Environment Outlook for the Arab Region

Environment for Development and Human Well-being

UNEP

CEDARE

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EOAR

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Foreword

The world is facing many challenges, and climate change is among the most pressing. It is now an indisputable fact that needs to be dealt with and whose impacts must be managed. For this

to happen, developed countries must follow through on their obligations not only to build close ties with developing countries, but also to enable the next generation to enjoy its right to life,

particularly since some people still regard environmental issues as a luxury only the wealthy can afford, rather than a vital aspect of life itself, intrinsically related to development and a motor for that development.

Environmental issues that are particularly challenging in the Arab region include water management, combating desertification, reducing pollution and rehabilitating degraded coastal areas. We also need to consider other emerging environmental threats such as the increased frequency and intensity of natural disasters. In this framework, the Council of Arab Ministers Responsible for the Environment (CAMRE)

was established in 1987. Since its inception, the Council has approved a number of directives for improving the quality of life and fostering development in the Arab region. It launched the Sustainable Development Initiative in the Arab region, the Arab Ministerial Declaration on Climate Change, and other initiatives to raise public awareness, encourage positive behaviour, strengthen environmental legislation and increase preparedness for natural disasters, especially those due to climate change.

The Council attributes particular importance to the need for the whole of the Arab region to adopt a sustainable lifestyle, and this entails developing and implementing a unified environmental strategy. In its 17th session in 2005, the Council requested that the United Nations Environment Programme (UNEP) prepare a report on the environment outlook for the Arab region, in cooperation with the Council's technical secretariat; the collaborating centres, led by the Centre for Environment and Development for the Arab Region and Europe (CEDARE); as well as Arab experts from academic institutions, NGOs, the media, regional organizations and other relevant United Nations bodies in the region.

For the last three years, these organizations have been developing this report. It aims to provide a comprehensive and rigorous scientific assessment of the current situation and what the future holds, reflecting the interaction between environment and society. The report reaffirms the diversity of priorities, policies and initiatives in the Arab region during the past 36 years. It also presents a holistic assessment of how environmental standards, trends and impacts contribute to serving human welfare and achieving sustainable development. The report includes an analysis of future scenarios to assist decision-makers in taking decisions and developing policies for improving environmental management and making progress towards sustainable development in the region.

The report provides an assessment of the current state of environment in the Arab region, the causes leading to this state, and its consequences on the future of human beings. It analyses the impacts of pressures on the state of environment throughout the past years. It considers the efforts exerted, and the successes achieved, by the Arab region in dealing with these issues. Finally, the report deals with trends for the future and steps to be taken to render it more sustainable. All of these issues are considered from an environmental perspective, in an objective, balanced manner.

The report is divided into five main sections: Environment for Development and Human Well-being; State and Trends of Environment: 1972–2008; Environmental Change and Human Dimensions; The Outlook – Towards 2015 and beyond; and Environment for Development: Our Common Future.

Arab leaders have been paying attention to the issues related to environment and sustainable development. The recent Arab socio-economic Development Summit held in Kuwait launched the emergency programme for Arab food security and established the foundations for a strategy for water security in the Arab region. It also approved Integrated Water Resource Management as a tool for achieving sustainable development in the Arab region. Within the same framework, the League of Arab States – through its secretariat; the technical secretariats of the ministerial councils; the various Arab federations and specialized organizations; Arab funding institutions; other national, regional and international institutions; the private sector; and civil society organizations, each in its field of work – provides council, support and capacity building in the fields of environment and sustainable development to all Arab countries. The League of Arab States works to promote coordination and cooperation between all parties in all fields to achieve sustainable development, which is the basis of economic and social development, while preserving the environment for future generations.

Amre Moussa

Ex-Secretary General, League of Arab States

Preface

Environment Outlook for the Arab Region (EOAR), requested by the Council of Arab Ministers Responsible for the Environment (CAMRE), is the first integrated and comprehensive environmental assessment report for the region. It underlines the challenges, trends and opportunities at a time of rapid population growth: we are likely to see 586 million people living in the region by 2050, up from just over 334 million in 2008. Water scarcity is identified as perhaps the biggest challenge with per capita water availability having declined to just 1 000 m3 per inhabitant per year: this means that Arab countries are now among the most water-scarce in the world.

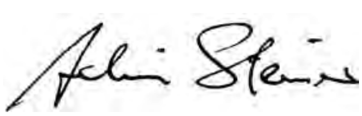
A further, overarching challenge in terms of achieving the Millennium Development Goals (MDGs) is climate change which may increase the risk and frequency of natural disasters. The report suggests that the Arab region will be among the hardest hit by the potential direct and indirect impacts of climate change. These include loss of coastal zones, more severe droughts and desertification, water scarcity, increased groundwater salinity and a surge in epidemics and infectious diseases.

On the positive side, there has been tangible progress in the Arab region, especially since the 1990s, in a variety of areas, notable among these have been the creation of legislative frameworks for environment, the raising of environmental awareness and the active participation of the region in the global environmental movement. There are also tremendous opportunities to strengthen the political framework to shape the emergence of a fruitful linkage between the environment, development and human well-being.

Strengthening the political framework can also lead to the better utilization of science to formulate policies while diversifying economic activity, and to change the development structure by integrating environment into national development plans – including a Green Economy approach – as part of a transition to a low carbon, more resource – efficient path.

EOAR is an excellent example of cooperation between UNEP and ministerial fora, such as the CAMRE, in terms of catalyzing concerted efforts to address environmental challenges at the regional and global levels. I would like to thank the Secretariat of CAMRE for working closely with UNEP to bring this report to fruition.

I would also like to thank the Centre for Environment and Development for the Arab Region and Europe (CEDARE) for its important partnership role with UNEP in realizing the report. My thanks are also extended to other collaborating centres especially the Arabian Gulf University and the Arab Centre for the studies of Arid Zones and Dry Lands (ACSAD). I would also like to thank the Norwegian government and the Abu Dhabi Global Environmental Data Initiative (AGEDI) for providing financial support and all the other partners, experts, reviewers and individuals who have contributed to the preparation of this report in one way or another.



Achim Steiner

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

Prelude

H.R.H. Prince Turki Bin Nasser Bin Abdulaziz

General President of Meteorology and Environmental Protection Head of the Executive Office of the Council of Arab Ministers for the Environment Chairman of the Board of Trustees, Centre for Environment and Development for the Arab Region and Europe (CEDARE)

The Environment Outlook for the Arab Region report was prepared in response to the request of the Council of Arab Ministers Responsible for the Environment (CAMRE) in its 17th session, headed by H.R.H. Prince Turki Bin Nasser Bin Abdulaziz, whose vision and support, in both intellect and action deserve great credit in the realization of this report.

The Environment Outlook for the Arab Region (EOAR) report can be seen as a large and transparent window from which we can contemplate the state of our Arab environment today. It also provides a glimpse of the future. It has been an honour for us to actively participate in the production of this pioneering report, in close cooperation with our valuable partners from the League of Arab States, the United Nations Environment Programme (UNEP), other regional and international organizations and a world class group of experts from the Arab region.

Many messages emerge from the report, rooted as they are, in our current needs and our legitimate expectations. Special focus is based on benefiting from constructive initiatives and success stories, since these are shining examples and a driving force in our Arab region. Our real edge invariably lies in achieving results together, in joint actions to enrich our accomplishments – and there are many – and in dealing scientifically, practically and collectively with what lies ahead. This bears special significance since this region is blessed with human resources of inestimable value: civil society organizations with their broad influence and popular base; the private sector, a robust motor for development that is driving unprecedented changes in the world today; young people, our secured investment in the bank of the future; and women who are effective partners in decision making.

The slogan "environment for development and human well-being", adopted by the report, reflects our deep commitment and sense of responsibility towards society and future generations. It also refers to the constructive efforts that continue to be exerted by governments and the Arab peoples to this end, through building qualified leaders, adopting modern technologies, and committing to internationally approved standards.

Likewise, I am pleased that the report addresses a number of concepts and key terms, which form the language of this age, ranging from green economy, green architecture, ecological footprint, renewable energy, sustainable consumption and production, peace and the environment, to environmental security. This report is also a comprehensive and contemporary vision of the most forceful/influential environmental problems that we face. This takes into consideration Arab priorities and common interests, and is based on Arab complementarity, emerging from diversity, and reflecting the vitality of this nation, within a framework of regional and international cooperation.

The interrelated environmental challenges faced by our region are massive. At the same time, they represent attractive opportunities for development. This is particularly important, since today, there is no longer a contradiction between environmental protection and economic development, since solving environmental problems will help remove many of the obstacles hindering development.

In today's "globalizing" world, which does not recognize borders or barriers, we are all partners in facing enormous and growing global challenges. We have to meet these challenges together through progressive thinking, scientific, technological and evidence-based knowledge, and strong determination and confidence. We have to reaffirm our commitment to a unified Arab vision for the environment, in line with global environmental thinking and action. At the same time, this vision must reflect the urgent needs of this vast and cherished homeland, which has blessed us with great wealth and enriched us with the glory of its ancient civilizations.

Nadia Makram Ebeid

Nadia Makram Ebeid

Executive Director
Centre for Environment and Development for the Arab Region and Europe (CEDARE)

Reader's Guide

Environment for development and human well-being

The Arab region is facing critical environmental issues (for example, water management, desertification, degradation of coastal environment, air pollution, waste management, biodiversity loss), as well as emerging environmental threats, such as climate change hazards. As these issues are inextricably linked to human welfare, "Environment for Development and Human Well-Being" has been chosen as the theme for the Environment Outlook for the Arab Region (EOAR).

EOAR builds upon the previous landmark assessments adopted by the United Nations Environment Program (UNEP) and upon the growing interest and attention devoted to environmental and developmental issues in the Arab region. It profiles the region's environmental resources both as assets and challenges for sustainable development.

Background

The report was compiled in response to a resolution adopted by the Council of Arab Ministers Responsible for the Environment (CAMRE), in its 17th session, held at the headquarters of the Secretariat-General of the League of Arab States, in Cairo, Egypt, in December 2005.

The resolution invited UNEP to prepare an Arab Environment Outlook in cooperation with specialized Arab organizations and collaborating centres in the region. After a few years of data-gathering and analysis by experts in their respective fields, the result has been an up-to-date, comprehensive, scientifically credible, regional assessment of the interaction between environment and society in the Arab region.

Objectives and target audience

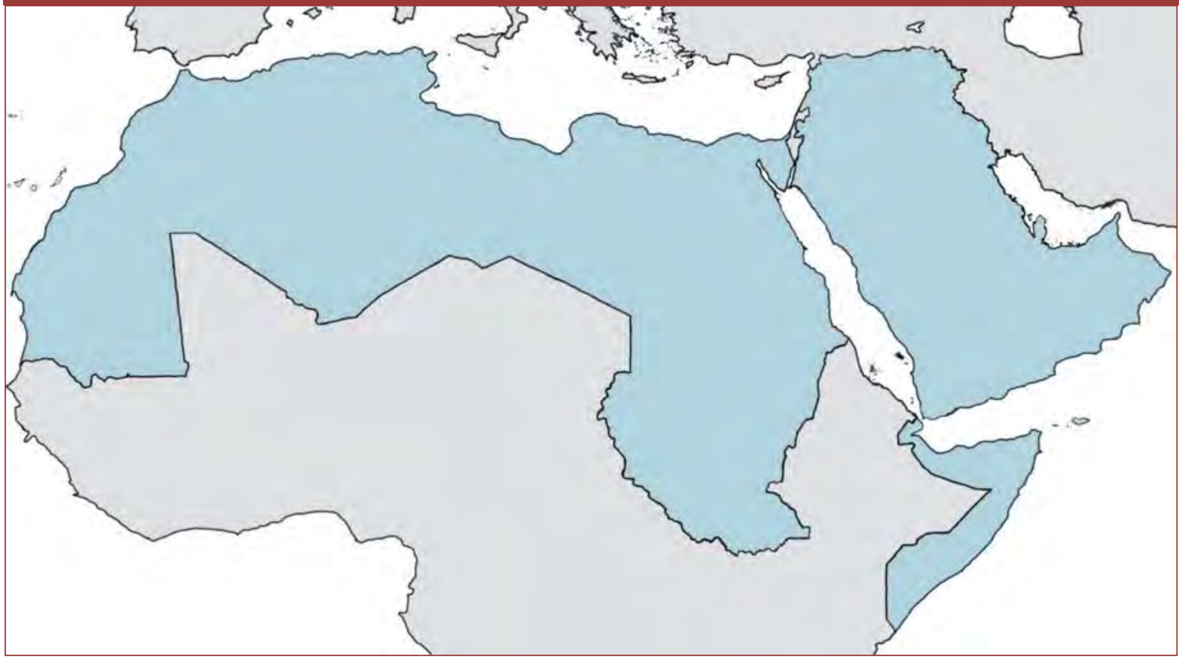
The report aims to provide an up-to-date, comprehensive, reliable, scientifically credible, policy-relevant and legitimate regional assessment and outlook of the interaction between environment and society. This authoritative document will be used by regional and national stakeholders for sound decision making and policy formulation to improve environmental management and achieve progress towards sustainable development in the region. EOAR reaffirms the need for sustainable livelihoods and for an integrated, unified and implemented Pan-Arab environmental strategy.

Although the region is riddled with environmental problems, it has the ability – in terms of financial and human resources – to build sustainable economic development.

The primary target of this report is the Council of Arab Ministers Responsible for the Environment (CAMRE) and other relevant entities of the League of Arab States. However, the report also targets policy-makers at the national and sub-regional levels, in addition to non-governmental organizations, the private sector, academics, teachers, and the public and donor agencies.

The report sheds light on the state of the environment in the region from 1972 to 2009; using all available data to assess environmental situations through reflections of socio-economic development on Arab environment.

Figure 1 Arab region



The Arab region consists of 22 countries that are members of the League of Arab States: 12 in West Asia (Jordan, United Arab Emirates, Bahrain, Saudi Arabia, Syria, Iraq, Oman, Occupied Palestinian Territories, Qatar, Kuwait, Lebanon, and Yemen) and 10 in Africa (Tunisia, Algeria, Djibouti, Sudan, Somalia, Comoros, Libya, Egypt, Morocco, and Mauritania).

In addition to the EOAR authoritative regional assessment report, other associated documents will be produced, such as a summary for decision-makers, fact sheets, vital graphics, etc, which will provide an analysis of the main environmental issues, their causes, impacts on society, current responses as well as environmental policy options and priorities. EOAR is anticipated to be the first scientific assessment of the region's environment.

Data and Statistics

The report uses up-to-date statistics derived from national, regional, and international specialized sources, taking into account data variation according to different sources. For this reason, all data have been referred to their original authoritative source.

