction of dams to collect water from flash floods and rain, and afforestation, or supportive measures (institutional), such as establishing a committee to manage a protectorate, building the capacities of government employees, applying polluter pay principles and so forth . For example, Saudi Arabian authorities have already applied some of these measures, and Egyptian authorities are considering declaring

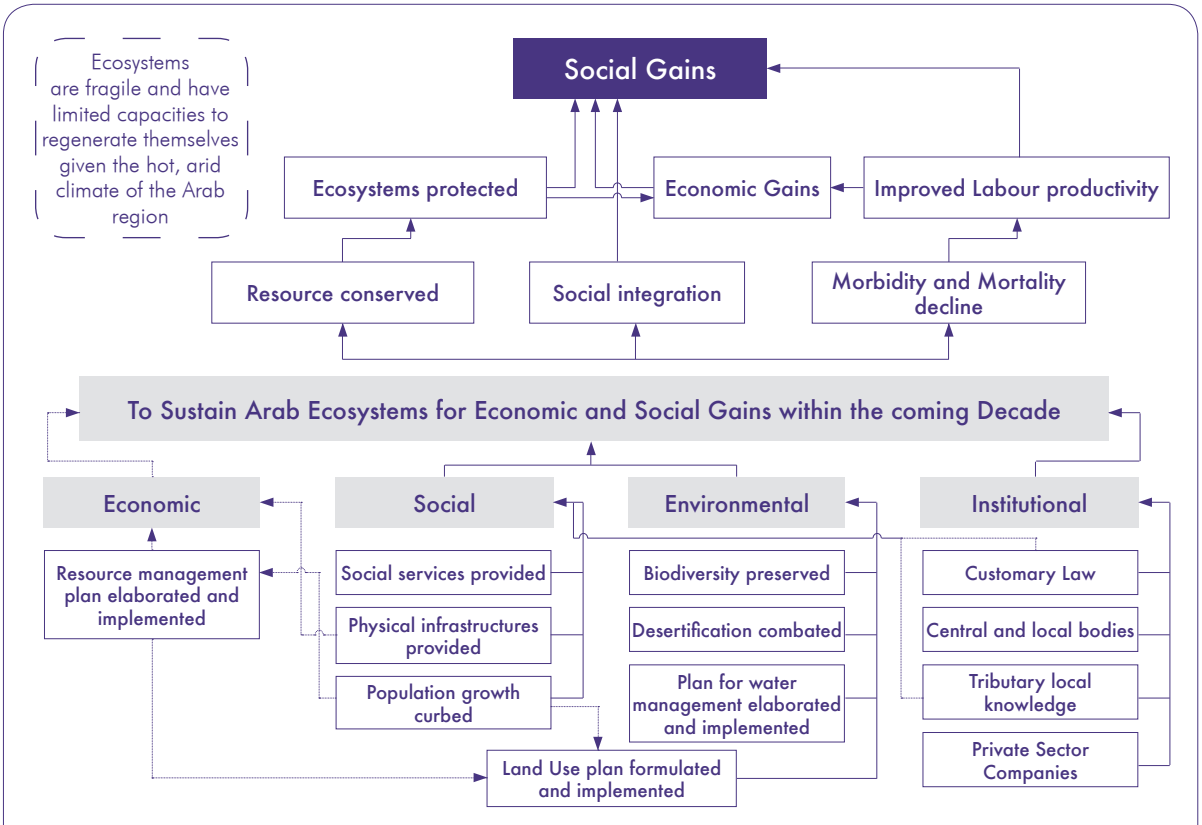

Figure 6.2 Objective Tree

Source: UNEP, 2010

El Maghara a protectorate. Often these responses are sporadic and executed with little synergy due to lack of a framework for action. Moreover, there is a lack of attention paid towards monitoring and reporting on the status of these ecosystems. This section of the chapter is reviewing the currently planned and executed efforts in Tafilalet, ANP and El Maghara.

El Maghara known for its rich ecosystem and arid nature, but there are no clear records for past or ongoing attempts to protect its ecosystem. There are some existing elements that can improve the area's situation considerably, the Egyptian strategy and action plan for protecting biodiversity, as well as an action plan for combating desertification and managing drought. Additionally, the high potential is clear in the El Maghara ecosystem assessment. The latter could attract the attention of international and national agencies to protect and regenerate the ecosystem of El Maghara. Moreover, the existing offered proposal for policy responses which consider the role of international and national agencies in the improvement of the area. There is also a proposal to declare El Maghara area as a protectorate. Most of the responses in El Maghara were community based responses. Using indigenous knowledge, the local community initiated and implemented responses to adapt to local circumstances.

The case of ANP is different; Saudi Arabia public institutions had taken actual sustainable steps towards not only the protection of the ecosystem but had also served the inhabitants of the areas. The government of Saudi Arabia has paid great attention and concern towards forest conservation and development. This was reflected in the preparation of the National Forest Strategy (NFS) and National Forest Programme (NFP). The afforested area reached 143.6 hectares.[2] In the year 2000 a Royal Decree was issued banning the issuance of any licenses for wood collection or charcoal making for five years. The Decree also allowed the import of firewood and charcoal from abroad.

The Presidency of Meteorology and Environment (PME) established a "Regional Training Centre" in Al-Soda to train Saudi graduates in the field of environmental management. In addition, the Ministry of Agriculture required conserving ANP through sustainable initiatives. For example, It used local raw materials to build ANP management buildings. Additionally, it also had offered young citizens a chance to operate and maintain conservation of the park.

It had also established, The Raydah Reserve to preserve a relatively pristine example of Asir juniper, woodland habitats, and their associated wildlife. In 1989, the Raydah escarpment was declared a Special Nature Reserve. Raydah provides one of the few intact examples of virtually pristine escarpment juniper woodland, and serves as a habitat for a high density of south-west

2. Sub-global Arab Millennium Ecosystem Assessment for Asir National Park, (2009). Saudi Arabian Millennium Ecosystem Assessment for Asir National Park. Kingdom of Saudi Arabia, 2008

Arabian endemic and near endemic bird species. The inhabitants of Raydah and As-Suqah village - members of the Rejal Al-Ma and Baalahmer tribes - private sector companies in the field of tourism, together with the local administration at Abha and the central body, that is the Ministry of Agriculture, Department of National Parks which administers ANP, are engaged in the administration and management of the park – an example of a collaborative effort toward environmental sustainability for the benefit of the locals and future generations.

The Saudi Arabian government provided the local population with both social and physical infrastructure. For example, it supplied primary health care services by building health care centres at city and village levels in ANP to ensure adequate health services for its citizens and residents. In addition, the government provided specialist hospitals with the latest equipment and technology. It also constructed a number of dams in ANP to collect and store rain water. The new dam capacity of Abha is 2 130 million m^3. The dam water is used generally for irrigation purposes, while Al-Shuqaiq desalination plant produces potable water. Expansion of water collection and storage includes building dams at Atood, Maraba, Heli and Yeba, as well as expanding the capacity of the Abha Dam capacity to almost 2 450 million m^3. Furthermore, efforts to secure fresh water include the increasing abstraction of groundwater to reach 2.7 million m^3 a year (Ministry of Water 2004).

In Morocco, the case is not any different, responses are sectorial. The Regional Office of Agricultural Investment of Tafilalet organized rangelands and the grazing process, established 17 agricultural cooperatives for 4 450 farmers, raised awareness and trained farmers on the sustainable use of natural resources, and distributed barley at both the time of drought and planting crops. To protect date-producing palms, the Government of Morocco passed Law No. 06-01 in 2007, associated with a bundle of interventions, such as assistance on producing and packing dates. The assistance extended to other crops and agricultural activities, such as the production of olives and beekeeping. The latter initiatives not only sustained the use of natural resources, but also the livelihoods of the inhabitants.

The government executed other interventions aimed to protect natural resources. For example, The UNDP-GEF supported a number of projects that associations implemented to protect vegetation cover. In 1996, a site of significant biological diversity was demarcated, but further action was not taken to protect it, hoping that legislation for protection of the environment would pass and give this site legal protection.

The assessment of Tafilalet suggests rarity and wasteful use of fresh water resources which have led to depletion of reserves. This is the case of many oases in Morocco; consequently, the government responded with a number of legal and technical interventions. An example of these legal measures is Law 10-95 whose regulations include measures

to induce rational use of water by reducing consumption, and protecting fresh water resources from sources of pollution. The government provides up to 60 per cent of the cost of projects for modern on-farm irrigation techniques, such as drip irrigation. The results obtained, from a financial point of view are encouraging due to water savings. The depletion of surface water during recent years has prompted the Regional Office of Agricultural Investment of Tafilalet to invest more in managing floodwaters by building hydraulic facilities along rivers. In line with these technical interventions, the Regional Office of Agricultural Investment of Tafilalet has embarked on rehabilitating the hydro-agricultural infrastructure, and will probably augment it by establishing a hydraulic basin agency in Tafilalet - an example of a quasi-integrated intervention - as linkages to other aspects such as biodiversity are not clear.