Arab region

The report covers the Arab region which stretches from the Atlantic Ocean to the ROPME Sea area and is known for its unique ecosystems and its arid (and semi-arid) climate (see Figure 1). The region straddles two continents with an area exceeding 14 million square kilometres, which represents 10.2 per cent of the global area of land. Arab African countries occupy 72.1 per cent of the total area of the region and 33 per cent of Africa while Arab Asian countries occupy 27.9 per cent of the region's area and 8.8 per cent of Asia.

Structure

The report is structured with emphasis first given to the diversity of priorities and policy initiatives of the past 35 years throughout the Arab region (since the UN Conference on the Human Environment held in Stockholm in 1972). EOAR provides a comprehensive assessment of environmental conditions and trends and their implications on human well-being and sustainable development. It also includes an analysis of scenarios and projections to best assist policy-makers in decision making. For each issue or topic, the report raises five main related questions, as cited below:

1. What is the status of the environment?
2. What are the serious implications on humans and the environment? What analysis can be provided as to the environmental state and trends over the past 35 years in terms of pressures?
3. What is being done in terms of policy responses, and how effective have such policies been?
4. Where is the Arab region heading to?
5. What are the measures that should be undertaken to achieve a more sustainable future?

To answer these questions, the report is divided into five sections:

Section 1: Environment for Development and Human Well-Being sets the overall context for the analysis by providing an overview of the human dimension and well-being in the environment-human nexus. The main chapter in this section (Chapter 1) explores the critical primary linkages between human well-being, economic development, and a viable and sustainable environment. It also outlines the development of the environmental concept in the region since 1972 and underlines the importance of environment to sound economy. The chapter further discusses the main socio-economic human drivers of environmental change, and considers their impacts on human well-being, environment, and development.

Section 2: State and Trends of Environment (1972–2009) focuses on the major environmental issues in the region and presents the state of environment through them. Therefore, individual chapters are devoted to the following themes: water, land, coastal and marine environment, human settlements, biodiversity, and atmosphere. Each of these thematic areas is assessed by using the Driver – Pressure – State – Impact – Response (DPSIR) analysis framework (see Figure 2).

Section 3: Environmental Change and Human Dimensions explores, in depth, the complexities of environmental issues, given the state and trends discussed in Sections 1 and 2. It also demonstrates the complex relationships that exist between various environmental sectors, and their interaction with environment and development. Specifically, chapters are devoted to interlinkages, challenges and opportunities, and emerging environmental issues.

Section 4: The Outlook – Towards 2015 and Beyond. Chapter 11 (the Future Today) examines various environmental scenarios that could impact the Arab world and its sub-regions. Through these scientifically-based scenarios, it becomes clear that sub-regions cannot work independently in resolving environmental and economic developmental problems; rather, there is a critical need – and urgent opportunity – for full regional integration and cooperation.

Section 5: Environment for Development: Our Common Future concludes with a chapter devoted to clear, implementable policy options, based on the previous chapters. The environmental and economic problems afflicting the Arab region are severe and varied; nevertheless, with a unified Pan-Arab strategy, achieving a sustainable environment is plausible.

Analysis and Approach

The EAOR process has followed the model of the Global Environment Outlook (GEO) reports, which began in 1995 with two components, the first being a global environmental assessment that is participatory and cross-sectorial, incorporating regional views and perceptions and building consensus on priority issues and actions through dialogue among policy-makers and scientists at the regional and global levels. Similarly, the EOAR process has been participatory, with inputs by scientists and other experts from national and regional institutions as well as government stakeholders in the Arab region.

A peer review was conducted with several entities, including governments, academia, research centres, non-governmental organizations, special interest groups, regional and international organizations, independent experts, selected international experts, in addition to a review group consisting of prestigious public figures concerned with sustainable development in the region. The report was also subject to a consultative meeting attended by the aforementioned concerned entities.

The second component of the Global Environment Outlook (GEO) is geared towards finding out the outputs that provide guidance for decision making processes such as the formulation of environmental policies, business planning and resource allocation. The GEO-4 report serves as an integrated assessment of the global environment, with inputs by various governments in the region. It relies on national, sub-regional and regional information, assessments and experiences. The EOAR achieves the same goals, but with more emphasis on the regional level.

The EOAR analytic process follows GEO-4 conceptual framework, which seeks to analyse and understand various environmental challenges. Its framework is specifically distinguished by the following:

1. The ability to merge human (social and economic) and environmental aspects;
2. Applicability on different levels from local to international (in different circumstances of time and place and through different scientific and political processes);
3. Ideological neutrality;
4. Accessibility and relevance to policies;
5. Relevance to science and ability to link extremely complicated information and dynamics, such as non-linear relations, interactions and thresholds; and
6. Dependence on existing basics, concepts, viewpoints and approaches along with the ability to merge them.

The conceptual framework seeks to further improve our understanding of the links between environmental services, human well-being and vulnerability to environmental change. This approach focuses on the human-environment interaction as expressed through the DPSIR framework (Driver – Pressure – State – Impact – Response). It is an attempt to bring different ideas together into a coherent overarching analytical approach.

The EOAR analytic framework focuses on various aspects of human-environment interaction. In its analysis, environmental issues are not separately tackled, as in many cases, rather, a comprehensive framework is used taking into consideration every issue and every individual effort in the human-environment interaction and its linkage to other efforts in order to reach more efficient responses to achieve sustainable development.

The framework begins by reviewing and assessing the state of the environment in the Arab region. Assessment is merely "the complete social process of conducting a critical and objective evaluation and analysis of customized data and information that suit user's needs and support decision making. It applies experts' decisions on the existing knowledge in order to provide a scientifically credible answer to the questions related to policies."

There are many conceptual frameworks derived from different kinds of assessments, such as the Millennium Ecosystem Assessment Framework and other integrated assessments of environmental impacts.

DPSIR framework has been used in EOAR as a conceptual analysis approach that gathers available data and information and conducts a comprehensive assessment of the interaction between environment and society. It is supplemented by two approaches, namely ecosystems services and vulnerability analysis. This framework has set the basis for environmental assessment using different tools; it attempts to reflect the key components of the complex and multidimensional, multidisciplinary and temporal chain of cause-and-effect that characterizes the interactions between society and environment (see Figure 2).

The series of causative links begins by "Driving Forces" (economic sectors and human activities), followed by "Pressure" (emissions and wastes), "State" (natural, chemical and biological), "Impact" (on ecosystems, health and human activities) and ultimately reaching political "Response" (setting priorities and determining objectives and indicators). The EOAR report has underlined the importance of recognizing the comprehensive nature of environmental problems in the Arab region, alleviating pressures, in addition to transforming challenges into possible opportunities.

Terms and Expressions

The terms and expressions mentioned below, and wherever mentioned, each according to the context and the established sources thereof, shall have the following meanings:

Arab Countries:

The League of Arab States members: Jordan, United Arab Emirates, Bahrain, Tunisia, Algeria, Djibouti, Saudi Arabia, Sudan, Syria, Somalia, Iraq, Oman, Occupied Palestinian Territories, Qatar, Comoros, Kuwait, Lebanon, Libya, Egypt, Morocco, Mauritania and Yemen.

West Asian Countries:

Jordan, United Arab Emirates, Bahrain, Saudi Arabia, Syria, Iraq, Oman,Occupied Palestinian Territories, Qatar, Kuwait, Lebanon and Yemen

Countries of the Arabian Peninsula:

United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, Kuwait and Yemen

Gulf Cooperation Council Countries (GCC):

United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar and Kuwait

The ROPME Countries (Regional Organization for the Protection of the Marine Environment):

Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Islamic Republic of Iran

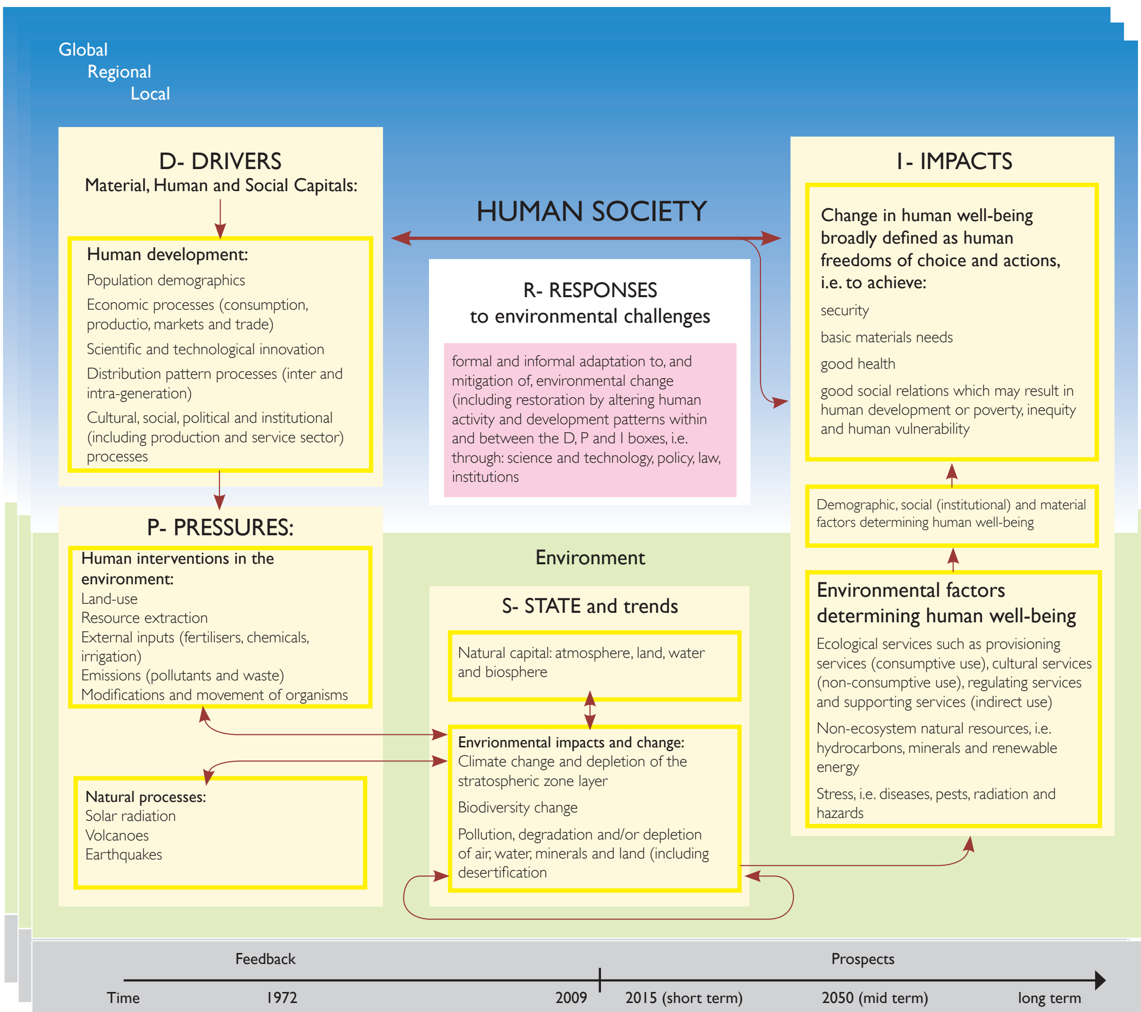
Least Developed Countries (LDCs):

Djibouti, Somalia, Comoros, Mauritania and Yemen

The Arab Mashriq Countries:

Jordan, Syria, Occupied Palestinian Territories, Lebanon, Egypt.

Figure 2 Framework for Drivers, Pressures, State, Impact and Responses (DPSIR)



The Mashriq Countries:

Jordan, Syria, Iraq, Occupied Palestinian Territories, and Lebanon

The Maghreb Countries (North African Countries):

Tunisia, Algeria, Libya and Morocco

Nile Basin Countries:

Egypt and Sudan

The Arab Region.
Jordan
United Arab Emirates
Bahrain
Tunisia
Algeria
Djibouti
Saudi Arabia
Sudan
Syria
Somalia
Iraq
Oman
Occupied Palestinian Territories
Qatar
Comoros Republic
Kuwait
Lebanon
Libya
Egypt
Morocco
Mauritania
Yemen

Section

One

Overview

Chapter 1: Environment for Development and Human Well-Being

Chapter 1

ENVIRONMENT FOR DEVELOPMENT AND HUMAN WELL-BEING

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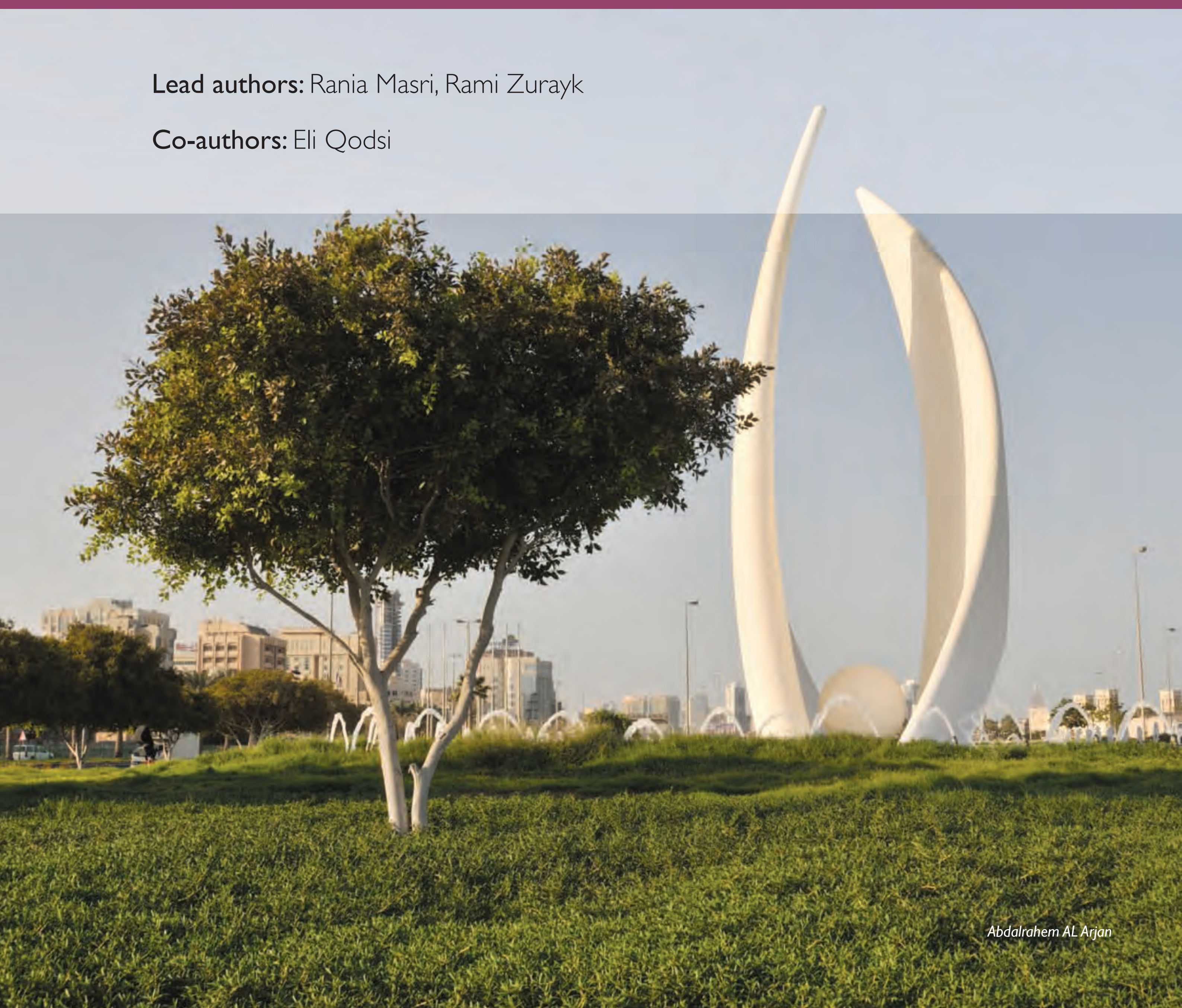

Abdalrahem AL Arjan

Main messages

The environment is the basis for socio-economic development. Sustainable development is the concept that reconciles the protection and maintenance of environmental resources – including crucial biotic elements, renewable and non-renewable resources – with development requirements that address people's needs and desires without extravagance. Therefore, sustainable development can forestall environmental threats and protect society from their impacts. The following are the main messages of this chapter:

- There is a strong link between the environment and economic development. Economic development that does not heed the carrying capacity and capabilities of ecological systems often leads to environmental degradation, represented in the inability of the environment to meet people's needs. This resembles economic deficiency that could accumulate, with future generations bearing the responsibility of its reform. It is imperative to explore other patterns of development that do not deplete limited environmental resources, and preserve some of these resources for future generations. The deterioration of the natural capital will definitely be reflected in terms of expenditures rather than income.