In Morocco, there is a legal arsenal for the management of natural resources, such as: forestry laws that date back to nearly a century; hunting laws; water laws; the law for protecting and enhancing the environment; the law for environmental studies, the law for solid wastes management; and the law for air quality. Why then does environmental degradation take place – as indicated in earlier chapters – if these laws are enforced? In reality, the environment cannot be protected by only command and control; there are other tools needed, including but not limited to, economic instruments, financial mechanisms, environmental education and training. This is not the case in Morocco only, but occurs in many Arab countries. Morocco is eager to meet the MDGs, and is therefore implementing a number of cross-sectorial initiatives, such as the National Initiative for Human Development (NIHD), which is being implemented in all Moroccan regions, particularly in the poorest communities. Some macro-economic projects are implemented in the region of Tafilalet. These responses are more integrated because they involve many players and various economic sectors. However, the real outcomes of these initiatives are not clear for a number of reasons, such as idle trickle-down mechanisms responsible for equitable distribution of wealth and dividends of development, which is the case in many Arab countries. Furthermore, the long-term impacts of these initiatives, both social and environmental, might not be properly assessed as governmental institutions tend to heavily discount the future.

6.5 PROPOSED RESPONSES

In addition to the above planned and implemented response, there are a number of proposed interventions that could be generally implemented on the Arab region situation. These proposed responses occur in three spheres of action: a) regenerating the ecosystem; b) human resources development, which includes both social and economic interventions; and c) institutional reforms. Under each sphere there are a number of interventions proposed in three different, but complementary, components: a) information and monitoring measures;

b) corrective and preventive actions; and c) supportive procedures to assure the successful attainment of the sub-goals of each component.

The St. Catherine's Protectorate, Egypt, is an example to emulate. The entry point was to improve the income of inhabitants, by making use of the tourism industry and agricultural activities. The community use the indigenous medicinal plants in the area to heal and treat diseases. Capitalizing on the assets in the area and indigenous knowledge, the project introduced a number of interventions, such as establishing an NGO, establishing a school for educating the locals in the use of medicinal plants, beekeeping, greenhouses to produce shoots to generate endangered plants, and a seed bank, to turn the protectorate into a source of income generation that the locals own.[3]

A. Regenerating the Ecosystem

Actions to regenerate the ecosystem are grouped into the following seven areas:

1. Environmentally Friendly Management of Water Resources

The Arab region is one of the most arid regions, where water scarcity is a priority issue. However, water issues in the region do not stop with its scarcity, but also extend to the threats faced by freshwater resources pollution, such as untreated human wastes and agricultural drainage.

3. These include both economic and financial returns capturing social benefits, and conserving biodiversity.

Water quality and quantity are direct drivers of environmental change in the Arab region. Lack of clean, fresh, and regular water supply is the main reason for a variety of diseases that affect the community at all stages of life. It is also the main reason for the successive waves of out-migration of young generation.

Water scarcity is the most important and serious driver in the study areas. Water shortage has its impact on a wide variety of issues that include agriculture, health, education, out-migration of youth, and many others. Agriculture is mostly sporadic because of water shortage and the failure of many crops to grow. The impact of this issue on other environmental issues, such as biodiversity and desertification, is profound. The aim of this proposed programme is to protect water resources from both irrational use and pollution.The aim of the water resources management programme is to: a) increase water resources to meet growing demands and needs; b) make efficient use of available water resources; c) protect water resources from pollution and wastes; and d) contribute to the equitable distribution of water among the various users both socially and spatially.

Information and Monitoring Measures

Many Arab countries need to strengthen their water resources information base through water resources assessment, starting with an inventory of all basins and wells that will eventually lead to a water census.

Corrective and Preventive Actions

Protecting Water Resources (Quality and Quantity)

The optimal use of all available water resources is possible through an integrated plan that translates the overall policy targets into long-term programmes. The main actions proposed to minimize water loss include, but are not limited to, use of pipelines to transfer water, particularly at locations of high porosity soils; replacement of the level-based water distribution system to the flow-based water distribution system, through calibration of control structures; and use of new technologies for irrigation system maintenance and operation.

Irrigation improvements entail enhancements of the efficiency of water use at farm level. They also initiate user participation in the operation and maintenance of the irrigation system. The framework of irrigation improvement includes rehabilitation and renewal of water structures, use of pipeline, use of one point collective pumping, and land levelling using modern techniques. Other actions include redesign of the field irrigation systems. It is crucial in this regard to consider formulating/supporting water user associations that reflect the new vision for water distribution management process.

Reuse of drainage water is an option in order to meet part of the irrigation water demands. The re-use of drainage water increases the overall efficiency of the water system, but requires strict regulation to prevent negative environmental impacts.

To achieve better water quality, protecting water resources from pollution is a must, and thus pollution abatement programmes have to be set in place. The proposed preventive measures include enforcing measures in laws and regulations for protection of water resources and other legislation, as well as a regular assessment of the water quality status and suitability for various uses.

Actions are also needed to improve drinking water and wastewater management through:

Safe, Clean Drinking Water:

Despite rapid population growth in the Arab world, the percentage of the population with access to municipal water supply has increased over the past two decades, due in part, to sizeable investments in the water sector (EOAR 2010). Even though development of the overall water supply coverage has been rapid and impressive, service coverage varies widely throughout Egypt and Morocco. The parts of the population that have no access to piped water obtain their water from public standpipes (often connected to groundwater wells) and street vendors.

Poor quality drinking water is a concern in many parts of the Arab region. This is due, in part, to the fact that sources of water in many areas have become increasingly polluted, and therefore require more sophisticated treatment to produce drinking water of adequate quality. Furthermore, water treatment units do not always function properly as a result of lack of maintenance and proper operation. Even when water treatment is satisfactory, drinking water is

sometimes contaminated by leaks in the distribution network, which may be infiltrated by sewage. Another source of bacterial contamination of drinking water is the poorly maintained rooftop water storage tanks.

The proposed action is to develop a water treatment plant and a distribution network of piped water to residential, commercial, and other production facilities in El Maghara and Tafilalet. The capacity of the production plant and pumping stations should be suitable to provide safe drinking water to the population today and into the future. Establishing a system for monitoring the quality of the produced water is central to this proposal. The local administration can offer similar proposals as an investment package or an opportunity for the private sector as a Public-Private Partnership (PPP) modality.

Wastewater Management

According to the Joint Monitoring report 2012 data analysis, 77 per cent of the urban areas in the Arab countries are covered with household sewage connections. Although rural population densities are often high, coverage rates are very low. In areas without sewage networks, wastewater is often collected in septic tanks, or in other on-site disposable systems. These installations frequently leak, due in part to poor construction and maintenance, and are a major source of water pollution and unhygienic living conditions. The activities of the wastewater management programme include:

- Developing and implementing low-cost technologies for domestic wastewater treatment, such as small bore holes, taking into account some traditional and indigenous practices; and
- Devising an equitable system to finance the cost of extending sanitary services to non-served areas in order to close the gap between rural and urban areas.

The output of such a programme serves areas such as El Maghara and Tafilalet that lack sanitation, improving the quality of life of the local residents and attracting investments. This will have its own economic and financial gains, once a system that deals with sanitation as a revenue generating activity is in gear. The supportive measures for this programme include addressing the existing institutional and financial constraints to enhance the inspection authority of the specialized public body to ensure the effective implementation of the law.

Supportive Measures

Countries of the region have to expand strategies for developing and rationally using fresh water resources including, but not limited to, groundwater. It is not enough to have a strategy, equally important is to have policies, plans, programmes and projects implemented and evaluated to assess the impact, effectiveness and efficiency of the strategy.

These proposed interventions aim to encourage agricultural development of desert areas, which are to be the basis for

initiating new communities that can attract part of the populous areas and primate cities, such as Cairo, Rabat, Beirut and Riyadh. The expected increase in future demand for groundwater requires continuous monitoring and evaluation of the groundwater aquifers to avoid any possible deterioration as a result of misuse or overuse, as well as pollution. Groundwater may be very deep and needs vast investments to be utilized. Therefore, future strategies for best utilizing groundwater include:

- The use of modern technologies for determining the main characteristics of each aquifer, its maximum capacity, and safe yield. This data should provide the basic criteria for selecting the most suitable projects that could use such aquifers as a sustainable source of water;
- The use of non-conventional sources of energy such as solar and wind energy to minimize the costs of pumping; and
- The use of new technologies for farm irrigation in desert areas to minimize field losses, especially deep percolation due, in part, to the high porosity of such soils.

Raising environmental awareness through organized campaigns, media (particularly TV and radio), festivals, etc., is another supportive measure for any action to conserve and rehabilitate an ecosystem.

Central bodies and local administrations have to consider the use of economic incentives in addition to command and control systems. Some implemented and suggested economic instruments include:

- Encouraging private sector participation in environmental management through financial packages that promote compliance;
- Adopting the polluter pays principle;
- Introducing incentives (tax exemption) for promoting the adoption of clean technologies;
- Encouraging recycling efforts through deposit recycling schemes, tax incentives for recycled material, and grants and soft loans for recycling industries; and
- Reducing fresh water pollution resulting from industrial effluents through effluent charges, soft loans, and grants to finance the purchase of wastewater treatment equipment.

2. Environmentally Sound Management of Land Resources

A growing population and an expanding economy trigger competition of land use and tensions among various users. The sustainable use of land means finding a balance that attains the greatest benefits for social and economic development while still protecting and enhancing the environment.

Proper land management is necessary to protect biological diversity and to utilize the land in a sustainable way. Securing property rights, accounting for protected areas and habitats, and the rights of local communities, including local indigenous groups such as nomads, are necessary to reach sustainable use of land.

A number of factors, such as aridity, weather events, mobility of sand encroachment, and water scarcity cause land degradation. Development activities such as mining for coal and quarrying for building materials has accelerated deterioration of natural vegetation in general, and grazing plants in particular, leading to an accelerated rate of land degradation (desertification).

The proposed programme aims to:

- Prevent and/or reduce land degradation;
- Rehabilitate partly degraded land;
- Reclaim desert land; and
- Expand and execute an environmentally sound management of agricultural and rural development.

Information and Monitoring Measures

Establishing a database on traditional and indigenous systems in agriculture is imperative. This will facilitate in the assessment of land affected by salinity in terms of area, locations, and types of salinity. It will also ease the process of measuring levels and magnitude of degradation in rangelands, thus making the assessment of rural-urban migration possible.

Corrective and Preventive Actions

For all environmentally sensitive areas a master plan should be prepared to protect cultivated and range areas, and to formulate integrated measures for the conservation and sustainable use of land and water resources of fragile agricultural areas.

Supportive Measures

Supportive measures include: a) capacity building and training on improving traditional seed selection; b) outreach and extension for proper use of available resources; and c) institutional transformations, including a system of information generation and dissemination and financial incentives.

3. Drought Management and Combating Desertification

The assessed sites are endowed with a wealth of diversified natural plants adapted to the varied ecosystems and varied terrain. Many of these natural species are of high economic value aside from their value as genetic resources. Many of these species face serious ecological threats. Despite the relative scarcity of appropriate developmental activities and appropriate investigations, the study areas need major efforts to combat desertification and introduce appropriate sustainable development of the available resources.

Information and Monitoring Measures

Many Arab countries do not have a fully functional time-series data of desertification in these countries. Furthermore, they did not submit their reports to the convention. Several Arab countries have put together strategies and action plans for combating desertification, but few have been able to implement the elaborate schemes. There is a need for information on the trends of desertification in order to assess economic and social costs.

Corrective and Preventive Actions, and Supportive Measures

The plan to combat desertification and manage drought has two main objectives: a) to avoid the damaging flash floods, and the use of these floods as inputs for development through appropriate water spreading and water conservation techniques; and b) to conserve, manage, and utilize the highly valued and diversified natural flora and fauna resources in the area. Actions proposed include:

- To review the National Action Plans for Drought Management and Combating Desertification to find investments and projects in the pipeline to be implemented in the study area;
- To develop a project for the study area in case the National Action Plan lacks actions designed for this specific area. The project has to address the specific agro-ecological attributes of the study area;
- To address and focus on the varied natural attributes, specific desertification processes, and action priorities;
- To facilitate the identification of suitable indicators of development and appropriate techniques for monitoring ongoing and future desertification processes in this agro-ecological zone; and
- To improve the identification of projects, research needs, and public awareness campaigns geared and tailored to the needs of this agro-ecological zone.

4. Improving Air Quality

High speed windstorms result in an increased suspended particulate matter, including materials emissions. Massive amounts of mining and quarrying tailings have accumulated as loose sediment cover vast open surface areas in El Maghara. Furthermore, heavy trucks loaded with building stones and blocks release large volumes of particulate matter and dust into the atmosphere. All these factors affect the air quality in the study areas. Indirectly, this particulate matter could have adverse effects on human, faunal, and floral diversity as well as on soil.

The overall objective is to reduce emitted gases and suspended particulate matter in and around Tafilalet and El Maghara. Achieving general air improvements will have its positive impacts on improving the quality of indoor air. The actions to attain this objective include:

Information and Monitoring Measures

- Establishing an inventory of "pollution sources" in human settlements;
- Establishing an inventory of wind speed and directions, seasons, etc.
- Preventive and corrective actions:
- Formulating and enacting a strategy for air pollution abatement;
- Establishing and operating a network for monitoring air quality to collect information pertaining to proper decision making. If this is not possible, a mobile laboratory for assessing air quality should be used;

- Formulating a contingency plan for controlling pollution; and
- Imposing self-monitoring programmes for air quality around large sources of pollution by applying the law, such as having an environmental registry at the coal mines and the quarries.

Supportive Measures include

- Use of available funds, such as Global Environment Facility (GEF), to encourage the use of control technologies, and
- Implementation of public awareness and education modules.

5. Protecting Biodiversity

Almost all Arab countries have a strategy and action plan for biodiversity. The aim of biodiversity conservation is to set the basis for rational use and sustainable development of the national natural biological resources. The purpose is to keep these resources fit for use and capable of production in ways that provide for the legitimate requirements of the present, as well as for the basic needs of future generations.

There is, however, a need to fulfill four integrated objectives: a) conservation of natural resources; b) sustainable use of natural resources; c) integration and mainstreaming of biodiversity issues in Tafilalet and El Maghara into sectorial development plans at both national and local levels; and d) setting a framework conducive to implementing activities that ultimately protect biodiversity in Tafilalet, ANP and El Maghara. A number of suggested activities are designed to attain these goals.

Information and Monitoring Measures

Establishing a biodiversity scientific database and an information system for the assessed sites through the following measures:

- Conducting surveys and assessments of the region, natural ecosystems, and productive (managed) ecosystems within Tafilalet, ANP and El Maghara;
- Conducting surveys and assessments of species (particularly those that have a restricted range and are globally threatened);
- Searching for genatic resources and associated medicinal, pharmacological, and chemical potential resources (particularly the secrets and knowledge of women in the use of medicinal plants in the area to heal wounds and treat various types of illnesses and diseases);
- Developing a complete reference of collections and taxonomic research related to species native to ANP, Tafilalet and El Maghara;
- Initiating a project to establish monitoring stations and schemes; and
- Putting together an inventory list of indigenous knowledge related to living species in the study area.

Corrective and Preventive Actions

- Conserving and rehabilitating key endangered species through law enforcement, information gathering, and implementation of community-based in-situ conservation programmes of key endangered flora and fauna;

- Establishing an effective control and monitoring system backed up with an information system and legislative framework for the trade, use, and control of alien invasive species.
- Engaging in in-situ[4] conservation of rare and endangered native taxonomic groups of plant species by improving knowledge and understanding of species and ecosystems, and by establishing and strengthening gene banks, seed banks, green belts, botanical gardens and public gardens;
- Conserving biological resources through adopting ecologically sustainable agricultural and pastoral management practices, including control of fertilizer and pesticides, terrace management, traditional land-use and water management systems, and introducing modern irrigation systems;
- Reducing adverse impacts on habitat and ecosystem infrastructure and industry through eco-tech introduction, EIA enforcement, and effective regulating policy;
- Reducing adverse waste impact on ecosystems through adopting an ecological policy and introducing new techniques such as recycling, treatment and, green technology; and
- Mitigating the impacts of greenhouse gas emissions and the subsequent climate change on biodiversity and desertification through the energy mitigation strategy included in the national Intergovernmental Panel on Climate Change (IPCC).

Supportive Measures

- Raising the environmental awareness of local society through integrating environmental themes into university and school curricula, promoting green media, and supporting youth clubs and eco-industry;
- Reviving traditional biological knowledge, innovations, and techniques in conserving biological resources;
- Strengthening productive capacities of individuals, agencies, and communities in the planning, implementing, monitoring, and evaluating of biodiversity conservation programmes;
- Enabling communities and individuals to conserve and to use sustainable biological resources by facilitating their participation in planning and managing natural resources, and providing the local population with secure access to biological resources and sufficient financial and technical funding for community-based environmental programmes; and
- Maintaining and strengthening relations of Arab countries, and cooperating with international and regional partners in the field of biodiversity, thus attracting attention to Tafilalet, ANP and El Maghara.

6. Solid Wastes Management

Solid wastes include all domestic refuse and non-hazardous wastes such as commercial

4. It is a Latin phrase that literally means "In position"

and institutional wastes, street sweepings, and construction debris. Unsustainable consumption is increasing the amount and variety of produced wastes. Consequently, waste disposal costs will increase.

Industrial solid waste, emanating from coal and other extractive industries, is another major problem in the assessed areas. Serious problems are being caused as a result of the magnitude of industrial solid waste in El Maghara. Policies of cleaner production should be introduced to facilities operating in the area in order to minimize the generation of such waste.

Information and Monitoring Measures

The best way to cope with waste problems is by means of a waste-prevention approach, focused on changes in lifestyles, and on production and consumption patterns. The first step is to prepare an inventory of sources of waste generation in both qualitative and quantitative terms.

Corrective and Preventive Actions

- Developing transit stations;
- Founding plants for composting and co-composting of solid wastes; and
- Developing sanitary landfills

Supportive Measures

- Waste management charges should require those who generate the wastes to pay the full cost of environmentally safe disposal. This will make waste recycling and resource recovery cost effective.
- Establish guidelines for the safe reuse of waste.
- Financial and economic measures include providing incentives for proper management of solid wastes, which includes recycling, re-use, and recovery; encouraging markets for recycled and re-used products; funding pilot programmes such as small-scale and cottage recycling industries; and lastly, composting production and recovery of energy from wastes.