- Since 1972, environmental thinking in the Arab region has made progress that was accompanied by development in environmental institutions and legislation. Nevertheless, several indicators reveal that many countries throughout the region have continued to deplete their natural resources at rates well beyond sustainable levels. In addition, the direct economic cost of environmental degradation in these countries has been found to be 1.5 to 2 times higher than that of high-income countries. The ecological footprint of numerous Arab countries exceeds the global average as well.

- Population growth remains the most important social driver in the region, as well as a significant environmental driver. At the current growth rate, projections show that the Arab population will reach 586 million by 2050 (6.5 per cent of the world population). This will further increase the production of waste and pollutants, consumption of non-renewable resources, and the stress on urban and rural lands. This high rate of population growth raises important questions about the region's future economic health.

- There are a number of constraints that limit the implementation of sustainable development in the Arab region, including population pressure on the limited resources as well as the inability of current development mechanisms to support a sound pursuit of sustainable development. Achieving sustainable development necessitates striking a balance between population growth and the provision of economic growth requirements that increase demand for various environmental elements. Nevertheless, meeting the demands of a growing population without affecting ecological systems is a matter of paramount importance. This, in turn, would emphasize the need for a framework that would allow for reaching the desired balance and reshaping development mechanisms, with due concentration on socio-economic development. This socio-economic development minimizes environmental impacts and promotes sustainable development. In this respect, Arab countries would need to change their conventional views towards their national economies that postulate a limitless growth of these economies. A vital step to sustainability would start by coupling economic development with economic welfare rather than striving for economic growth that relies on limited resources, and overlooking the relationship between economy and the environment.

- There is a close relationship between poverty and environmental degradation, similar to the relationship between population health as well as environmental and economic health. Poor communities in the Arab region depend on natural resources for their living. These communities are often the most vulnerable to any changes or deficiency in ecosystem services. Despite the successful efforts exerted to significantly alleviate poverty in the 1980s and 1990s, it still remains a serious regional challenge to sustainable development. This necessitates developing a unified pan Arab strategy in which developed countries assist less developed ones in building their healthy economies and environments. This should also include a comprehensive solution to additional issues in such a way that comprises gender equity, general education and health care enhancement.

- The Arab region has achieved considerable progress in a number of issues including education, health, gender equity, and poverty alleviation. Nevertheless, maintaining and accelerating this momentum requires exerting tremendous effort and expediting work towards a balanced environmental and socio-economic development. This could be accomplished through formulation of promising policies and implementation of suitable tools to create a sustainable environment, necessary for the achievement of balanced development goals. This should be coupled with the sustainable use of environmental resources throughout the region in a way that positively affects livelihood and well-being.

- Lack of peace and security is a major constraint to sustainable development and establishing them is a prerequisite for this development. Wars and conflicts have exhausted and drained the capabilities of countries in the Arab region, and as a result the environment has been the most affected. Peace has become a strategic option for the people in the region; however, it needs international legitimacy support and the presence of real partners to reach fair and just settlements based on recognition and restoration of rights from usurpers. This will further direct resources towards social development in a way that conserves and develops the environment.

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Introduction

There is a mutual relationship between the environment and human development. Physical environment provides the basis for socio-economic development which, in turn, provides stability and replenishment of environmental resources and services. Common to other areas, the Arab region is an example of this mutual relationship. It is characterized by being an almost singular, arid/semi-arid ecological zone stretching from the Atlantic Ocean to the ROPME Gulf Sea Area. Its total area amounts to nearly 14 million square kilometres representing 10 per cent of the total world land area and is split between the two continents of Africa and Asia. The Arab-African countries occupy about 72.1 per cent of the total Arab region and 33 per cent of the African continent, while the West Asian Arab countries occupy 27.9 per cent and 8.8 per cent of the Asian continent.

Arab countries have depended on natural resources for their development for centuries. In university classrooms around the world, examples are taken from the rich Arab history of environmental management to vividly portray how the environment can provide for economic development, and how the economy and civilization falter when environmental resources are depleted and ecosystem services are undermined. A well known example was the use of oak and cedar wood in trade and development, which was recorded as the oldest reason for forest removal in Syria and Lebanon. Another famous historical example was the development of irrigated agriculture by the Sumerians in Mesopotamia, which led to soil salinity and eventually contributed to the decline of the Sumerian civilization.

Sustainable development is generally viewed as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). This definition recognizes that economic growth and over-consumption hinder the development of future generations by depleting essential natural resources. It also emphasizes the concept of "needs" (rather than desires) and therefore prioritizes the world's poorer communities as well as efforts exerted to alleviate poverty. There is no doubt that environmental sustainability is related to the carrying capacity and efficiency of ecosystems, which cannot be changed unless society changes the way it produces and consumes (Lee and others 2005).

Certain schools of economic thought have shifted their attention from development towards a holistic approach that takes into account social and environmental factors as well as human well-being. According to this view, the environment is considered a source of services that enhances human well-being and improves quality of life (WCED 1987). Furthermore, the economy becomes a subset of the environmental system, rather than falsely considering the environment as a subset of the economy. Consequently, it is the state of ecosystems that determines the size of the economy, and not the reserves, because it is the ecosystem that provides all the resources that the economy depends upon for growth and prosperity (Daly 1991, 2003).

The first part of this chapter will introduce the evolution of thought concerning the environment and development on a global level, and specifically in the Arab World since the Stockholm conference in 1972 and the establishment of the Council of Arab Ministers Responsible for the Environment (CAMRE) in 1987. In the second part, the links between the socio-economic context, human well-being and environment in the Arab region will be discussed. The final part of the chapter will briefly highlight the situation in the region and challenges facing countries in meeting sustainable development and the Millennium Development Goals (MDGs).

Progression of Environmental Thought in the Arab Region

Official international environmental policy making began at the United Nations Conference on Human Environment in Stockholm in 1972, during which environmental issues were included in the national political agendas of numerous countries, including those in the Arab world. From 1972 to 1987, environmental thought progressed from linking environmental degradation to industrialization, to the idea of sustainable development in "Our Common Future" report. This report, written by the World Commission on Environment and Development (WCED), also known as the Brundtland Commission, introduced the link between environment and development by studying six global problems: population and human resources, food security, species and ecosystems, energy, industry, and the urban challenge.

The report also covered shared resource management, ecosystem services as well as issues of peace, security, development and their relation to the environment. Among its major achievements was the definition of the concept of sustainable development (WCED 1987). The publication of the Brundtland Report was followed by the adoption of numerous Multilateral Environmental Agreements (MEAs), most prominently, the agreements adopted by the United Nations Conference on Environment and Development (Earth Summit) held in Rio in 1992. The Rio Earth Summit succeeded in creating stepping-stones for a new institutional framework to implement sustainable development, in addition to global development (see Box 1). The Rio Summit was followed by a number of meetings held in the Arab region that produced the first Arab Convention on the Environment (held in Qatar) and the Arab Declaration on Sustainable Development.

Like the greater international community, the Arab region developed a series of policy changes and actions following the 1972 Stockholm Conference. Exemplifying their supportive attitude towards environmental sustainability, Arab countries signed and ratified more than 75

Box 1. Global environmental actions undertaken since 1992

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1. The Rio Declaration on Environment and Development (1992): Heads of state adopted this declaration during the Earth Summit. It consisted of 27 principles to promote sustainable development around the world – including the right to development and sustainable development, the right to life and a healthy environment, intergenerational equity and the precautionary principle. The Earth Summit further introduced policy changes including the integration of the environment and development in policy making, the attainment of sustainable levels of production and consumption, and the "polluter pays" principle (UN 1992b).

2. Agenda 21 (1992): Agenda 21 is a programme for sustainable development adopted by the heads of state participating in the Earth Summit. It is meant for implementation at the international, national and local levels. Agenda 21 contains 40 chapters divided into 4 main sections: i) Social and economic dimensions; ii) Conservation and management of resources for development; iii) Strengthening the role of major groups; and iv) Means of implementation (UN 1992a).

3. The Millennium Development Goals (MDGs) (2000): 192 states agreed to endeavour to reach the Millennium Development Goals by the year 2015. One of these goals is to ensure environmental sustainability. In order to achieve this objective, countries agreed to: i) Integrate the principles of sustainable development into country policies and programmes, and reverse environmental resources loss; ii) Achieve significant reduction in biodiversity loss by 2010; iii) Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation; and iv) Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020.

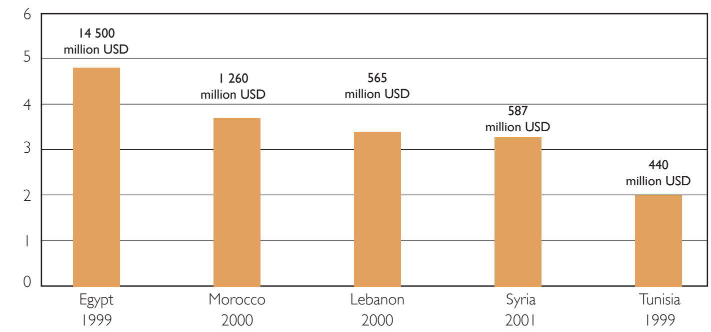
4. The World Summit on Sustainable Development (WSSD) (2002): At this summit, new agreements were reached on water and sanitation, poverty eradication, energy, sustainable production and consumption, chemicals, management of natural resources, and the restoration of the world's depleted fisheries (UN 2002).

UN 1992a, 1992b, 2002

different international and regional environmental agreements (UN-ESCWA 2003, UNEP 1999, CEDARE and others 2001) and adopted and ratified MEAs in their national laws. In addition to international and regional environmental agreements, Arab countries issued national strategies for environmental protection and sustainable development. They created action plans for developing the necessary frameworks for the financing mechanisms needed to properly implement the agreements. They also invested their abilities in assessing their own capacities and environmental situations, and in developing environmental institutions to implement MEAs.

The establishment of the Council of Arab Ministers Responsible for the Environment (CAMRE) was a crucial step in promoting joint Arab action in the field of environment and devising its organisational frameworks, particularly those related to unifying and coordinating Arab stances towards environmental issues (see Chapter 12). At the World Summit on Sustainable Development (WSSD) in Johannesburg (2002), the Arab Initiative on Sustainable Development was launched, and work priorities were set, which are being implemented in the region in cooperation with Arab and UN agencies.

Figure 1. Economic cost of environmental degradation as a percentage of GDP



Sarraf 2004, Sarraf and others 2003, 2004 World Bank 2002

Environmental awareness in the region has improved during that period, as demonstrated by the increase in the number of environmental non-governmental organizations - including the Arab Network for Environment and Development, formed in 1990. Also indicative has been the increase in number of journalists and reporters dedicated to dealing with environmental issues, and the establishment of academic institutes and programmes specialized in the study of the environment.

Importance of Environmental Health to Economic Health: Costs and Benefits

Environmental health and vitality have both direct economic costs and benefits. One indicator of the deterioration of the environment is net savings, which measure the true savings rate in an economy after allowing for the depletion of natural resources. Net savings in the region are estimated at 6 per cent of gross national income, compared to 1 per cent in Sub-Saharan Africa, 5 per cent in Latin America, 12 per cent in South Africa, and 23 per cent in East Asia and the Pacific Ocean (Sarraf 2004).

Environmental economists have also calculated the direct economic cost of environmental degradation in select Arab countries. This cost ranges from 2.1 per cent of the nation's GDP in Tunisia to 4.8 per cent of the nation's GDP in Egypt (see Figure 1). Costs of environmental degradation were estimated for six categories: indoor and outdoor air pollution, lack of access to water supply and sanitation services, land degradation, coastal zone degradation, waste management, and global environment. In Egypt, environmental degradation was calculated to have a relatively large economic cost on society due to the health impacts of air and water pollution and productivity losses associated with soil degradation. Air pollution alone has cost the country an estimated 2.1 per cent of its GDP (World Bank 2002). The cost of environmental degradation in Egypt was two times higher than that of high-income countries, while in Syria, Lebanon and Morocco, the cost was one-and-a-half times higher than high-income countries. In other words, environmental degradation increases the cost of economic growth (see Box 2).

Box 2. Gas flare – environmental pollution and economic loss

Gas flare is a natural combustion process which accompanies oil elevation to the surface. It causes significant economic and environmental losses. In addition to the lost economic value, gas flare is a major contributor to climate change because of the carbon dioxide emissions it causes. According to the World Bank, there is about 150 000 million m3 of natural gas burnt and released annually. The Middle East and North Africa (MENA) are the second highest emitters, after Russia and the Caspian Sea region. In the MENA region, about 45 000 million m3 of gas are burnt annually, with an annual cost estimated at US$10 000 million. Qatar is the first Gulf Cooperation Council country to contribute to the World Bank efforts to reduce greenhouse gas (GHG) emissions emanating from natural gas flare.