7. Climate Change Eco-Based Adaptation[5]

Climate change is an issue of great concern in the Arab region, with most Arab countries falling within the hyper-arid, arid and semi-arid zones. Although the Arab region contributes less than 5% of the total global greenhouse gas emissions, scientific assessments indicate that the Arab region will be one of the most vulnerable regions in the world to the potential impacts of climate change. The changes observed in the regional climate have already affected many of the physical and natural systems and there are indications that social and economic systems have also been affected.

The impacts of climate change may range from threats to coastal areas, increased drought and desertification, to scarcity of water resources, increased salinity of groundwater and the spread of epidemics, pests and diseases in an unprecedented manner. This

5. IDB & CEDARE (2012). Increasing Adaptive Capacities to Climate Change in the Arab Region. Cairo, Egypt: CEDARE

will likely lead to a decline in agricultural production, vegetation cover and food security, loss of biodiversity, increase water stress, and sea-level rise that could flood crop fields and coastal settlements and threaten the existing vulnerable marine ecosystems.

Vital economic investments will also be affected by climate change, which may have social and security implications and may also be the cause of migration of citizens from affected areas to other areas within the same country or to neighbouring countries.

Negative repercussions may accrue on the sustainable development process and increase the vulnerability of all sectors of development, with serious socio-economic implications, and a low resilience of the majority of stakeholders.

Information and Monitoring Measures

- In order to differentiate between the consequences of climate change and natural climate variability the need for consistent and dependable time-series data is required for accurate decision making and policy formulation against climate change impacts.
- Climate adaptation programs should focus on monitoring and understanding the patterns of climate variability and change, developing methodologies for the exchange of data and information, and conducting research related to climate change. Capacity-building is needed to accomplish the objectives including strengthening of monitoring networks. It should also include the possibility of establishing an Arab / regional center for long-term forecasting.
- There is a need for the development of a Climate Change Environmental Data Portal to provide key information to support decision making by providing climate change related information about the Arab region, particularly those concerned with improving livelihoods of the poor environments.

Corrective and Preventive Actions

- International action and solidarity is required in the context of the goals of sustainable development. This is based on the principle of common, but differentiated responsibility, that benefits all nations and pays particular attention to protecting the ecosystem and assisting the developing countries most vulnerable to climate change.
- Immediate adoption of urgent and decisive actions on issues of political, social, economic and environmental implications is needed to avoid losses that are likely to be very large in the future, and perhaps to the extent of deeply affecting the region's economy and threatening its security.
- It is possible to avoid many of the negative impacts of climate change on the ecosystems and productive sectors in the Arab region, and to reduce people's vulnerability and exposure to the risks of economic and social marginalization by being well prepared to manage the

risks of climate change. This should be conducted through the implementation of adequate adaptation measures to address the potential risks of climate change.

Supportive Measures

- Protection and conservation of existing natural resources against impacts of climate change through the implementation resource management strategies.
- The implementation of pilot initiatives to demonstrate the feasibility of alternative resources and develop necessary standards and guidelines.
- Adopt sustainable practices and integrated pest management techniques; enhance genetic selection of local breeds; and promote mixed exploitations.
- Develop policy and legislation options, research topics for improved vulnerability assessment and monitoring, and adapted infrastructure.
- Encourage investment in more sustainable activities; develop and promote alternative and sustainable types of economic activities.
- Adjustment of current settlements and infrastructure to future climatic changes mainly through better land-use planning; adopting protective measures against sea level rise and other extreme weather events and anticipating floods in vulnerable areas through hard and soft engineering measures.
- Raise the awareness of the impacts of climate change on health, both within and outside the health sector, and develop the capacity to respond to the hazards and risks of climate change on health.
- Enhancing an Early Warning Alert and Response System (to improve the capacity of the current system to respond to unexpectedly occurring disasters.
- More specific measures against sea level rise consist of pulling back human activities from the coast through the creation of buffer zones, moving sources of urban, industrial and agriculture activities and investments from the coast, introducing effective early warning systems for coastal hazards, and creating protective structures to limit potential damage.

B. Developing Human Resources

Achieving sustainable development is political - it requires major institutional transformations, and cannot be done without political acceptability. The paradigm shift to sustainable development is sustainable human development, which rests on expanding people's choices and capabilities by forming social capital. Sustainable development, therefore, starts with people, and will occur only when people are in charge of their future. Achieving sustainable human development in Tafilalet, ANP and El Maghara will require good governance, which will result from institutional transformation, but it also requires specific steps with respect to the development of human resources. These steps

involve poverty alleviation, extending social services, and achieving economic growth that is sustainable.

Corrective and Preventive Actions, and Supportive Measures

Poverty Alleviation

Poverty is considered the result of a set of natural and human factors, domestic policies, and external factors that come together to create an environment conducive to the occurrence and spread of poverty and its increase in severity. Reasons for poverty include the lack of skills to be competitive in the labor market, inefficient management of natural resources, and an unfriendly business environment that is overloaded with regulations and complicated procedures. Poverty in the some of the Arab region is also the result of lack of social justice and an inefficient economic system, and not the result of lack of natural resources (El-Naggar 2005a, El-Naggar 2005b).

The relationship between poverty and the environment is complicated, due in part to the fact that the poor are essentially reliant on the environment for their livelihood. In addition, they are affected by the methods by which natural resources are exploited. Since most parts of the region's natural resources are limited and susceptible to deterioration, the improvement of environmental management and regulation of the management of natural resources leads to benefits for the population at large, and for the poor in particular.

Although population growth, if not managed in a rational way, may initially lead to environmental deterioration, what occurs long-term is more subject to policies. One of the ways to alleviate poverty is to give the local population more responsibility and access to resources, particularly youth and women. As NGOs, grassroots organizations, and women's groups are important sources of innovation and action at the micro-level. In many cases, they have proven their ability to promote sustainable livelihoods.

For example, in order to participate in protecting and sustainably managing their natural resources, the people of Tafilalet and El Maghara need to have access to these resources and share the benefits that they provide. They also need funds, education, health services, and training to be more productive.

Community-based organizations can be the means toward localizing sustainable development in Tafilalet, ANP and El Maghara. Finally, they need to network their experiences with similar communities in Egypt and abroad to share lessons learnt and best practices.

Another means of poverty alleviation and development is the urgent need for family planning and relief from debt. Adopting such programmes has positive impacts on the health of women, and better child care. Equally important is to relieve the national economy from foreign and domestic debts.

Extending the Social Infrastructure

The mechanism of social infrastructure in many areas in the Arab region reflects the poor state of the inhabitants and the ecosystem. Enhancing social infrastructure can ensure the sustainability of the area's communities. It refers to the range of services that could be offered by organizations to support the formulation, development and maintenance of the community.

For example, human health depends on a healthy environment including clean water, sanitary waste disposal, and an adequate food supply. Good health depends on social, economic, and spiritual development, as well as a healthy environment. People need health care facilities, properly equipped and staffed with qualified physicians, dentists, nurses, and other health care service professionals to provide the people in the areas with the utmost attention and concern.

Another example is education. Many children at Tafilalet and El Maghara are still not enrolled in primary school; especially girls, for numerous reasons. Primary school education costs, such as uniforms, books, copybooks, and tutoring, are a major barrier to access, and the opportunity cost of child labour is still higher when compared to educating a child. Under severe poverty, a family will be reluctant to send children to school rather than send them to the field, the rangeland, or the workshop to earn a living and help support the family.

Furthermore, many primary school teachers lack adequate qualifications. Many people aged fifteen and older live without basic literacy skills. There is a need to give priority and finances to youth and adult literacy programmes by:

- Expanding quality primary and lower-secondary education;
- Expanding youth and adult literacy programmes

Scaling up literacy programmes for youth and adults requires:

- Active government responsibility for adult literacy policy and financing as part of planning the education sector;
- Clear frameworks to coordinate public, private, and civil society provision of literacy programmes;
- Increased budgetary and aid allocations;
- Programmes based on an understanding of learners' demands, especially their language preferences and their motivations for attending class, determined in consultation with local communities;
- Curricula that build on these demands, with clearly stated learning objectives and the provision of adequate learning materials; and
- Adequate pay, professional status, and training opportunities for literacy educators.

Literacy is associated with a wide spectrum of benefits. Human benefits are closely related to an individual's self-esteem, confidence,

and personal empowerment. Participation in literacy programmes brings a wide range of benefits, including increased civic participation (whether in labour unions, community activities, or politics) and enhanced cultural diversity, as it improves people's ability to engage with their own culture.

Research shows that women who participate in literacy programmes have better knowledge of health and family planning, and are more likely to adopt preventive health measures like immunization, or to seek medical help for themselves and their children. The correlation between education and lower birth rates is well established. Educated parents - especially mothers (whether they receive their education through formal schooling or adult programmes) - are more likely to send their children to school and to help them with their studies. The economic returns to education include increased individual income and economic growth.

Promoting Economic Growth without Sacrificing Sustainability

Changing Production and Consumption Patterns

One of the major causes of environmental deterioration in Tafilalet and El Maghara is the unsustainable pattern of consumption. Poor families are unable to meet food, health care, shelter, and educational needs. They have to "dig" their environment and exploit the ecosystem. This pattern aggravates poverty in the area. There is a need to seek ways of using natural resources in ways that minimize depletion and reduce pollution. These new concepts underline the importance of following economic objectives that account for the full value of natural resources. Achieving sustainable development in the surveyed areas requires efficient production processes and changes in consumption patterns. This entails changing the production and consumption patterns that have developed in the past.