A 12-year study (1995-2006) conducted by the American Department of Atmosphere and Oceans revealed that approximately 168 000 million m3 of gas were burnt in 2006. Satellite images also showed that from 1995 to 2006, the rate of burning gas rose in 22 countries, including 7 Arab countries, namely, Iraq, Mauritania, Oman, Qatar, Saudi Arabia, Sudan and Yemen. On the other hand, the satellite images also demonstrated that 16 countries reduced gas burn, including 4 Arab countries, namely, Algeria, Egypt, Syria and United Arab Emirates, while 9 countries, including Kuwait have stabilized their burnt gas.

Both Iraq and Qatar are the first Arab countries to join the World Bank partnership aiming to reduce gas burning from oil extraction at the global level. In its pursuit to reach a zero gas burning level, Qatar is trying to eliminate the conventional sources of gas emission, and is working on how to collect and preserve emitted gas to minimize or stop burnt gas, in addition to identifying possible alternatives for gas use that might reduce gas burning. It is expected that Kuwait, Oman and Saudi Arabia join the global initiative for gas flare reduction.

World Bank 2008, undated 2009

The ecological footprint is another indicator of the direct relationship between the environment and development as well as the significance of environment for economic development. It measures the human demand on the biosphere in terms of area of biologically productive land and sea required to provide the resources used and to absorb produced waste (see Chapter 10). As of 2003, the global ecological footprint exceeded the Earth's biocapacity by approximately 25 per cent. It is also important to remember that we share this Earth with five to ten million species. By choosing how much of the planet's biocapacity we use, we determine how much is left for their use – and thus we further test the strength and resilience of our ecosystems and the production of necessary ecosystem services and products.

There are five factors that impact a nation's footprint, namely, population size, average consumption per person, average footprint intensity per unit of consumption, extent of biologically productive area available, and productivity of that area. With the exception of finite land area and environmental conditions that govern biocapacity, management and policy can significantly impact these factors – either positively or negatively.

On the other hand, the environment can also present economic opportunities if sustainably managed. For example, the Arab region is extraordinarily rich in its potential for solar and wind power. Every square kilometre of land in the region annually receives an amount of solar energy that is equivalent to 1.5 million barrels of crude oil (Trieb 2007). For example, Egypt alone could hypothetically cover the world's energy demands by fully exploiting its solar power potential.

Thus, solar power could support development by reducing environmental costs, reducing energy costs, providing a rich market for employment and business, and triggering investments worldwide of over US$30 000 million. The Syrian government has already begun to capitalize on this resource by investing US$1 480 million, from 2003 to 2011, to produce power from environmentally friendly renewable energy sources. This renewable energy source, from solar and wind power, will provide approximately 4 per cent of the country's needs and create 7 225 jobs. Furthermore, it could save the country US$2 000 million in energy costs (Gabriel 2006).

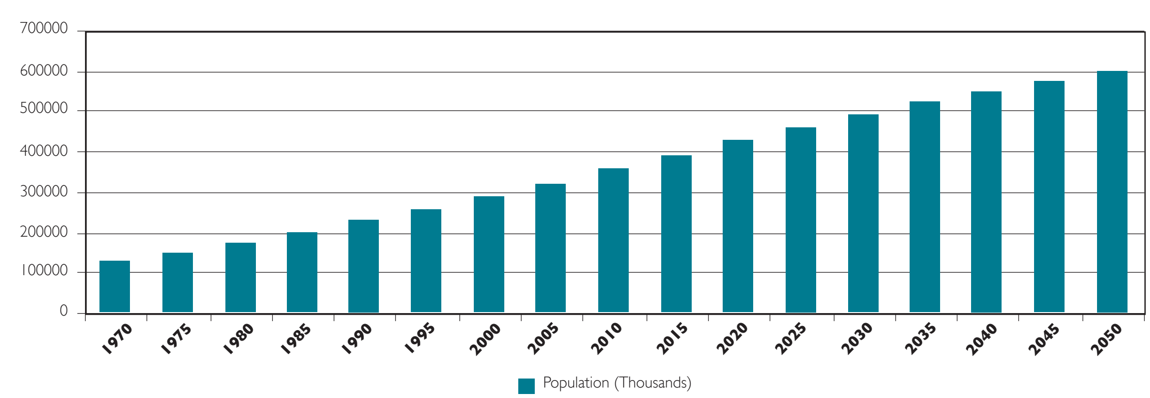
Socio-Economic Context, Human Well-Being, and Environment

Social Development

Population growth

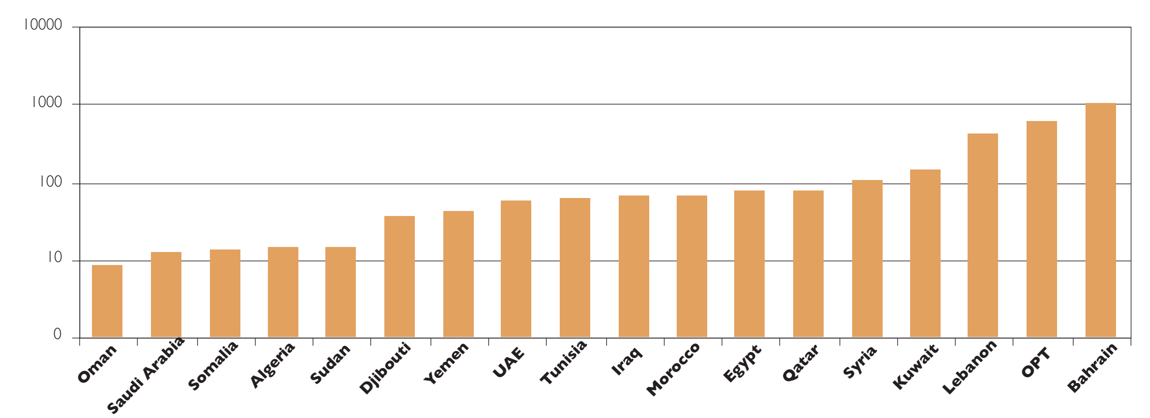
Population growth is the most important social driver in the region and a significant driver for numerous environmental issues (see Figure 2). It increases the demand for natural resources such as fresh water, land and urban space.

Figure 2. Actual and expected population growth of the Arab region



Makdissi and Cherfane 2005, UN-ESCWA 2001

Figure 3. Population densities in the Arab region 2007



World Bank 2007

Population growth also increases the production of waste and pollutants, contributes to coastal and marine degradation, enhances competition over agricultural land, and ultimately drives land degradation further. It also increases per capita consumption, stimulating industries, and worsening environmental pollution with smoke and other industrial waste.

In 2008, the population of the Arab world was estimated at 334 million, with a growth rate of 2.4 per cent. Despite the decrease in population average growth rate during the last 12 years, it is still considered the highest among the major regions of the world with the exception of Sub-Saharan Africa (LAS and others 2009). Projections show that Arab population will exceed 586 million by 2050, and their percentage of the world population will increase to reach 6.5 per cent. As for the current annual growth rate, it is estimated at 2.1 per cent (CEDARE and others 2001). The population growth rate continues to rise despite the steady decrease in fertility rates, from 6.8 per cent during the period from 1970 to 1975, to 4.5 per cent from 1995 to 2000 (UNEP 2003), and to 3.4 per cent in 2007 according to UNEP data. This decrease probably reflects public awareness of the problems caused by high population growth rates in addition to increased percentage of educated women.

Population density significantly impacts environmental health and sustainability. Generally, the higher the population density, the greater the localized pressures on the environment, and consequently, the greater the potential for environmental damage (see Figure 3). For example, high population density – coupled with high per capita income – may negatively influence the degree to which a country can manage sustainability amidst critical environmental conditions (Esty and others 2003). High urban population densities may also adversely affect air quality, as in City where traffic congestion has caused nitrogen dioxide levels to exceed air quality guidelines in the outskirts and centre of the city (EAD 2007). On the other hand, very low population densities may result in difficulties related to access to social services.

Urban Areas

Urbanization is another driving force of environmental sustainability – one that could have a positive or negative impact on the environment depending on the existing level of urban planning and management. Nevertheless, since demand for resources has largely become concentrated in cities, rural-urban migration needs to be evaluated with a focus on environmental management and environmental sustainability. The sustainability assessment approach should be used to provide policy options to assist cities in reducing impacts of local, regional and global transformations while improving liveability and opportunities for their residents (Newman 2006). Given the increased level of urbanization and the evolution of policy systems in Arab countries, it can be said that the region's most vulnerable communities are found in cities, and not in rural areas (CEDARE and others 2001). Thus, as urban populations continue to grow throughout the region there will be increased impoverishment in urban communities, creating even greater concern for human well-being and environmental sustainability.

Arab countries differ widely in terms of urbanization rates. The highest rates of urbanization are found in GCC countries, where approximately 87.3 per cent of the population lives in urban areas; a dramatic increase from 1961 when only 33.9 per cent of the population lived in cities. Mashriq countries exhibited large disparities between urbanization rates with the highest level of urbanization found in Lebanon, where 87.5 per cent of the population lives in cities. The lowest urbanization rates, and the largest disparities between countries, were in the least developed countries (LDCs), where urbanization ranged from 25.7 per cent in Yemen to 83.6 per cent in Djibouti, according to World Bank statistical data. Moreover, urbanization rates are expected to rise significantly in Iraq and Syria by 2015. A medium pace of urbanization is projected for the Occupied Palestinian Territories (OPT) and a low level for Jordan and Lebanon (UN Population Division 2004).

Poverty

Poverty and environmental degradation are very much interrelated, with the world's poorest communities intimately dependent on natural resources for their livelihood and well-being. To adequately benefit from these resources in the long-term, they need to practice sustainable management of resources. However, the poor are rarely in a position of power concerning the management of, access to, or ownership of resources. Thus, communities become more vulnerable to environmental changes and fluctuations in the provision of ecosystem services (UNEP 2007).

Poverty alleviation efforts yielded a positive outcome in the 1980s and early 1990s in the Arab world. However, if income were to be equitably distributed, the actual improvement of living standards would be diminutive, since economic growth rates were roughly equal to population growth rates with little margin to improve the standard of living.

Since the 1990s, poverty reduction has largely stagnated (CEDARE and others 2001) and as a result, poverty remains a serious challenge to meeting sustainable development for many

Ahmed Saad

countries in the region (UN-ESCWA 2002). In non-GCC countries, there has actually been an increase in the incidence of extreme poverty (Abu-Ismail and others 2009).

Kuwait ranked 33rd in the Human Development Index, whereas Djibouti and Yemen ranked 149th and 153th, respectively, out of a total of 177 countries (UNDP 2006). Only four Arab countries have a small rate of human poverty incidence while incidence of poverty remains significantly high in approximately 94 per cent of the countries. Furthermore, since data is missing for Iraq and the OPT, both of whom critically suffer from poverty, the current poverty levels are likely to be much higher.

Both urban and rural areas suffer from poverty in the Arab region. Rural areas are often impoverished due to decentralization, which translates into 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, nomads, refugees and internally displaced persons who live in shanty towns with little or no access to the city's services. These people – the "sometimes poor" – are considered more vulnerable to poverty than the rural poor, also known as the "always poor". The urban poor rarely benefit from the national social safety nets and poverty reduction plans that are set up for the "always poor".

Education

Achieving primary education is a goal of both the MDGs and the Arab Ministerial Declaration. Education is directly tied to population growth, and plays an important role in raising the awareness of numerous environmental relationships. As a

Table 1. Illiteracy as an indicator of gender equity in education, 2007

Countries	% Illiterate (> 15 years) M/F
Jordan	5/15
Tunisia	17/35
Algeria	20/40
Saudi Arabia	13/31
Sudan	29/48
Syria	14/26
Iraq	16/36
Oman	13/26
OPT	3/12
Kuwait	6/9
Egypt	17/41
Morocco	34/60
Mauritania	40/57
Arab States	20/41

UNFPA 2007

group, Arab countries have managed to increase the average years of schooling from 1.1 years in 1960 to 4.8 years in 2000, recording an annual increase of 4.2 per cent, the highest rate among all regions of the developing world. With the exception of the least developed countries (LDCs), Arab countries are likely to meet the goal of universal primary and secondary enrolment by 2015. The LDCs in the Arab region, however, are highly unlikely to meet this goal since nearly one-half of primary school aged 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 the LDCs.

Gender Equity

In the Arab region, the dependence of women on resources, such as water, fuel for cooking, and foodstuffs, is often higher than that of men. However, more often, they have less access to these resources. In addition, women generally have less financial, institutional, and decision making authority than men. 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 equality are education and employment, both of which demonstrate a gender gap throughout the region. Consequently, women still suffer from gender inequality at various levels, and this gender inequality significantly impacts the ability of women – and society – to use resources sustainably and efficiently.

One of the main indicators of female vulnerability is their level of education. Although the region has witnessed the adoption of national policies promoting equal access to education for boys and girls, and although progress has been evident, there remains a critical need for further promotion, particularly in certain sub-regions.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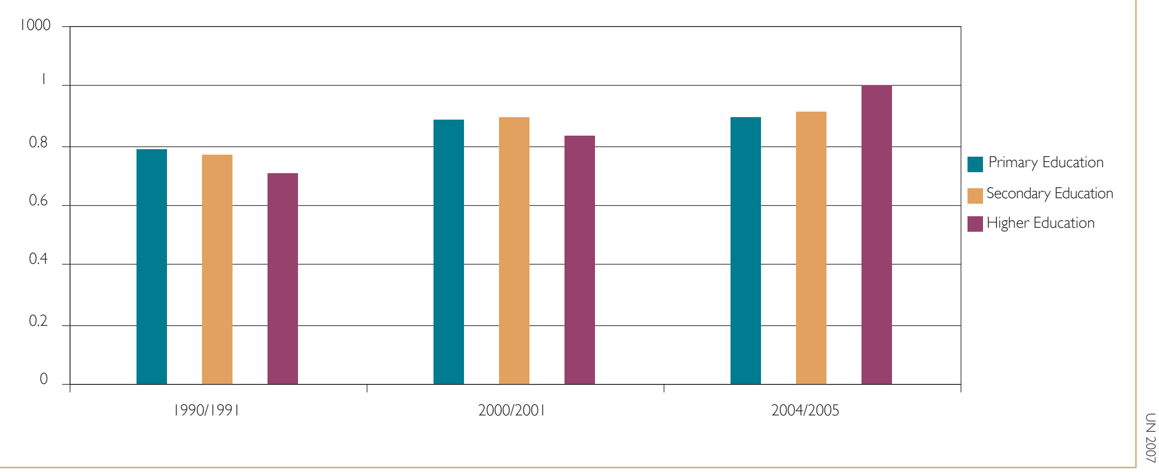
The gender parity index (GPI), measured by the girls-to-boys enrolment ratio has substantially increased at all levels of education over the period from 1991 to 2005. Nevertheless, gender parity in enrolment at primary and secondary levels has yet to be achieved and large disparities between sub-regions and individual countries persist. In 2007, 41 per cent of girls under the age of 15 could not read or write, as compared to 20 per cent of boys (see Table 1 and Figure 4).