Using Economic Instruments to Induce Changes

A market-based approach to environmental management utilizes offering incentives to producers and consumers to make better use of resources. Economic instruments, together with regulations and voluntary agreements can all be part of this strategy. There is a need for the cooperation of private sector companies and both the central and local bodies responsible for environmental management and economic growth. Significant changes in consumption and production patterns will occur once prices of materials and goods reflect the cost of environmental degradation.

Economic instruments fall into seven broad categories: a) property rights; b) market establishment; c) fiscal instruments; d) charge systems; e) financial instruments; f) liability instruments; and g) performance bonds and deposit refund systems (Panayotou 1994). The lowest per capita incomes of the people in Tafilalet and El Maghara imply higher marginal utility of income and lower willingness to pay for environmental improvements and amenities. Whenever

development opportunity and environmental protection are in conflict, existing levels of income, as well as other factors such as preferences, and environmental awareness, influence the choice between the two. Thus, economic instruments to be developed for improving local ecosystems have to be set according to estimates of marginal damages or marginal benefits and hence of people's willingness to pay for a benefit (or accept compensation for a damage). This is particularly important at low levels of income, such as in the case of El Maghara, where a small change in prices or a reduction in income can threaten the survival of native households.

C. Transforming the Institutional Framework

In the Arab Region, the need to achieve economic growth while closing the gap between social classes during the 1960s and 1970s, and the need to meet the basic needs of a rapidly growing population exerted great pressures on the natural resource base, and led to environmental deterioration. With the government as the major player in the development process, civic society organizations including the private sector remained largely weak, with little capacity to participate in the development process. Accordingly, the institutional framework for effective compliance and enforcement remained largely undeveloped (EOAR 2010).

The 1990s marked a turning point toward more effective environmental management as several Arab countries, such as Egypt, Morocco, Djibouti, Tunisia and Yemen, started the Economic Reform and Structural Adjustment Programme (ERSAP) that expressed commitment to pursuing the goal of sustainable development. Currently, the principles of sustainable development and UN conventions such as Agenda 21 and the WSSD (World Summit for Sustainable Development) Johannesburg Action Plan are the basis for environmental policy making in many Arab countries (EOAR 2010).

The strategic objective of environmental activities in Arab countries is to mainstream, introduce, and integrate environmental concerns relevant to protecting human health and managing natural resources into all national policies, plans, programmes, and projects. The medium-term objective aims to preserve natural resources, biodiversity and national heritage within a context of sustainable development. The short-term objective is to reduce current pollution levels and minimize health hazards to improve the quality of life in Arab countries (EAOR 2010).

Policy making in many Arab countries to date has largely been based on the sectorial approach. This has resulted in fragmented economic, social, and environmental policies. Issues such as poverty, unemployment, health, and the environment, have been addressed independently with little consideration to the interrelationships among these issues and their causes and solutions.

The development of environmental regulations has followed the traditional regulatory approach, which focuses on end-of-pipe

controls implemented through command-and-control regulations. Legislation in many Arab countries are, to a large extent, reactive to emerging environmental problems and enforcement oriented. In other words, the emphasis is on output rather than outcome. The substance of Saudi and Egyptian environmental regulations appears to be single-based emission limits, with little consideration to variations among point sources or to ambient carrying capacity, and with weak links to any land-use planning regulations.[6]

Laws for protecting the environment and nature in many Arab countries concentrate on informing the polluter of a violation. However, these laws have few provisions for phasing in compliance measures after the violation has been announced. This most likely results from the fact that the law is being implemented in gradual steps and is probably why industries have been given an extended grace period (EOAR 2010).

Environmental Affairs Agencies in Arab countries set environmental policy after consultation with legislative, political, and public representatives. Compliance with the above-mentioned laws are usually weak because enforcement is still not efficient enough. There is a need to strengthen the institutional mechanisms necessary for effective environmental management (EOAR 2010).

6. Please read the Egyptian Law for protecting the Environment 9/2009 http://www.eeaa.gov.eg/arabic/law4_text_en.doc and the Saudi law http://www.pme.gov.sa/EnvARules.pdf

Most sectoral ministries, such as the Ministries of Health, Water Resources, and Agriculture, are involved in administrating laws and numerous decrees with environmental components. These central bodies undertake work that has very strong environmental implications, such as new crop varieties, chemicals, land zoning, tourism development, water issues, and infrastructure projects.

Information and Monitoring Measures

Developing Information for Decision Making

The most significant constraint to effective environmental policy making and implementation in the Arab world is lack of reliable and timely information. Another constraint is that existing data and information are not adequately managed due to a host of factors, including the lack of financial resources, trained workforce, awareness and availability of information, and/or institutional setup. Other constraints relating to the processes of environmental information collection, production, and dissemination are evident. Furthermore, monitoring organizations do not feed their results into a common information system, and there is no comprehensive methodology for data collection (EOAR 2010).

Policy-makers need environmental information to prioritize problems and take necessary actions. Most environmental problems are complex and decisions are often made with great uncertainty. No effective planning and decision making can be achieved and implemented without

a solid and dynamic information base that is based on monitoring. The design of environmental monitoring systems should be systematic and compatible with the planning and decision making process. It should be based on a unified methodological framework that facilitates the development of environmental quality objectives, targets various media and sectors of the economy, as well as development of both regulatory and non-regulatory policy instruments (EOAR 2010).

There are substantial inventories of statistics in Arab countries, but they are not shared and they are not comparable. However, it is also the case that additional data of different types are required for collection at the local, regional, national and international level to elucidate a more detailed, accurate story of environment and development nexus.

Furthermore, there is a need for standardizing data collection and storage, and making it accessible to technical and managerial levels. Reports and related information tend to be located in different bodies between which there is little or no coordination, cooperation, or exchange, resulting in gaps, duplication, incompatibility, and limited utilization of data. This situation hinders policy development, planning, implementation, and follow-up. In order to improve decision making, it is imperative that enhancements be made in data collection and analysis. The Ministries of Finance, Planning, Higher Education, and Environmental Affairs, bureaus for statistics, academia, and the private sector all have some responsibility towards promoting environmental statistics and information.

The proposal to establish a programme of environmental information management system has two main objectives: a) to strengthen local, regional, and national capacity to collect, analyse, and use multi-sectorial information for decision making by better identification of users, both public and private, and of their information needs at the local, regional, and national levels; and b) to improve overall quality, such as, validity and reliability, coverage, and timeliness of and access to environmental information.

The required activities include:

- Carrying out inventories of environmental, resource and development data for determining gaps and organizing activities to fill those gaps;
- Developing a coordinated, standardized data collection and assessment framework;
- Establishing systems to verify the quality of data gathered, in other words, a source check;
- Establishing procedures for measurement and evaluation;
- Organizing continuous and accurate data collection systems, making use of GIS, databases, expert systems, models, and the like; and
- Cooperating with the private sector and international bodies to facilitate transfer of technology and technical know-how.

Improving the quality of environmental data and statistics requires strengthening institutional capacity, promoting ongoing education, awareness, and training while ensuring financial commitment as well. There are many sources for statistical information, including government archives, academic institutions, UN documents, the World Bank, as well as other international bodies. Efforts should be made to gather information from various sources to form a more complete profile that can be the basis for a better decision making process.

Monitoring and Evaluating

Monitoring, evaluation, and other feedback-generating activities play important roles in assessing programme performance, achievements, and shortcomings. Monitoring begins during, not after, the implementation phase; as regular documentation of both implementation activities and effects allows for comparison and evaluation of action strategies, approaches, and impacts on local conditions for use in future performance evaluation. Certain programmes, such as biodiversity protection, depend heavily upon diligent monitoring activities to gauge and maintain system health.

Generally, monitoring is required for internal management purposes, whereas evaluation and feedback activities have both external and internal applications and are important for guiding planning and resource allocation, maintaining accountability to stakeholders, informing the public, and signalling when a project must change. The logical framework (log frame) approach is now being widely adopted. Its purpose is to provide a clear, rational framework for planning the envisioned activities and determining how to measure a project's success, while taking external factors into account. The strength of the log frame is in the analysis. Under the log frame approach to project management, objectively verifiable indicators are an important element of project design, implementation, and evaluation. Therefore, one of the most important aspects of monitoring and evaluation (M&E) is the choice of suitable and meaningful indicators. An indicator is a qualified/quantified parameter that details the extent to which a project objective has been achieved within a given timeframe and in a specified location. For instance, an indicator measuring conservation of biodiversity might look at the change in the area (km^2) of habitat protected.

Above all, indicators must be practical and realistic and should, whenever possible, be meaningful and consistent with the main objectives of the project. An indicator can also be considered a signal that shows the change in a parameter compared to a baseline or a future target. Due to the empirical nature of indicators, a project proponent and an external observer will both reach the same conclusion about the project's progress. By specifying project objectives in more concrete and verifiable terms, indicators allow an impartial and indisputable assessment of whether a particular objective has been achieved. The

project team should go one step further and interpret what the indicator means in the context of the project.

Monitoring and evaluation methodologies are dependent on well-developed sets of indicators. The indicators provide the basis for before and after analysis, and describe the effects of project interventions (positive and negative), anticipated and unanticipated, intended and unintended. They can be grouped into two categories:

- indicators of implementation progress, that is, the delivery of technical services, capital inputs with related disbursements, and the resulting outputs generated (facilities created, activities and participatory processes organized, and people trained); and
- Indicators of environmental impact in local and global terms that demonstrate environmental accomplishments.