GCC countries have shown the highest rates of school enrolment for girls at all levels of education in the 1990s and 2000s. In Kuwait, Bahrain and the UAE, the number of women enrolled in universities was even higher than the number of men. This is due to a number of factors including an increasing trend toward female education, the tendency of males in poorer communities to drop out of school to start work and support their families, or to travel abroad for university

Figure 4. Gender equity indicator of education in the Arab region



education. In contrast, females are encouraged to study in their home communities (CEDARE and others 2001).

In 2004, only 18.3 per cent of women in the Arab world were reported to be involved in economic activity outside of the agricultural sector. This figure is lower than the average for the developing regions (30.6 per cent). This low participation in labour markets has been a consequence of a combination of factors that include low educational and conventional perceptions of the role of the different members of society, and employment regulations that implicitly create a bias against women (UN 2007). While there was low participation in the non-agricultural economic sector throughout the Arab region, women's participation in agriculture was much higher, most particularly in the Arab LDCs. These countries feature high rates of employment for women in agriculture largely because their economies rely so heavily on this sector. Furthermore, within the agricultural work force, there is also gender discrepancy. In all Arab countries (for which there is published data), female employment proportion in agriculture was greater than that of the males. In 2005 in Egypt, proportion of males working in the field of agriculture reached 28 per cent against 39 per cent for females. Meanwhile, male to female employment in agriculture reached 24 per cent to 58 per cent in Syria, 39 per cent to 57 per cent in Morocco, and 43 per cent to 88 per cent in Yemen (FAO 2006).

In countries where agriculture is not a significant contributor to GDP, women's employment is different. GCC countries have very low rates of employed women, due to the fact that the oil industry is not deemed suitable for women, whereas in the more diversified economies heavily reliant on the services sector, higher rates of employed women are observed.

Health

Health is an integral indicator of development. Throughout the Arab world, the infant mortality and the under-five mortality rates have dramatically decreased since 1970 with the exception of countries experiencing armed conflicts such as Iraq and the OPT (UN 2005). Nevertheless, while excellent progress in child health has been achieved throughout the region, infant mortality and under-five mortality rates in the LDCs are still devastatingly high. In the Arab

LDCs, for example, around one in twelve children die before reaching his/her first birthday.

In addition to LDCs, child mortality is highest in countries where human security itself is threatened by occupation and conflicts. We find that child mortality figures are the highest in the OPT, Iraq, Djibouti, Somalia, Sudan and Mauritania, where one out of ten children dies before the age of five (UN 2005). Accordingly, reducing child mortality cannot be separated from overall issues of conflict, poverty, and low-levels of social services, all of which are intrinsically tied to socio-economic development.

Maternal mortality rates have decreased from 465 per 100 000 live births in 1990 to 377 in 2002. Improvements were more remarkable in the LDCs where maternal mortality rates declined by 2.2 per cent than their 1995 levels. This reduction in maternal mortality is linked to the significant increase in births attended by a skilled health professional (UN 2005). The decrease in maternal mortality in the Arab world can also be attributed to the reduction in adolescent pregnancy. Adolescents aged 15 to 19 are twice as likely to die during childbirth and those under 15 are five times as likely to die during childbirth compared to women in their twenties.

Economic Development

Introduction

In the Arab region, economic development has historically been – and still is – closely tied to natural resources. The region's economic growth has evolved considerably since the 1960s, and especially so during the 1970s, due to the oil exporting countries' high revenues and workers' remittances to non-oil exporting countries (Shaban and others 1995). During those years, the Arab region embarked on a strategy of industrial and agricultural protectionism and of public subsidies for food, water, and energy. The 1980s, however, were economically difficult for the region, particularly for the oil exporting countries, due to falling oil prices, deteriorating productivity, and adoption of the World Bank's structural adjustment policies. Beginning in the late 1990s, and markedly over the past five years, oil prices have increased, leading to a dramatic, but not stable rebound in the region's economies.

It is important to recognize that any economy is still defined by its GDP, which is the total market value of all goods and services produced in a country in a given year. In conventional economies, the primary goal is to increase goods and services produced by sectors, thereby increasing GDP. Thus, conventional economies are based on the assumption that GDP can grow vertically and infinitely and that this increase is positive, beneficial to all, and even possible. However, this analysis of economic growth does not include health, education, and the ecosystems necessary for human well-being. Therefore, the increase in GDP is not indicative of a healthy economy. In addition to the pure economic measures of growth, a healthy economy needs to include measurements of social capital (human well-being and happiness), economic equity, and environmental health and sustainability.

In much of the economic literature, it is suggested that with increases in GDP, the status of the environment will be affected. This is the theory of Environmental Kuznets Curve which states that many environmental health indicators, such as water and air pollution, increase with the rise in per capita income until they reach a threshold and then, when basic physical needs are met, interest in a clean environment rises. However, as expressed by the ecological footprint, and presented by numerous published case studies that dispute the Kuznets Curve, use of energy and land resources does not drop with rising income. Furthermore, recent studies have underlined the significance of environmental governance to the GDP. One recent study examining data from 123 countries found no evidence that GDP growth will turn environmental degradation around after a certain point. Instead, GDP's impact, particularly on water quality, is mixed and conditional upon governance (Tan 2006).

Overview of regional economies

Unemployment hinders economic growth and poverty alleviation (UN 2005). A comparative study of unemployment showed that in 2005 the Arab region had the highest unemployment rate in the world at 13.2 per cent while the global average unemployment rate for that year was 6.3 per cent.

Unemployment rates in the region affect 21 per cent of youth, and impact women more than men. The significance of unemployment becomes even more alarming when considering that the labour force increases by 3.5 per cent per year due to population growth, creating an even greater number of unemployed youth.

The Arab region also has the lowest employment rate for population, that is – the number of working age people – that varies between regions. For example, 46.4 per cent of the working age population was employed in 2005, compared to 71.1 per cent in East Asia (ILO 2006). In addition, the region had the highest poverty rate despite availability of work; as families work but family members find themselves still locked in poverty. Thus, there is an urgent need to tackle not only the employment deficit but also wages and inequitable distribution of wealth.

There are significant intra-Arab disparities with regard to economies. For example, the GCC countries account for only 12.4 per cent of the total population of the region and 58.5 per cent of the

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region's GDP, while the Arab LDCs account for 22.5 per cent of the population and only 5 per cent of the region's GDP. Intra-Arab economic disparities are also evident in consumption expenditures per capita (see Figure 5). For the GCC countries, personal consumption expenditures (PCE) per capita amounted to approximately US$5 800 per annum, implying a daily expenditure of US$15.8 per person. In the Arab LDCs, PCE per capita amounted to US$626, or US$1.8 per person per day.

Sectorial examination of the economy

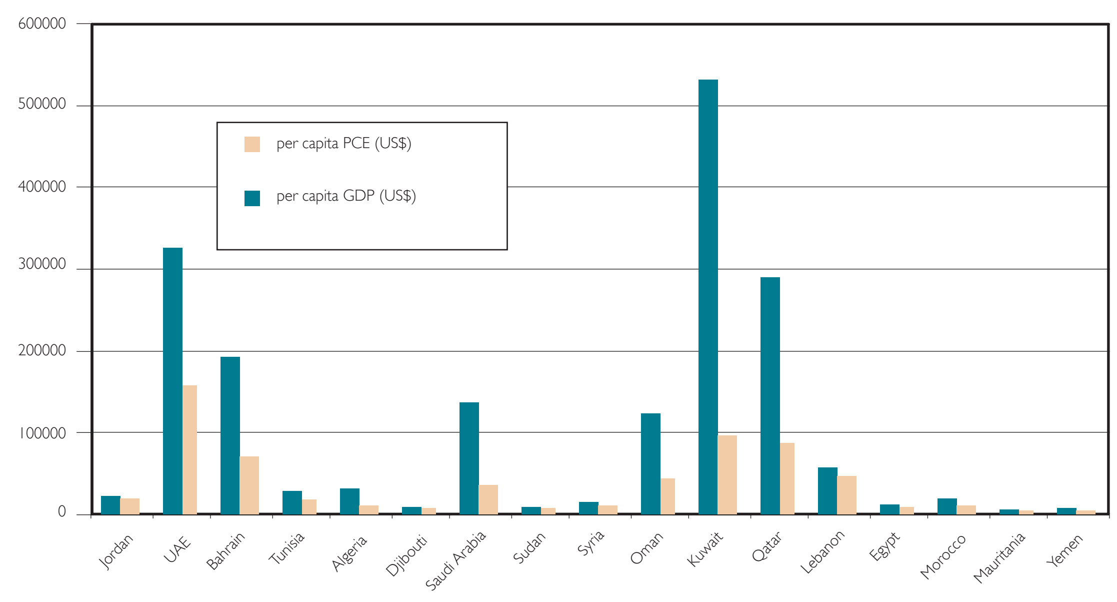
Examining the region as a whole, it becomes clear that the economy's GDP has been consistently dependent on production (see Table 2 and Figure 6), and that dependence on the industrial sector has been steadily increasing, from 31.9 per cent in 1999 to 49.7 per cent in 2006 (see Table 3).

Industrialization in the region has been primarily based on the exploitation of non-renewable natural resources. Moreover, the focus on the extractive industries has steadily grown. Constituting 63 per cent of the industrial sector in 1999, it increased to reach 81 per cent in 2006 (see Table 3). Oil and gas resources in the Gulf States, Libya, Algeria and Egypt, play an important role in this process as exports and supporting inputs for energy-intensive, value-added industries are proliferating throughout these countries.

The extractive industries, which include natural gas, mining, and quarrying industries, provide the region with significant income through trade, employment, and the added value of primary resources. Although oil and natural gas reserves are unevenly distributed among countries in the Arab region, these resources have provided the basis for rapid socio-economic development in the region: directly for oil-producing economies, and indirectly through workers' remittances and aid flow to other countries. The largest share of oil and natural gas can be found in the GCC countries, Algeria and Libya. Other countries such as Syria, Yemen, Tunisia, Egypt and Sudan are also considered exporters of these resources. Recent developments in this sector have further boosted economic growth in most of the Arab region, particularly following the Second Gulf War and the surge in oil prices in 2003 and 2004. Oil import proceeds have increased with an annual average of 6.1 per cent in Bahrain, Oman, Saudi Arabia and the UAE (World Bank 2005). Furthermore, the average OPEC Basket Crude Oil Price increased dramatically – from US$12.28 in 1998 to US$109.42 in 2008. However, despite this wealth of natural resources, the ever-growing demand for electrical energy in the Arab world is not evenly met and cities often benefit from power at the expense of the rural areas. Indeed, 20 per cent of rural areas do not have sufficient access to electricity, which hinders development in the region.

Mining and processing of industrial minerals and metals have increased alongside fossil fuel extraction and are considered an important source of foreign currency in the region. Extracting iron in Algeria and Libya represents 6 per cent of the extracting industry output, while extracting phosphate in Morocco, Tunisia, Egypt and Syria represents about 12 per cent of the total extracting industry output. Mining in general

Figure 5. Personal consumption expenditure in Arab countries (2005)



Abdel-Gader & Abu-Ismail 2009

Table 2. Sectorial composition of GDP in the Arab region, 1995–2006 (Percentage)

Sectors/Year	1995	2000	2005	2006
1. Goods Production	50.4	56.4	60.7	61.9
a. Agriculture	9.5	8.3	6.4	6.2
b. Extractive Industry	21.7	31.0	38.5	40.0
c. Manufacturing Industry	11.3	10.6	9.0	9.5
d. Construction and Electricity	7.9	6.5	6.2	6.1
2. Services*	45.9	40.9	37.7	36.6
a. Public services	15.1	12.2	11.0	10.4

***Services include trade, hotels, restaurants, transport, communications, financial and banking affairs, housing and other public social services.**

LAS and others, 2007

Table 3. Percentage share of industrial sector in GDP of the Arab region

Year	Extractive Industries	Manufacturing Industries	Total Industrial Share
1999	20.0	11.8	31.9
2000	28.1	11.0	39.1
2001	25.1	11.3	36.4
2002	25.1	11.4	36.5
2003	28.3	10.9	39.1
2006	40.2	9.5	49.7

LAS and others 2004, 2007

(metallic and non-metallic ores) accounts for 18 per cent of extracting industries in the Arab Region (UN-ESCWA and LAS 2005).

Furthermore, extractive industries far surpass manufacturing industries as a share of total industrial exports. Therefore, the focus on mining and quarrying has continued to increase in those economies where it is dominant. However, for the more diversified economies in the region such as Egypt, Jordan, Morocco and Tunisia, manufacturing industry exports are more significant than mining and quarrying exports (see Figure 6).

Of particular interest is the tremendous rise in the percentage of extractive industries' contributions to GDP in certain countries. For example, in Saudi Arabia GDP from extractive industry production increased from 38.1 per cent in 2003 to 50.1 per cent in 2006 and in Libya from 57.5 per cent to 71.9 per cent over the same period. The most dramatic rise has been in Iraq, where the GDP increased from 19.5 per cent to 76.7 per cent. In Iraq and Libya, this significant increase was due to the lifting of sanctions. However, of particular importance for these countries' economic and environmental interests, is whether the cash flow from such mining operations will be reinvested in the local and national economy, or whether it will be siphoned out to foreign corporations (see Figure 7).

The increased importance of mining and quarrying industries in Arab economies raises the question of sustainability and credibility within these industries, since mining and quarrying as well as oil and natural gas are dependent on non-renewable resources.

Thus, it is important to both re-invest revenues earned from this sector in renewable resources, particularly human resources, and to ensure that these industries abide by environmental standards in the extraction of resources, and in the rehabilitation of lands that might be affected by these industries.

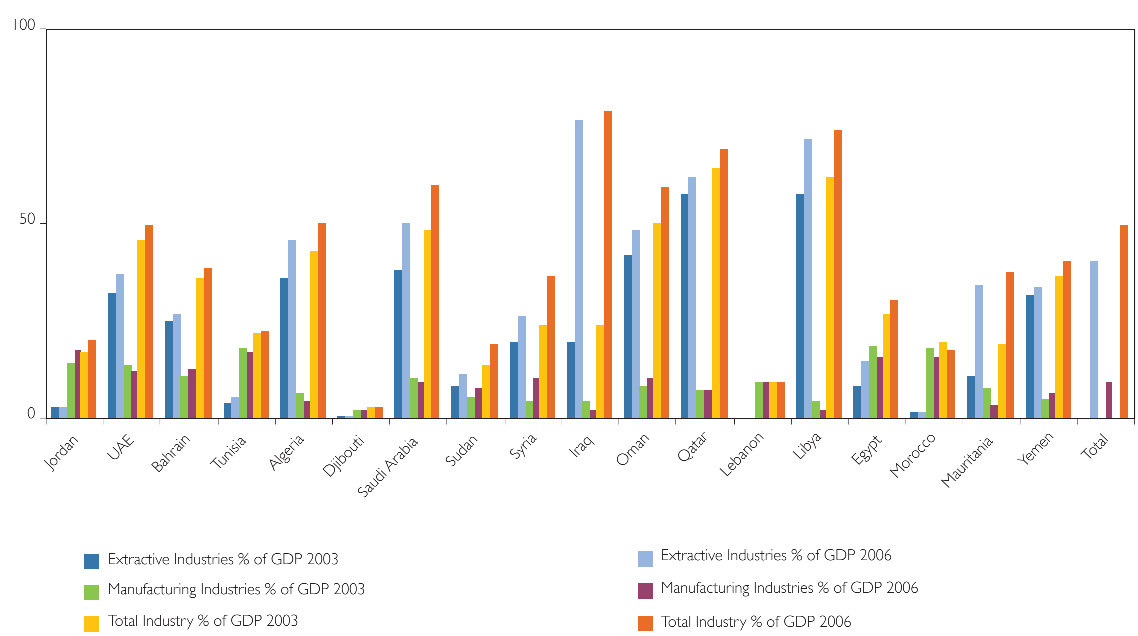
The region's industrial sector is dominated by small and medium-sized enterprises (SMEs) that employ less than 50 employees (Makdissi and Cherfane 2005). However, with the trade liberalization policies implemented in the region, many small businesses could be forced to close, thus contributing to increasing unemployment rates.

Another consequence of industrialization in the region is the environmental degradation it produces. In general, industrialization, specifically aging industries if associated with mismanagement, increases the consumption of natural resources, especially water, and raises levels of pollution. In addition, the proper environmental management and treatment of industrial waste are still missing in much of the region (CEDARE and others 2001). Fortunately, Arab countries are showing increased interest in new pollution-preventive industrial processes with a "detectable trend of shifting from end-of-pipe treatment to more proactive methodologies including cleaner production and at-source waste minimization" (UNEP 2003).

National economies in the Arab region rely on agriculture although it provided the smallest GDP by sector (6.8 per cent in 2005). Agriculture plays a vitally important social role in sustainable development by providing employment for about 30 million local inhabitants (30.6 per cent of total working force estimated for the same year) (AOAD 2008). A strong agricultural sector also helps reduce urban drift and the demand for land for urban activities. It also contributes to trade and ensures food security (UNEP 2003, CEDARE and others 2001). Nevertheless, agriculture places significant stress on water resources as it consumes 88 per cent of water in the Arab world (see Chapter 2: Water Resources).

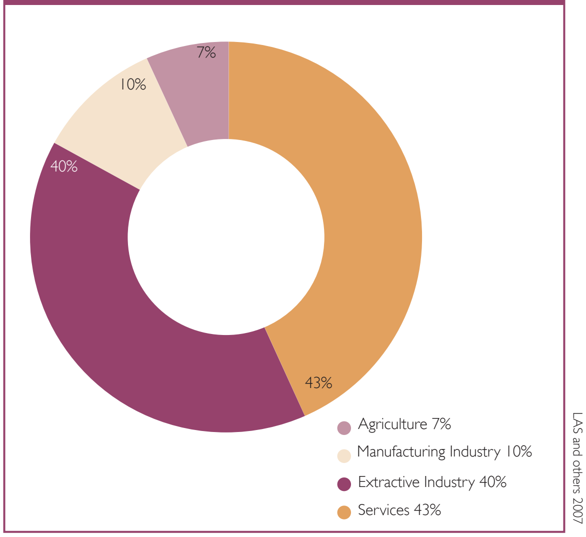
Agricultural employment in the region has declined, from 31.4 per cent in 2000 to 28.2 per cent in 2006 (LAS and Others 2007). In many countries, workers in the field of agriculture leave a life of rural poverty in the hope of finding something better in an urban setting. Nevertheless, many of these rural migrants end up worse or not better off

Figure 6. Percentage share of extractive and manufacturing industries in GDP for selected Arab countries (2003 and 2006)



LAS and others 2004, 2007

Figure 7. GDP distribution by sector in the Arab region, 2006



in the positions they find in cities, usually as casual labourers or petty traders. These issues need to be addressed by policy-makers to ensure that the development process leads to poverty reduction.

The fishing industry is another sector that requires development and sustainable management in the region. Countries such as Morocco, Tunisia, Mauritania, and Oman gain significant revenue from their fisheries resources, contributing to a fair share of trade – primarily exports. Unfortunately, these resources are decreasing due to coastal and marine degradation, overfishing, and increased ship traffic (UNEP 2003). If the exploitation rate of fisheries continues to increase, it will lead to a decrease of fish stock in seas of the Arab region. Most notably, the Bluefin Tuna is nearing extinction because of widespread illicit fishing in the Mediterranean Sea (Black 2007). In addition, the Mediterranean Sea has the highest number of threatened sharks and rays in the world. The extinction of such keystone species will have repercussions throughout the marine food chain. It is important to realize that changes in marine ecological systems may have – as it has had in the past – serious effects on people who rely on their ecological goods and services (IUCN 2007).

It seems that the sector with the least direct negative impact on the environment is the service sector. The service sector's share of total GDP in the Arab region increased slightly, but steadily, from 1985 to 1995, after which point it began to steadily decline. However, in 2001, researchers predicted that the service sector "could well become one of the leading sectors in the near future" (Al-Deen and El-Kholy 2001). Their prediction is still likely, although more research on the future of the service sector needs to be done, particularly since this sector might have a significant impact on education, which may ultimately result in creating more environmentally sustainable policies and economies (see Box 3).

Institutional Trends/Institutional Framework

National environmental institutions in the Arab world still have a very limited role in promoting sustainable development drive.

Box 3. Mega projects

Mega projects have increased significantly throughout the Arab region. They have spread across North Africa – from Tunisia, where a US$25 000 million, 873 ha real estate project is being developed (Bowman 2008), to Morocco, where a US$600 million, 230 ha tourist resort is also being developed on coastal land in Tangier (AME Info 2007), and Algeria, where luxury apartments and hotels are built along the waterfront at a cost of around US$520 million (AME Info 2008). In many Gulf States, man-made islands have been built, including residential compounds, hotels and other trade and service complexes. Most impressive, in size and expense, are the development projects in the UAE. Although these projects create jobs, they come at a high environmental cost which casts doubt on their long-term sustainability.

resources, results in the inefficient implementation of MEAs (CEDARE and others). This, in turn, implies the need for powerful and efficient environmental institutions and legal frameworks at the national level that would encourage public participation of NGOs, academia, civil society and the private sector.

This shortfall is due to the inefficiency of the institutional system in general and governance institutions in particular, in addition to the fact that Arab environmental institutions are fairly new (Abdel-Gader and Abou Ismail 2009). These institutions were established over the last two decades and suffer from lack of expertise and inadequate organization. Furthermore, they are often marginalized on the national political scene in favour of other institutions, such as the social and economic ministries which are viewed as more important by the policy committee. Other factors that limit the efficiency of environmental institutions in sustainable development include: the emergence of large constellations, limited institutional mandate, limited advisory capacity, limited budgets and capacity to generate income, and overlapping institutional jurisdictions (Khordagi 2004). In addition to the inefficient national institutional framework, public participation and NGOs involvement in environmental practices remain inadequate. Moreover, regional resources insufficiency, including financial, technological and human

Barriers To Sustainable Development In The Arab Region

In their pursuit of sustainable development, countries in the Arab region have worked on improving education, health and overall standards of living. At the regional level, sustainable development initiative for the Arab world has been formulated. This initiative addressed major issues that hinder sustainable development in the region namely peace and security, the institutional framework, poverty alleviation, population and health, education and awareness. Other issues included specialized research and technology, resources management, globalization of production and consumption, and trade and investment (Mallah 2002). At the national level, many countries have designed sustainable development strategies based on environmental and human needs and priorities for action (see Box 4).

In addition to the strategic objectives of sustainable development in the Arab region, the adoption of the MDGs was one of the

Box 4. The eight objectives of the Pan Arab strategy for sustainable development

1. Establishing peace and security and abolishing foci of tension and weapons of mass destruction in the Middle East on just bases.
2. Reducing poverty and unemployment.
3. Reaching a just equilibrium between population growth and the availability of natural resources in the region.
4. Fighting illiteracy and improving educational curricula and scientific research.
5. Promoting and strengthening development and environmental institutions, capacity building and environmental citizenship programmes.
6. Halting the degradation of natural resources and environment and striving for the sustainable management of these resources in order to achieve water and food security, conserve ecosystem resources and combat desertification.
7. Developing and integrating Arab production sectors and adopting cleaner production procedures to enhance the competitiveness of Arab products in world markets and increase preparedness for industrial and natural disasters.
8. Supporting the private sector and civil society, giving greater attention to the role of women to ensure their participation in the implementation of sustainable development.

Mallah 2002

global and Arab reactions to the move toward sustainable development. Countries are working to realize the Millennium national goals represented in the following: 1) Eradicate extreme poverty and hunger; 2) Achieve universal primary education; 3) Promote gender equality; 4) Reduce child mortality; 5) Improve maternal health; 6) Combat HIV/AIDS, malaria and other contagious diseases; 7) Ensure environmental sustainability; and 8) Develop a global partnership for development.

Conclusion

Many positive developments have occurred in the Arab world since the Stockholm Conference and the establishment of the Council of Arab Ministers Responsible for the Environment (CAMRE). The concept of sustainable development has been adopted and a lot of efforts have been exerted to achieve it at the national and regional levels. New institutions have been built, new legislation and agreements adopted, and active participation in regional and global meetings and conferences observed. Nevertheless, these arrangements still fail to achieve sustainable development that focuses on the intertwined relation between environment and development.

To achieve environmental sustainability in the Arab region, a new vision of the environment as a pillar of sustainable development has to be adopted and promoted. There should also be an adoption of strategies and programmes that rely on a multisectorial approach for development. There is no doubt that this vision recognizes that environment is a source of goods and services having a specific carrying capacity that can advance human well-being. It also realizes that environmental sustainability is the basis upon which a sound economy depends. In this context, issues of health, education, women's role, poverty alleviation and adoption of the integration principle need to be re-evaluated.

Governments need to achieve equality and fairness in resource investment by defining the various problems and needs of rural and urban communities, and increasing public participation in sustainable development action plans. Involving

civil society and NGOs along with governmental and private sectors, as well as different other entities will lead to reducing the urban-rural development gap. This, in turn, will limit unplanned urbanization and the related environmental degradation problems.

Moreover, there is a need for additional efforts and investments to improve governance, rule of law, democracy and human rights. Major constraints that impede the implementation of the MDGs in the Arab region are poverty, unemployment, wage gaps, gender inequality, illiteracy, wars and conflicts, and lack of Arab economic integration.

Finally, establishing peace and security in the Arab region is a necessary step towards achieving sustainable development, and enabling Arab countries to effectively contribute to global economy and integrate into world environment.

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Section

Two

State And Trends Of Environment: 1972-2009

Chapter 2

WATER RESOURCES

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Main messages

Sustainable management of water resources is the strategic option for the water scarcity prevailing in the Arab region. Integrated management of water resources is the basis for achieving sustainability and securing water resources necessary for socio-economic development. The search for technical, economical and environmental alternatives and options to preserve water are the core responsibility of governments and societies alike. The following are the main messages of this chapter:

- Maintaining water resources is an absolute necessity for sustainable development. Water resources are scarce in Arab countries, mostly located in arid/hyper-arid ecosystems, with very little rainfall, which affects the natural recharging of surface and groundwater resources. The Arab region is considered one of the world's most water-stressed regions, where water resources are facing pressures to meet various requirements of development. Other factors contributing to water problems include irrational use, escalating pollution and lack of strategies and policies for integrated water resources management based on comprehensive methodologies. These methodologies should be supported by suitable institutional frameworks and effective legislations. The present situation is highly risky since adverse impacts will not be restricted to future development, but will also affect the sustainability of various social and economic projects. The situation is aggravated by the ever-growing demand for water caused by accelerated population growth and irrational agricultural policies. Arab countries are currently using all their surface water resources, while groundwater is suffering depletion.

- Developing effective management of water resources requires reforming water policies, with due concentration on managing water supply and demand. It also necessitates improving legislative and institutional measures, empowering the role of water users and the participation of the private sector. Water management through increasing supply has proved a failure in reaching sustainability and ensuring water security to water-stressed Arab countries. Despite the strenuous efforts exerted by these countries to secure their water supply, they are still facing serious shortages of water, as a result of the increasing demand that exceeds available resources. Moreover, inefficiency of institutional arrangements as well as human and institutional capabilities – especially in the field of management and planning – is a major constraint to sound management of water resources in many Arab countries. It is therefore imperative to exert substantial efforts in education, capacity building, and training to set up an applicable mechanism for integrated water resources management.

- There is an urgent need to integrate water and agricultural policies that consider both availability and limitation of water resources as well as the serious repercussions of water overuse in agriculture and other sectors. Irrigation techniques used in Arab countries are mostly inferior. Therefore, efficient use of water resources in agriculture through improving irrigation and agriculture methods, and empowering agricultural integration are vital and urgent issues to ensure food production sustainability and security in the Arab region.

- Groundwater is an important and vital source of water for all developmental sectors in the Arab region. Planning for groundwater management and utilization should be done with caution in order to meet socio-economic development needs, and to support various biological systems that depend on groundwater. Some Arab countries depend on groundwater for up to 80 per cent of their needs. Even in Arab countries with abundant surface water resources, the use of groundwater is continuously growing, and this trend is expected to increase in the future. Groundwater is one of the basic resources in the Arab region; however, it is in a critical situation in many countries because of overuse and inferior quality. This condition has eventually led to a decrease in water supply, increase in water shortage and aggravation of the water problem in the region. It has also resulted in increased health risks associated with water shortage and inferior quality. It is crucial to endorse strategies for water conservation and protection to support water sustainability.

- Climate change has probably become a well-established fact, with a general consensus that most arid and semi-arid lands will experience increased water stress because of the impacts and repercussions of this phenomenon. Climate change is also expected to exacerbate water problems and food production. It is therefore necessary for Arab countries to study expected impacts of climate change on water management and planning and integrate suitable adaptation measures and strategies for water management and related programmes.

- Management of shared water resources is one of the major challenges facing the Arab region. It threatens water and food security and might impact stability in the region. Cooperation frameworks and mechanisms should be promoted between Arab countries and other states sharing water resources in order to maintain a sound management system.

- Growing dependence on unconventional water sources in the Arab region seems inevitable. However, Arab countries are not doing enough to develop these technologies and are mainly depending on importing them. Moreover, the added value of water desalination and treatment projects to Arab countries are very limited. Cooperation and coordination between Arab countries is therefore crucial in order to invest in research and development of these technologies, minimize the cost, increase the added value, reduce environmental impacts, as well as establish these technologies at the local level.