The choice of indicators and their source of verification are governed, among other things, by considerations of the costs involved in collecting the relevant data. Excessively complex or numerous indicators lead to high costs, which could be a reason to seek other, more indirect indicators, for which the data are easier to obtain, so requiring less research and entailing less expense. For example, instead of conducting a survey on income, the number of bicycles sold in the village might be counted.

When in doubt, a "common sense" approach should be used. The choice of indicators should never take up so much time that project managers lose sight of why they are establishing the indicators in the first place. It is far more important to direct resources toward project implementation than to come up with scientifically precise, detailed indicators. In other words, the project should not be driven by the indicators, but rather by its objectives.

While it is not possible to establish a particular set of indicators for all projects, it is possible to provide general guidelines on how to formulate indicators during the planning stage of a project. In particular, the following questions should be answered as part of the process of establishing indicators:

- Are the objectives and outputs clearly stated?
- What changes are anticipated as a result of achieving the project objectives and outputs?
- What are the criteria for judging the success of the project?
- Anticipating the end of the project, how would one know if the objectives have been achieved?
- Are the key stakeholders participating in the establishment of indicators?
- Is the data, which is necessary to measure change against a baseline or target, available at reasonable costs?

An ideal set of indicators would include indicators of implementation progress and impact. One must make sure that changes

in an indicator are attributable to project activities and not an external factor. The monitoring and evaluation section of a project brief or project document should include the following:

- Brief descriptions of standard M&E procedures, such as APR (annual percentage rate), PIR (project implementation review), midterm and final evaluation, inception report, financial reports, updating and revising work plan and budget, terminal report, and terminal reviews;
- Brief descriptions of specific M&E procedures, such as substantive review or steering committee meetings, submission of progress reports, and technical reports; and
- An M&E plan outlining in detail the following:
  - Timetable: When are the crucial M&E activities supposed to take place during the lifetime of the project (APR, PIR, audit, evaluations)?
  - Reporting requirements: What are the formats and frequency of reporting?
  - Data collection: What kind of data will be collected, when, by whom and where?
  - Responsibilities: Who will be responsible for the M&E tasks?
  - Budget: What are the costs for each of the M&E tasks?

Compliance with the tasks specified in the M&E plan should be monitored and adjustments should be made as appropriate.

For each of the standards and specific procedures, the following issues should be addressed:

- What mechanisms and tools will be used?
- What is the schedule and who has what responsibility (who is preparing reports and convening meetings, composition of the steering committee, identification of target groups)?
- What resources are allocated for each M&E task?

Furthermore, the M&E section should refer to the indicators and benchmarks documented in the log frame matrix and specifically address the question of provisions, costs, and methodologies for baseline data collection, data collection at regular intervals during implementation, and ex-post data collection and monitoring. Last but not least, some insights should be given on how lessons that have been learnt elsewhere are incorporated into the project design and how the project is going to extract, document, and disseminate its own lessons learnt. Learning and feeding back lessons are crucial to "closing the loop" of the project cycle. In turn, these lessons will be applied to the next project.

Corrective and Preventive Actions and Supportive Measures

The following are proposed interventions in the field of institutional transformation:

Making Decisions for Sustainable Development

Moving decision making from the narrow, sectorial approach towards mainstreaming

the environmental dimension in the decision making process requires the adoption of a participatory, bottom-up approach that will help develop partnerships and enable stakeholders to be in charge of their futures.

Prices, markets, and governmental fiscal and economic policies also shape attitudes and behaviour toward the environment. The local administration and central bodies responsible for licensing economic activities in the assessed sites have to consider actions that encourage protecting and regenerating the degraded ecosystem. Encouraging economic growth at the expense of social equity and the environment, hoping that one day after economic take-off that trickle-down processes will take place, is a fatal assumption.

Discontinuities are not just in temporal terms, but in many cases they are spatial, where ecosystems are exploited for the development of another locality, most probably where the headquarters of coal mining and quarrying companies are.

Applying Principles of Good Governance

Good governance will provide a strong foundation for transforming governments in ways that can make it effective at achieving sustainable development. Basis for such good governance are:

1. *Participation*. Participation by both men and women is a key cornerstone of good governance. Participation can be either direct or through legitimate intermediate institutions or representatives. Participation needs to be informed and organized. This means freedom of association and expression on the one hand and an organized civil society on the other hand. Governments of Arab countries have to expand the framework within current legislation and establish for each facility, such as schools and health care centers, a Board of Trustees whose members are prominent figures of the local community. The government has to empower and authorize the Board of Trustees to take control of the finances and management of the facility to produce services that meet the needs of the local population. The Board of Trustees will serve as a forum for participation and decision making.
2. *Rule of Law*. Good governance requires fair and legal frameworks that are enforced impartially. Accordingly, the norm in El Maghara has been to make no exceptions whatsoever. The local administration has to penalize any violator, collect fines and deposit them in special funds to improve the environment. There is always a grace period during which the local administration provides other options, after which the law and regulations are imposed.
3. *Transparency*. Transparency means that decisions are taken and enforced in a manner that follows rules and regulations. It also means that information is freely available and directly accessible to those who will be affected by such decisions and their enforcement. It also means that the information is provided in easily understandable forms and media.

Moreover, before making a decision, local and central administrators have to meet with the people and present their ideas. Consultations take place, and based on the inputs of the public and their legitimate representatives and natural leaders, the authorities can make a decision. This process is flexible and should include a loop for monitoring, evaluation, and verification.

4. *Accountability.* Accountability is a key requirement of good governance. Not only governmental institutions, but also private sector and civil society organizations must be accountable to the public and to institutional stakeholders. Accountability is an issue that varies depending on whether decisions or actions taken are internal or external to an organization or institution. In general, an organization or an institution is accountable to those who will be affected by its decisions or actions. Accountability cannot be enforced without transparency and the rule of law.

5. *Responsiveness.* Good governance requires that institutions and processes try to serve all stakeholders within a reasonable timeframe. In Sinai, the governor periodically has to hold an open session that members of the Executive Council are required to attend as members of the public to present their case, and decisions have to be made on the spot.

6. *Consensus-oriented.* All decisions are the output of a participatory process for decision making. Participation generates information necessary to clearly define the situation, the reasons for the status quo, and the means to transform into a desirable future situation. Consensus building is at the crux of the development process. There are several actors and as many viewpoints in a given society. Good governance requires mediation of the different interests in society to reach a broad consensus on what is in the best interest of the whole community and how this can be achieved. It also requires a broad and long-term perspective on what is needed for sustainable human development and how to achieve the goals of such development. This can only result from an understanding of the historical, cultural, and social contexts of a given society or community.

7. *Effectiveness and efficiency.* Good governance means that processes and institutions produce results that meet the needs of society while making the best use of resources at their disposal. The concept of efficiency in the context of good governance also covers the sustainable use of natural resources and the protection of the environment. Today all projects and new developments are obliged by law to perform environmental impact assessments (EIAs), and an environmental management system (EMS) is central for economic establishments operating in the assessed areas. Adopting EMS at the local level, and the role government and local authorities can play in this respect is one of the means of achieving effectiveness and efficiency in Tafilalet, ANP and El Maghara.

8. *Equity and inclusiveness*. All decisions have to be made aiming to achieve equity, and there is room for all sub-population groups to present their concerns and defend their interests. A society's well-being depends on ensuring that all its members feel they have a stake in it, and do not feel excluded from mainstream society. This requires all groups, but particularly the most vulnerable, to have opportunities to improve or maintain their well-being.

Implications of the Scenarios

Implementing the proposed actions is expected to have a number of implications:

1. *Good governance promotes information sharing*. The reform process will stimulate local players representing different interests to share information. Participation, building partnerships, and increasing capacity of the Bedouin to enable them to participate in running their own affairs is a process that will emerge as a mechanism that is essential to attain effective developmental progress.
2. *Environmental concerns can be part of the local development agenda*. Adopting a participatory mechanism will bring environmental concerns to the development agenda and sharpen the focus on managing natural resources. The proposed process for decision making will clearly show the success of, and the need to continue, cross-sectoral coordination and interested party participation.
3. *Participation, partnership, and empowerment will cause institutional transformation*. Inviting the representatives of different interest groups in the assessed areas to participate in decision making and implementation will persuade the masses to adopt this innovative modality as a process for urban planning and management, and take decision making outside the rigid governmental institutions into more spacious popular institutions that are grounded in the realities of both the Governorate and the community.

To implement the prescribed actions, several trade-offs have to be kept in mind. First, there is no way to stop economic activities in the area and return the ecosystem to its original status. The only way to regenerate the ecosystem is to encourage sensible economic growth and expansion without sacrificing the quality of life of the locals. This is possible by weighting economic growth against both social equity and conserving the ecosystem and balancing the three goals of economic growth, social equity, and conserving the ecosystem.

Second, private and public sector companies operating at Tafilalet, ANP and El Maghara require government interventions in the form of extending physical infrastructure, such as roads, and social services such as health care facilities, but do not want strict regulations. This contradiction is inherent in the market system. Governing bodies need to reach win-win solutions, in which they focus

on the interests of both the production establishments and the community. The use of economic instruments will be of great importance in reaching such agreements, which can only be done if natural resources are properly priced to reflect the cost of current development to present and future generations.

Third, the terrain, land, and other natural resources are subject to property contradiction. In other words, the dilemma that will confront the implementation of the proposed programmes is the contradiction between market value and the use value of land. The owners of the land see only its market value - its exchange value on the market; while the society sees its use value - what the land means to the local population.

The solution involves applying command and control regulation and using proper economic instruments that enable reaching a win-win agreement - economic growth and expansion without damaging the environment and/or threatening the stability of the local community.

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ACRONYMS AND ABBREVIATIONS

ANP	Asir National Park
CBD	Convention on Biological Diversity
DWRI	Department of Water Resources and Irrigation
DPSIR	Driving forces - Pressures - State - Impact - Response
EFP	Ecological footprint
ERSAP	Economic Reform and Structural Adjustment Programme
FAO	Food and Agriculture Organization
FRA	Forest Resource Assessment
GIS	Geographic Information System
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GPI	Gender Parity Index
GEF	Global Environment Facility
IPCC	Intergovernmental Panel on Climate Change
KACST	King Abdulaziz City for Science and Technology
MA	The Millennium Ecosystem Assessment
MDG	Millennium Development Goal
MATEE	Ministry of Land Use, Water and Environment
NCWCD	National Commission of Wildlife Conservation and Development
NFS	National Forest Strategy
NFP	National Forest Programme

NIHD	National Initiative for Human Development
ONEM	The Moroccan National Observatory of the Environment
PME	Presidency of Meteorology and Environment
PSR	Pressure - State - Response
RS	Remote Sensing
RAMSAR	The RAMSAR Convention on Wetlands
TDS	Total Dissolved Solids
UNCCD	United Nations Convention to Combat Desertification
WSSD	World Summit for Sustainable Development

GLOSSARY

- **Afforestation:** Planting of forests on land that has historically not contained forests.
- **Agrobiodiversity:** The diversity of plants, insects, and soil biota found in cultivated systems.
- **Alien species:** Species introduced outside its normal distribution.
- **Aquaculture:** Breeding and rearing of fish, shellfish, or plants in ponds, enclosures, or other forms of confinement in fresh or marine waters for the direct harvest of the product.
- **Aquifer:** An underground geological formation or group of formations, containing usable amounts of groundwater that can supply wells and springs.
- **Arable land:** Land under temporary crops (double-cropped areas are counted only once), temporary meadows for meadows for mowing or pasture, land under market and kitchen gardens, and land temporarily fallow (less than five years).The Abandoned land resulting from shifting cultivation is not included in the category.
- **Baseline:** A set of reference data sets or analysis used for comparative purposes, it can be based on a reference year or a reference set of (standard) conditions.
- **Biodiversity:** The variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within and among species and diversity within and among ecosystems.
- **Biome:** The largest unit of ecological classification that is convenient to recognize below the entire globe. Terrestrial biomes are typically based on dominant vegetation structure (e.g., forest, grassland). Ecosystems within a biome function in a broadly similar way, although they may have very different species composition. For example, all forests share certain properties regarding nutrient cycling, disturbance, and biomass that are different from the properties of grasslands. Marine biomes are typically based on biogeochemical properties. The WWF biome classification is used in the MA.
- **Biotechnology:** Any technological application that uses biological systems, living organisms, or derivatives thereof to make or modify products or processes for specific use.
- **Capacity building:** A process of strengthening or developing human resources, institutions, organizations, or networks. Also referred to as capacity development or capacity enhancement.
- **Catch:** The number or weight of all fish caught by fishing operations, whether the fish are landed or not.

- **Climate change:** Any change in climate over time, whether due to natural variability or as a result of human activity. (The UN Framework Convention on Climate Change defines climate change as "a change of climate which attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods").
- **Coastal system:** Systems containing terrestrial areas dominated by ocean influences of tides and marine aerosols, plus near shore marine areas. The inland extent of coastal ecosystems is the line where land based influences dominate, up to a maximum of 100 kilometres from the coastline or 100 metre elevation (whichever is closer to the sea), and the outward extent is the 50-meter-depth contour.
- **Constituents of well-being:** The experiential aspects of well-being, such as health, happiness, and freedom to be and do, and, more broadly, basic liberties.
- **Cultivated system:** Areas of landscape or seascape actively managed for the production of food, feed, fiber, or biofuels.
- **Cultural services:** the fibre non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experience, including, for example, knowledge systems, social relations, and aesthetic views.
- **Decision-maker:** A person whose decision and actions can influence a condition, process, or issue under consideration.
- **Deforestation:** Conversion of forest to non-forest.
- **Degradation of ecosystems:** A persistent reduction in the capacity to provide ecosystem services.
- **Driver:** Any natural or human-induced factor that directly or indirectly causes changes in the ecosystem.
- **Desertification:** This is land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. It involves crossing thresholds beyond which the underpinning ecosystem cannot restore itself, but requires ever-greater resources of recovery.
- **Drylands:** Areas characterized by lack of water, which constrain two major, interlinked ecosystem services: primary production and nutrient recycling. Four dryland sub-types are widely recognized: Dry sub-humid, semi-arid, arid and hyper-arid, showing an increasing level of aridity or moisture deficit. Formally, this definition includes all land where the aridity index value is less than 0.65.
- **Driver, direct:** A driver that unequivocally influences ecosystem process and can therefore be identified and measured to differing degrees of accuracy.

- **Driver, indirect:** A driver that operates by altering the level or rate of change of one or more direct driver.
- **Ecosystem:** A dynamic complex of plant, animal and microorganism communities and their nonliving environment interacting as a functional unit.
- **Ecosystem approach:** A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use. An ecosystem approach is based on the application of appropriate scientific methods focused on levels of biological organization, which encompass the essential structure, processes, functions, and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.
- **Ecosystem assessment:** A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision makers.
- **Ecosystem change:** Any variation in the state, outputs, or structure of an ecosystem.
- **Ecosystem function:** An intrinsic ecosystem characteristic related to the set of conditions and processes whereby an ecosystem maintains its integrity (such as primary productivity, food chain, biogeochemical cycles). Ecosystem functions include such processes as decomposition, production, nutrient cycling, and fluxes of nutrients and energy.
- **Ecosystem management:** An approach to maintaining or restoring the composition, structure, function, and delivery of services of natural and modified ecosystems for the goal of achieving sustainability. It is based on an adaptive, collaboratively developed vision of desired future conditions that integrates ecological, socioeconomic, and institutional perspectives, applied within a geographic framework, and defined primarily by natural ecological boundaries.
- **Ecosystem services:** The benefits people obtain from ecosystems. These includes provisioning services such as food and water, regulating services such as flood and disease control, cultural services such as spiritual, recreational, and cultural benefits, and supporting services such as nutrient cycling that maintain the conditions for life on Earth.
- **Endangered species:** Species that face a very high risk of extinction in the wild.
- **Endemic species:** species native to, a particular problems geographical region.
- **Environmental impact assessment:** An environmental impact assessment (EIA) is an analytical process or procedure that systematically examines the possible environmental consequences of the implementation of a given activity (project). The aim is to ensure that the environmental implications of decisions related to a given

activity are taken into account before the decisions are made.

- **Environmental policy:** A policy initiative aimed at addressing environmental problems and challenges.
- **Geographic Information System (GIS):** A computerized system organizing data sets through a geographical referencing of all data included in its collections. A GIS allows the spatial display and analysis of information.
- **Global scale:** The geographical realm encompassing all of Earth.
- **Globalization:** The increasing integration of economies and societies around the world, particularly through trade and financial flows, and the transfer of culture and technology.
- **Governance:** The manner in which society exercises control over resources. It denotes the mechanisms through which control over resources is defined and access is regulated. For example, there is governance through the state, the market, or through civil society groups and local organizations. Governance is exercised through institutions: laws, property rights systems and forms of social organization.
- **Groundwater:** Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table.
- **Habitat:** Area occupied by and supporting living organisms. Also used to mean the environmental attributes required by a particular species or its ecological niche.
- **Hazardous waste:** Products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics: ignitability, corrosivity, reactivity or toxicity, or appear on special lists.
- **Health:** Strength, feeling well, and having a good functional capacity. Health, in a popular idiom, also connotes an absence of disease. The health of a whole community or population is reflected in measurements of disease incidence and prevalence, age-specific death rates, and life expectancy.
- **High seas:** The area outside of national jurisdiction, i.e., beyond each nation's Exclusive Economic Zone or other territorial waters.
- **Heavy metals:** A group name for metals and semimetals (metalloids), such as arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc, that have been associated with contamination and potential toxicity.
- **Institutions:** The rules that guide how people within societies live, work, and interact with each other. Formal institutions are written or codified rules. Examples of formal institutions would be the constitution, the judiciary laws, the

organized market, and property rights. Informal institutions are rules governed by social and behavioural norms of the society, family, or community.