Introduction

Water is the most valuable resource on Earth. It is an important vector for both socio-economic development and supporting ecosystems. In the Arab region, the importance and value of water is even more pronounced because most of the countries are located within arid to extremely arid ecosystems. The Arab region is considered one of the world's most water-stressed areas. A significant portion of this part of the world is characterized by rainfall scarcity and variability coupled with high evaporation rates which limit renewable freshwater supply.

Scarcity of renewable water resources is not the only distinctive characteristic of the Arab region; inadequate levels of management, increasing water deficits and the continuous deterioration of the quality of its natural water resources have become equally distinguishing features during the past decades as well (Al-Zubari 2008a).

In the last three decades, rapid population growth and accelerated socio-economic development in Arab countries have been associated with a substantial increase in water demands. These demands have been mainly driven by the implementation of agricultural policies aimed at achieving national food security in Arab countries, rather than regional integrated agricultural policies.

This individual food security approach has not given careful consideration to the limited availability of water resources in Arab countries. Moreover, agricultural water demands have been exaggerated by inadequate irrigation efficiencies resulting from the use of traditional irrigation methods. This has led to an overall poor agricultural performance, and more dangerously, unsustainable use of water resources for agriculture, as demonstrated by the continuous decline of groundwater and the increasing salinity caused by overexploitation.

Ouzoud Falls in Marrakech are the highest falls in Morocco visited by thousands of tourists throughout the year

One of the foremost challenges facing Arab countries and aggravating water scarcity in the region, as well as impacting human health and ecological systems, is the continuous deterioration of the quality of surface and groundwater resources by industrial, domestic, and agricultural effluent discharges. Furthermore, groundwater resources are being overexploited to meet the ever-increasing water demands of municipal, agricultural, and industrial sectors.

Another major challenge facing the Arab region is the management of shared water resources, as more than 66 per cent of surface water resources originate from rivers outside the region. Conventions and agreements on equitable sharing of water resources have not been signed yet by riparian countries. This issue remains a leading concern threatening stability, food security, and water resources planning in concerned Arab countries. Furthermore, some

Box 1. Arab water under occupation

International conventions stipulate the illegitimacy of exploitation and investment by a military occupying power of natural resources within occupied territories as well as depriving the owner state from investing these resources. Nevertheless, the Israeli practices in the Occupied Palestinian Territories (OPT), the Syrian Golan Heights and South Lebanon violate these international conventions.

In the OPT and particularly in the West Bank and Gaza Strip, the West Bank Military Commander announced that the West Bank water resources belonged to Israel following the termination of the 1967 war. During 1967 and 1968, military orders were issued establishing Israeli authority over all water investments and well-drilling operations (the Israeli Military commander appointed an officer to supervise these operations). Israeli national water companies, Mekorot and Tahal, were contracted to drill water wells and sell water to the Palestinians; with Mekorot continuing to drill wells in the West Bank to date.

Although the Oslo 2 Agreement acknowledged Palestinian water rights, the details (securing and distributing water in addition to the sanitation network) were left to be decided in the negotiations of the final status of the West Bank, which have not taken place till now, leaving water rights mostly in the hands of Israeli authorities. Currently, Israel uses almost 85 per cent of the West Bank water resources and has issued military orders prohibiting West Bank residents from drilling new wells unless approved by the Israeli Military Commander, and only when drilling does not exceed 60 metres in depth. On the other hand, it has allowed settlers to reach depths of 600 metres (ESCWA 1993).

Current studies indicate the presence of 40 groundwater wells in the West Bank that provide Palestinians with drinking water, with an abstraction of about 30 million m3 /year. Clearly insufficient, the shortage is compensated for by purchasing water from the Israeli distributing water company or by collecting spring water. Per capita domestic water consumption is estimated at 50 to 70 litres/day (UNEP 2003) for Palestinians and 360 litres/day for Israeli settlers. Furthermore, Israel has imposed production caps on Arab-owned wells while giving Israeli companies unlimited production. This policy has led to the drying up of a great number of Arab wells. It is worth mentioning that Mekorot, which is in charge of water distribution in Israel, sells the water produced from West Bank wells to the Palestinian local authorities for US$1.5/m3, while Israeli settlers pay around US$0.33/ m3 (UNEP 2003).

Water in the Gaza Strip

The Gaza Strip's current population is around 1.5 million. As a result of climatic, topographic, and geological conditions, groundwater charged from rainfall is the only fresh water resource in the Gaza Strip. The total amount of water pumped from the aquifer according to the 2006–2007 records was about 167 million cubic metres per year (MCM/year). Of that, about 79 MCM/year was used for domestic purposes with about 43 per cent unaccounted for, while the remaining 87 MCM/year were used for agricultural activities. Taking into consideration the natural renewable water amount, which is about 60 MCM/year, the deficit in water balance reaches around 100 MCM/year (UNRWA 2008).

The domestic water supply is provided from local groundwater resources. Municipal wells and distribution networks, storage reservoirs and poster pumps are operated by the municipalities or by UNRWA inside refugee camps. The water supply is generally inadequate in terms of both quantity and quality (UNRWA 2008). In terms of quantity, the efficiency of the water distribution networks (losses account for 45–60 per cent) should be improved to increase the water share per capita. In most camps and municipalities, water supply is intermittent and insufficient to meet average family needs, even

Box 1. Arab water under occupation

when supplemented with rooftop and other storage. In terms of quality, 90 per cent of pumped water does not conform to drinking standards, with rates of watery diarrhoea reaching 14 per cent, and bloody diarrhoea 7.5 per cent in children 0–3 years of age among registered refugees in 2004 (UNRWA 2008).

The ongoing conflict over water resources has led to a crisis resulting in the following challenges:

Water falls in the dead sea, Jordan

- Delays in implementation of critical infrastructure projects in water supply areas, storm water drainage and wastewater collection and treatment projects, due to closures, curfews, inadequacy of construction materials, restricted movement of international and local consultants and work force, as well as disinterest on the donors part to invest in development projects under unstable conditions.
- Since the 2005 Israeli withdrawal from the Gaza Strip, and due to restricted movement of staff and vehicles, solid waste has been left to further accumulate in the camps and municipal areas with significant health risks. This forced the municipalities to use temporary dumping sites or to increase open burning.
- The wastewater treatment plant in the North of Gaza is another example of Israeli military intervention in water related issues, manifested in obstructing the implementation of the treatment plant Sea Outlet to avoid flooding of Um El-Naser village and the nearby agricultural land of Bait Lahia.
- Many water wells in Gaza and Mughraga area are not functioning due to the need for spare parts. These non-functional wells have caused a total deficit of 10 000 m3 per day of drinking water (5 per cent of the total water supply in the Gaza strip and 10 per cent of the total water supply in Gaza Governorate).
- Water wells are affected due to scarcity of fuel for stand-by generators and power supply. This shortage represents about 30 per cent of the production capacity, that is, about 60 000 m^3 per day. The deficit resulting from fuel scarcity, and the need for spare parts is estimated at about 70 000 m^3 per day.
- Chlorine necessary for sterilization is no longer available at the suppliers' stores.
- Due to absence of power supply many homes are unable to operate their domestic pumps to fill their roof tanks (UNRWA 2008).

The situation is not better in the occupied Golan Heights, as Israel invests all of the heights' water resources to cover about 30 per cent of its own annual water usage. The invested quantity is estimated at around 100 million m^3 per year (from the springs and wells Israel has drilled in the occupied heights). Meanwhile, the Golan settlements' actual consumption in 1986 was estimated at around 38 million m^3 per year (UN-ESCWA 1993).

Israel also utilizes water from the Banias River originating in occupied Syrian territories to join the Jordan River before entering Lake Tiberias with an average discharge of 160 million m^3 per year. The same applies to the River Dan originating in the Occupied Palestinian Territories (OPT) close to the Lebanese-Syrian borders with an average discharge of 240 million m3per year. Both the River Dan and the Banias River, in addition to the Hasbani River, which originates in Lebanese territories with an average discharge of around 150 million m^3 per year, form the main tributaries of the Jordan River. Israel taps into the Hasbani River water resources before it flows into Lake Tiberias and pumps around 500 million m^3 per year into the Naqb desert via the Israeli National Water Carrier. That figure is nearly equivalent to the

Box 1. Arab water under occupation

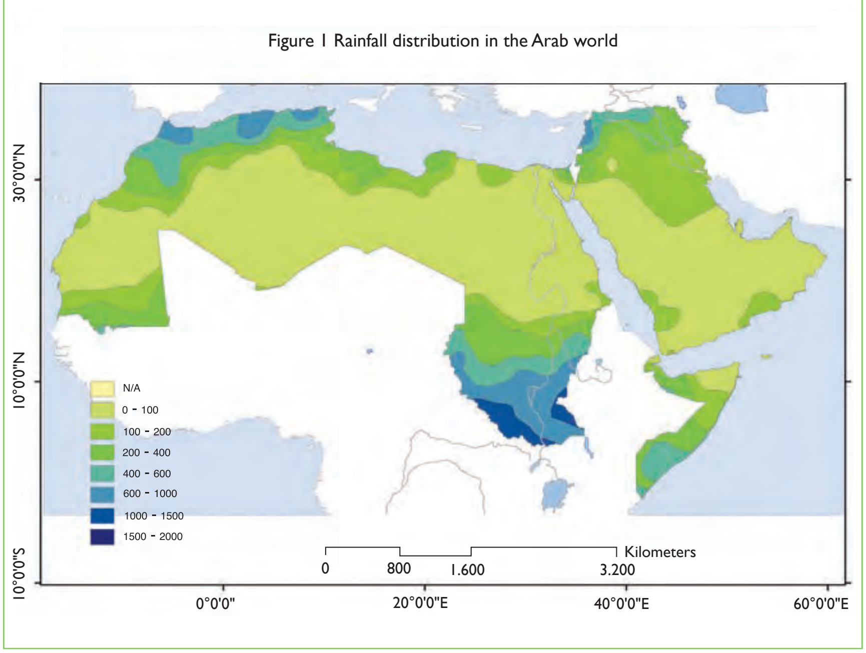
550 million m^3 per year cumulative discharge of the three rivers. Most of the water in the Israeli carrier is believed to be Arab (Droubi 2006).

Sanitary drainage collection pond in Khan Younis as a result of the non-functioning of the sewerage network

Meanwhile, Golan-neighbouring Syrian cities and rural areas of Damascus are dry. Damascus suffers from water outages in summer lasting more than 17 hours per day, while the Golan water reservoir is only 35 kilometres away. Syria continues to explore water resources hundreds of kilometres away (from the Syrian coast or Euphrates River) to meet its current and future water needs. Pumping from these distant water sources requires large sums estimated at more than US$2 000 million with high operating costs, while Israel uses water from the Golan Heights that is sufficient to meet all of Syria's consumption needs for the next 20 years (Droubi 2006).

In light of the aforementioned, more emphasis should be given to water resources management under occupation to guarantee the rights of local inhabitants to these resources. Thus, international legitimacy has a specific role to play in this context (Droubi 2006).

Figure 1. Rainfall distribution in the Arab region

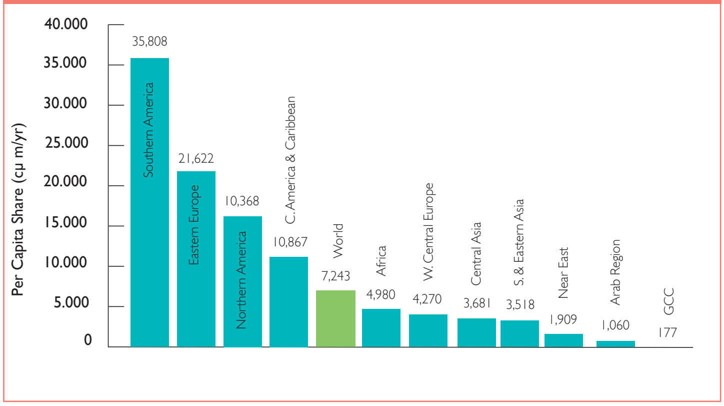


ACSAD 1997b

countries are deprived of their water resources by occupying powers, another major issue in the region constraining the socio-economic development of occupied Arab countries, or countries with some parts of their territories under occupation (see Box 1).

The critical nature of the current water situation in the Arab region is expected to be further aggravated

Figure 2. Per capita renewable fresh water availability in the Arab region compared to the global level



WWC 2006

by the potential impacts of climate change. It is anticipated that water scarcity and quality deterioration in the region will increase due to reduction in precipitation rates, increased domestic and agricultural water demands, and seawater invasion of groundwater resources due to sea-level rise.

Continuous increase of water scarcity

Water availability in the Arab region has played a dominant role in determining distribution of human settlements, socio-economic activities and development plans. More than 85 per cent of the Arab region is classified as arid and hyper-arid areas, receiving an average annual rainfall of less than 250 mm. Areas that have relatively high rainfall rates are limited to locations between the mountainous highlands on the coasts of the Mediterranean and those on the coasts of the Atlantic Ocean, in addition to the southern parts of Sudan (see Figure 1).

Furthermore, rainfall rates are characterized by high spatial and temporal variability with frequent drought cycles experienced in the region, which negatively impacts the reliability and availability of water resources.

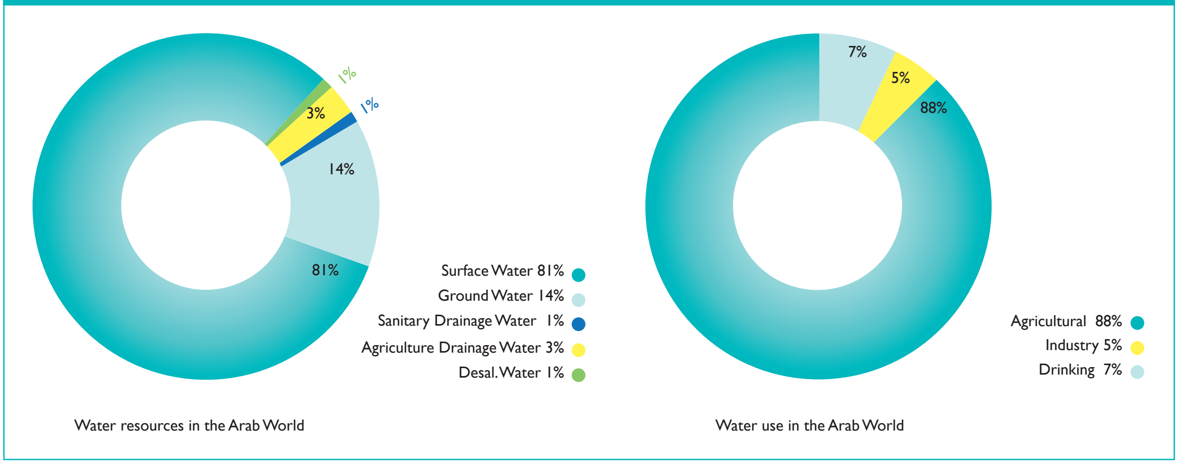
As a consequence of rapid population growth encountered in the region since the mid-1970s, overall per capita fresh water availability decreased dramatically from about 3 500 m3 per year in 1960 to about 1 230 m3 per year in 1995 (see Box 2 and Figure 2) (CEDARE and AWC 2004), and is currently about 1 000 m3 per year (WWC 2006). One thousand m3 per year is the borderline for water poverty, the level at which water becomes a limiting factor for economic development, human welfare and health – in comparison with the world average for per capita water availability which is about 7 240 m3 per year.