- **Indicator:** Information based on measured data used to represent a particular attribute, characteristic, or property of a system.
- **Indigenous knowledge** (or local knowledge)**:** The knowledge that is unique to a given culture or society.
- **Integrated responses:** Responses that address degradation of ecosystem services across a number of systems simultaneously or that also explicitly include objectives to enhance human well-being.
- **Keystone species:** A species whose impact on the community is disproportionately large relative to its abundance. The effects can be produced by consumption (trophic interactions), competition, mutualism, dispersal, pollination, disease, or habitat modification (nontrophic interactions).
- **Land cover:** The physical coverage of land, usually expressed in terms of vegetation cover or lack of it. Influenced by but not synonymous with *land use*.
- **Land degradation:** The loss of biological or economic productivity and complexity in croplands, pastures and woodlands. It is due mainly to climate variability and unsustainable human activity.
- **Landscape**: An area of land that contains a mosaic of ecosystems, including human dominated ecosystems. The term cultural landscape is often used when referring to landscapes containing significant human populations.
- **Level:** The discrete levels of social organization, such as individuals, households, communities, and nations.
- **Mainstreaming:** Mainstreaming the environment into development policy making means that environmental considerations are considered in the design of policies for development.
- **Malnutrition:** A state of bad nourishment. Malnutrition refers both to undernutrition and overnutrition, as well as to conditions arising from dietary imbalances leading to diet-related non-communicable diseases.
- **Mitigation:** Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.
- **Nutrient cycling:** The processes by which elements are extracted from their mineral, aquatic, or atmospheric sources or recycled from their organic forms, converting them to the ionic form in which biotic uptake occurs and ultimately returning them to the atmosphere, water, or soil.
- **Participatory approach:** Securing an adequate and equal opportunity for people to place questions on the agenda and to express their preferences about the final outcome during decision making to all group members. Participation can occur directly or through legitimate

representatives. Participation may range from consultation to the obligation of achieving a consensus.

- **Policy:** Any form of intervention or societal response. This includes not only statements of intent, such as a water policy or forest policy, but also other forms of intervention, such as the use of economic instruments, market creation, subsidies, institutional reform, legal reform, decentralization and institutional development. Policy can be seen as a tool for the exercise of governance. When such an intervention is enforced by the state, it is called public policy.
- **Policy-maker:** A person with power to influence or determine policies and practices at an international, national, regional, or local level.
- **Pollination:** A process in the sexual phase of reproduction in some plants caused by the transportation of pollen. In the context of ecosystem services, pollination generally refers to animal-assisted pollination, such as that done by bees, rather than wind pollination.
- **Pollutant:** Any substance that causes harm to the environment when it mixes with soil, water or air.
- **Pollution:** The presence of minerals, chemicals or physical properties at levels that exceed the values deemed to define a boundary between "good or acceptable" and "poor or unacceptable" quality, which is a function of the specific pollutant.
- **Poverty:** The pronounced deprivation of well-being.
- **Projection:** A potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Projections are distinguished from "predictions" in order to emphasize that projections involve assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized; they are therefore subject to substantial uncertainty.
- **Property rights:** The right to specific uses, perhaps including exchange in a market, of ecosystems and their services.
- **Provisioning services:** The products obtained from ecosystems, including, for example, genetic resources, food and fibre, and fresh water.
- **Prediction** (or forecast)**:** The result of an attempt to produce a most likely description or estimate of the actual evolution of a variable or system in the future.
- **Rangeland:** An area where the main land use is related to the support of grazing or browsing mammals, such as cattle, sheep, goats, camels, or antelope.
- **Regulating services:** The benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases.
- **Resilience:** The capacity of a system to tolerate impacts of drivers without irreversible change in its outputs or structure.

- **Responses:** Human actions, including policies, strategies, and interventions, to address specific issues, needs, opportunities, or problems. In the context of ecosystem management, responses may be of legal, technical, institutional, economic, and behavioural nature and may operate at local or micro, regional, national, or international level and at various time scales.
- **Risk:** The probability or probability distribution of an event or the product of the magnitude of an event and the probability of its occurrence.
- **Runoff:** A portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.
- **Salinization:** The buildup of salts in soils.
- **Scale:** The physical dimensions, in either space or time, of phenomena or observations.
- **Scenario:** A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technology change, prices) and relationships. Scenarios are neither predictions nor projections and sometimes may be based on a "narrative storyline." Scenarios may be derived from projections but are often based on additional information from other sources.
- **Security:** Access to resources, safety, and the ability to live in a predictable and controllable environment.
- **Sediment:** Solid material that originates mostly from disintegrated rocks and is transported by, suspended in or deposited from water.
- **Soil fertility:** The potential of the soil to supply nutrient elements in the quantity, form, and proportion required to support optimum plant growth.
- **Species:** An interbreeding group of organisms that is reproductively isolated from all other organisms, although there are many partial exceptions to this rule in particular taxa. Operationally, the term species is a generally agreed fundamental taxonomic unit, based on morphological or genetic similarity that once described and accepted is associated with a unique scientific name.
- **Species diversity:** Biodiversity at the species level, often combining aspects of species richness, their relative abundance and their dissimilarity.
- **Stakeholder:** An actor having a stake or interest in a physical resource, ecosystem service, institution, or social system, or someone who is or may be affected by a public policy.
- **Storyline:** A narrative description of a scenario, which highlights its main features and the relationships between the scenario's driving forces and its main features.
- **Supporting services:** Ecosystem services that are necessary for the production of all other ecosystem services. Some examples

include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

- **Subsistence:** An activity in which the output is mostly for the use of the individual person doing it, or their family, and which is a significant component of their livelihood.
- **Surface water:** All water naturally open to the atmosphere, including rivers, lakes, reservoirs, streams, impoundments, seas and estuaries. The term also covers springs, wells or other collectors of water that are directly influenced by surface waters.
- **Sustainability:** A characteristic or state whereby the needs of the present and local population can be met without compromising the ability of future generations or populations in other locations to meet their needs.
- **Synergy:** When the combined effect of several forces operating is greater than the sum of the separate effects of the forces.
- **Trade-off:** Management choices that intentionally or otherwise change the type, magnitude, and relative mix of services provided by ecosystems.
- **Tenure:** Although also sometimes used more specifically in reference to the temporal dimensions and security of property rights.
- **Threshold:** A point or level at which new properties emerge in an ecological, economic, or other system, invalidating predictions based on mathematical relationships that apply at lower levels. For example, species diversity of a landscape may decline steadily with increasing habitat degradation to a certain point, then fall sharply after a critical threshold of degradation is reached. Human behaviour, especially at group levels, sometimes exhibits threshold effects. Thresholds at which irreversible changes occur are especially of concern to decision-makers.
- **Uncertainty:** An expression of the degree to which a future condition (e.g., of an ecosystem) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined terminology or uncertain projections of human behavior.
- **Urbanization:** An increase in the proportion of the population living in urban areas.
- **Urban systems:** Built environments with a high human population density. Operationally defined as human settlements with a minimum population density commonly in the range of 400 to 1 000 persons per square kilometre, minimum size of typically between 1 000 and 5 000 people, and maximum agricultural employment usually in the vicinity of 50-75%.
- **Utility:** In economics, the measure of the degree of satisfaction or happiness of a person.

- **Vulnerability:** An intrinsic feature of people at risk. It is a function of exposure, sensitivity to impacts of the specific unit exposed (such as a watershed, island, household, village, city or country), and the ability or inability to cope or adapt. It is multidimensional, multidisciplinary, multisectoral and dynamic. The exposure is to hazards such as drought, conflict or extreme price fluctuations, and also to underlying socio-economic, institutional and environmental conditions.
- **Water treatment:** Any of the mechanical, biological or chemical processes used to modify the quality of wastewater in order to reduce pollution levels.
- **Water quality:** The chemical, physical and biological characteristics of water, usually in respect to its suitability for a particular purpose. Occurs when annual water supplies drop below 1 000 m per person, or when more than 40 per cent of available water is used.
- **Water scarcity:** Occurs when low water supplies limit food production and economic development, and affect human health.
- **Water stress:** An area is experiencing water stress when annual water supplies drop below 1 700 m per person.
- **Watershed** (also catchment basin)**:** The land area that drains into a particular watercourse or body of water. Sometimes used to describe the dividing line of high ground between two catchment basins.
- **Well-being:** A context and situation dependent state, comprising basic material for a good life, freedom and choice, health, good social relations, and security.
- **Wetlands:** Areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters. May incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six meters at low tide laying within the wetlands.

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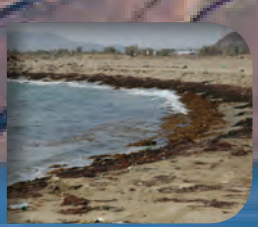

Humanity has always relied on the services provided by the biosphere and its ecosystems. The demands for ecosystem services are now so great that trade-offs among services have become the rule. Human well-being is affected by gaps between ecosystem service supply and demand, and also by the increased vulnerability of individuals, communities, and nations.

The **Arab Millennium Ecosystem Assessment** focuses on ecosystem services, the consequences of changes in the ecosystem on human well-being, and the consequences of changes in the ecosystem on other forms of life on earth. This report is based on a synthesis of three selected site assessments: Sinai Peninsula, Egypt; Tafilalet Oasis, Morocco; and Asir National Park, Kingdom of Saudi Arabia. One of the central issues of the Arab MA is the interrelationship between the environment and human well-being, represented by its goods and services and people's quality of life. The assessment intends to generate problem-solving knowledge that facilitates action on critical issues of sustainable development and protection of the environment through the design of institutional arrangements that foster the generation, collection, analysis, diffusion, and use of scientific knowledge for the sustainable use of ecosystems.

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