Box 2. Water availability per capita in the Arab region

Although Arab countries cover 10.2 per cent of the total area of the world, they only receive 2.1 per cent of the world's average annual precipitation and contain as little as 0.3 per cent of its annual renewable water resources. Their total annual internal renewable water resources account for only 6.3 per cent of their average annual precipitation, against a world average of 40.6 per cent. Moreover, the Arab region has very limited internal water resources which are less than 50 000 million m3 per year on average. The Arabian Peninsula countries also suffer severe water scarcity where the water share per capita does not exceed 169 m3 per year.

In fact, the average per capita internal renewable water resources in Arab countries are among the lowest in the world even when large rivers like the Nile, flowing from tropical Africa, and the Euphrates and Tigris, flowing from Turkey, are considered. The average per capita for all Arab countries is about 1 060 m³ per year (WWC 2006). Furthermore, this indicator is below the absolute water poverty line of 500 m³ per year in 12 countries, reflecting an extreme variability: from a minimum of 10 m3 per capita in Kuwait to more than 4 000 m3 per capita in Mauritania (Dabour 2006).

Figure 3. Water resources and water use in the Arab world

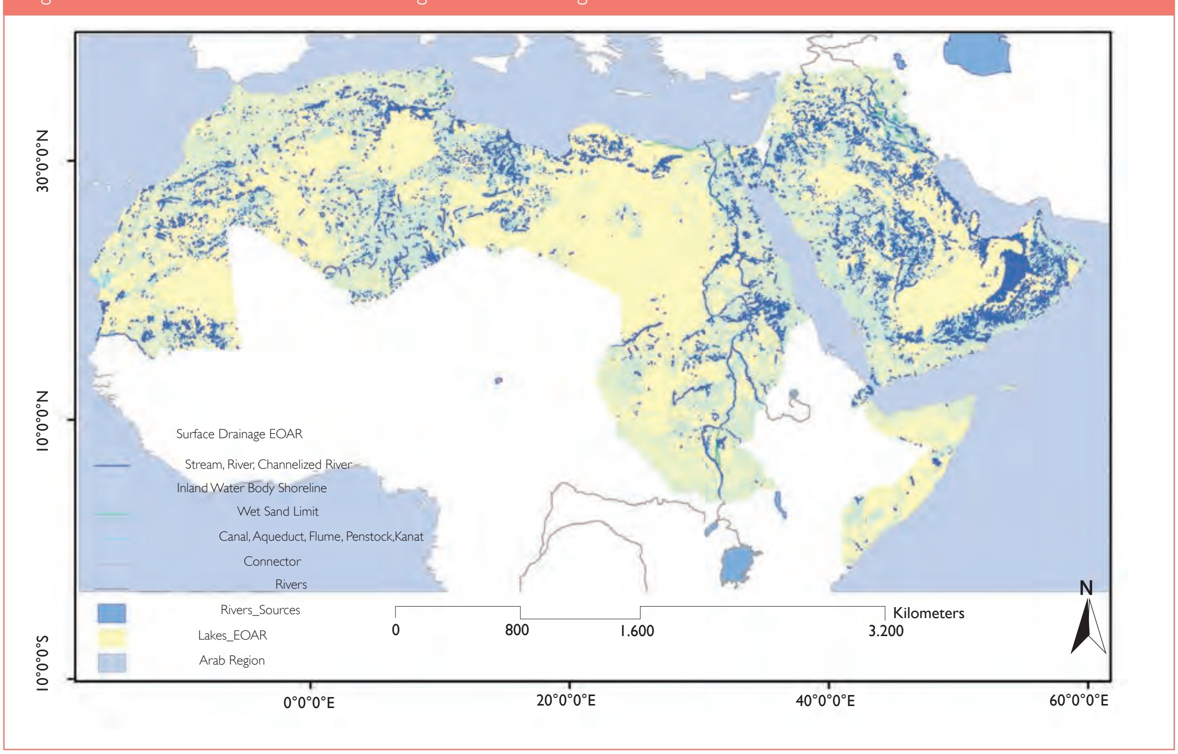


Khouri 2001

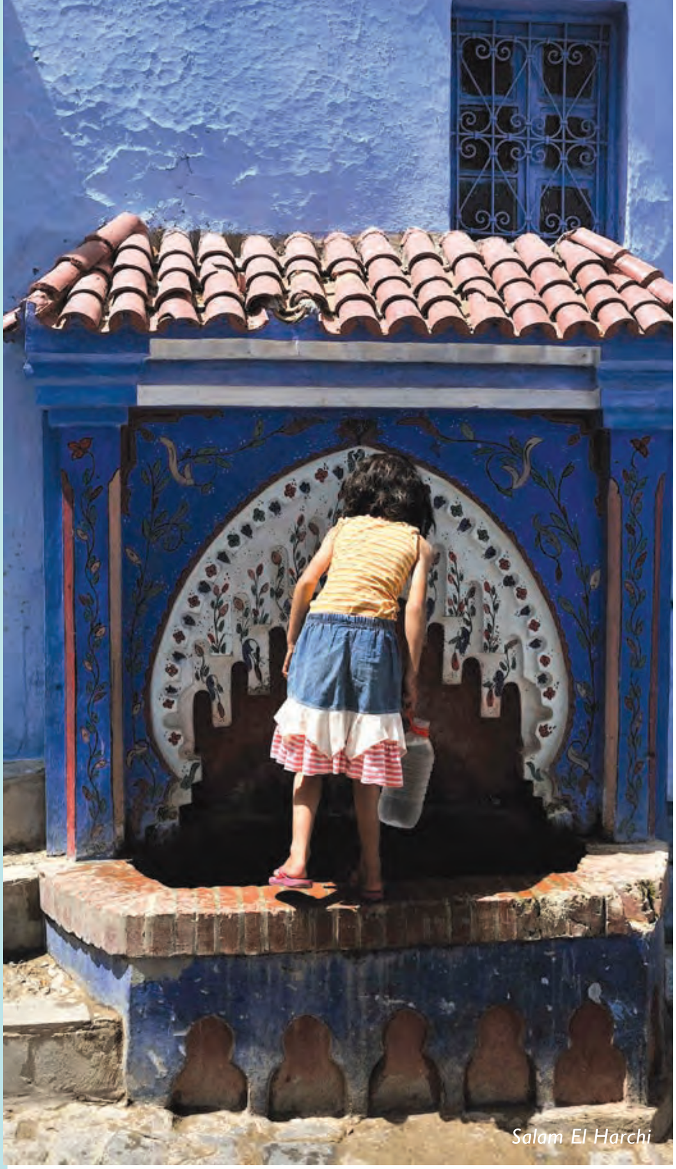
Even worse, based on the projected population increase in the Arab region, it is expected that this indicator will continue to decrease to less than 500 m3 per capita per year by the year 2025, meaning that the whole region will be among countries suffering acute shortage of water, in which water becomes a major limiting factor for life (IFAD 2004).

To meet escalating water demands, Arab countries rely on both traditional (surface water and groundwater resources) and non-traditional (desalinated water, treated wastewater, and agriculture drainage water) water resources to varying extents. Most of the Mashriq and North African countries depend mainly on surface

Figure 4. Surface water and surface drainage in the Arab region



CEDARE


Salam El Harchi

In twelve Arab countries, average water share per capita decreases to less than 500 m3 per year, which is the absolute water poverty line

water resources while those in the Arabian Peninsula rely primarily on renewable and non-renewable groundwater resources. Most Arab countries are increasingly using treated wastewater and the role of desalinated water in securing potable water is also increasing. In Saudi Arabia, desalinated water constitutes more than 90 per cent of the Kingdom's total needs of drinking water according to ESCWA sources. Figure 3 shows the distribution and use of water resources in the Arab region.

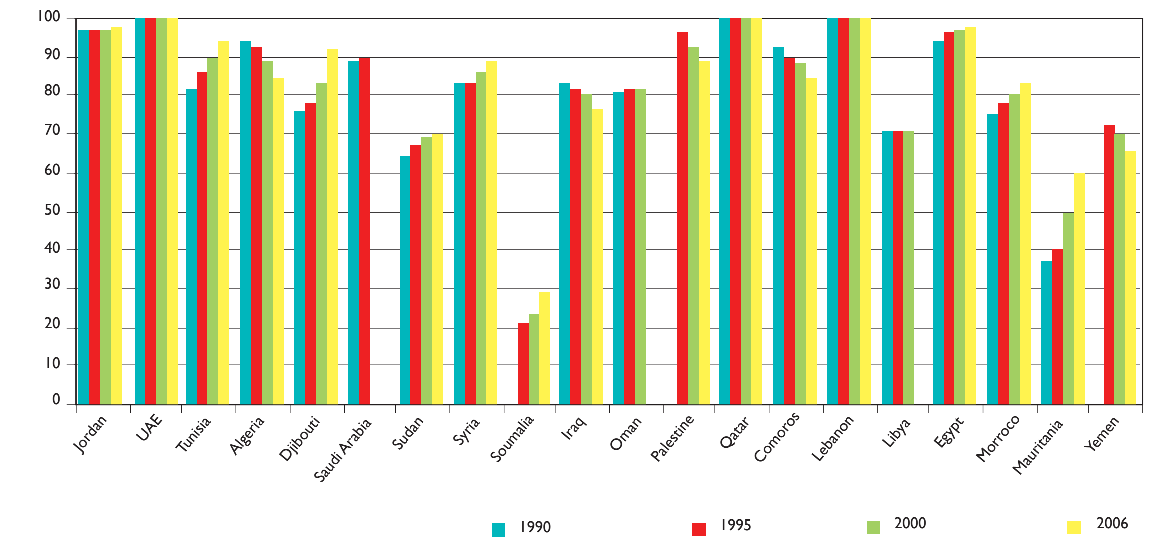
Surface water currently represents the main source of total water supplies in the Arab region, at a ratio of about 81 per cent. However, despite the availability of such surface water resources, more than 66 per cent of these resources (about 174 000 million m3 per year from a total of 224 000 million m3 per year) originate outside of the Arab region. These include major shared rivers (see Figure 4). Many countries in the Arab region share several comparatively small rivers, which include the Yarmouk (between Syria and Jordan), and the Orontes and Nahr El-Kabir Al Janoubi (between Lebanon and Syria). Agreements on equitable sharing of these water resources have not been signed yet by riparian countries. Management of shared water resources among countries located within or outside the Arab region represents one of the major challenges facing the region. It is also a major determinant of regional stability, threatens water and food security as well as national water resources planning.

Escalating domestic water demands

Rapid urbanization in almost all Arab countries escalates efforts and challenges to meet municipal water demands, especially for countries with limited public funds (see Chapter 5 and Chapter 8).

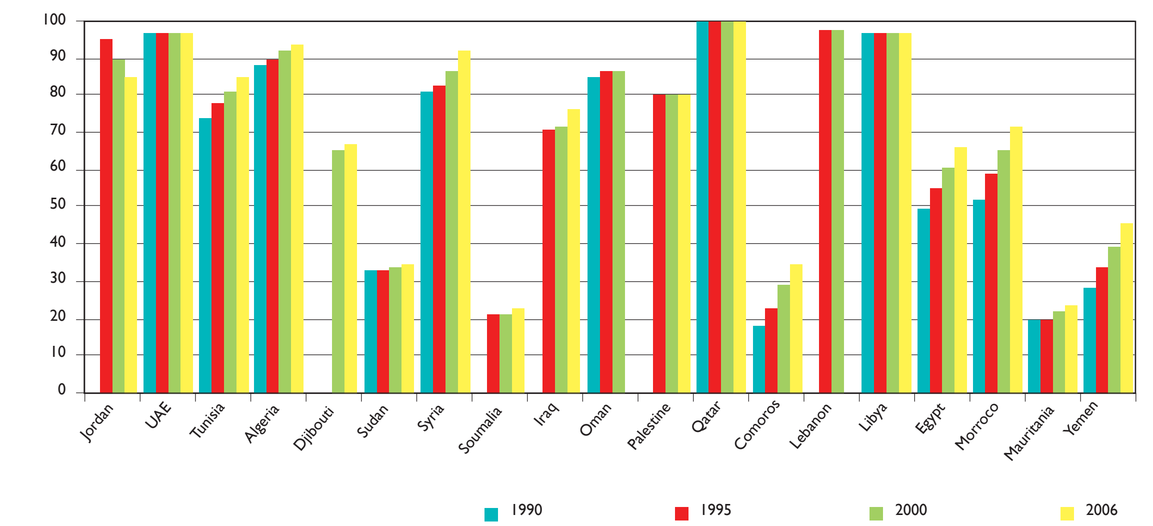
Total municipal water consumption in the Arab region increased from about 12 000 million m3 in 1995 (CEDARE and AWC 2004), to about 16 000 million m3 in 2002 (FAOSTAT 2008). This represents more than a 30 per cent rise in water consumption in less than a decade, a trend expected to persist in the Arab region in the future according to available information about population and urbanization. Currently, domestic water consumption represents about 7 per cent of the total water used in Arab countries (see Figure 3). Although a relatively large percentage of people in the Arab region have access to safe drinking water

Figure 5. Percentage of population provided with improved drinking water services in some Arab countries for 1990, 1995, 2000 and 2006 (%)



UN 2008

Figure 6. Percentage of population provided with improved sanitary drainage services in some Arab countries for 1990, 1995, 2000 and 2006 (%)



UN 2008

and adequate sanitation, these services are not always reliable, especially in low-income areas. This water deficit represents a problem in key cities like Sana'a, Amman, and Damascus (see Box 3).

Average per capita domestic water consumption in the Arab region is about 200 litres per day, but varies significantly among countries. For example, domestic water consumption in the Gulf Cooperation Council (GCC) countries ranges from 300–750 litres per capita per day.

The UAE is the second most global consumer of fresh water after the USA which ranks the highest in the world. The rise in per capita water consumption in these countries is attributed to many factors including the absence of proper demand management. Government policies have focused primarily on the supply side of water production, coming from groundwater or desalination plants. Water tariffs in the region are generally quite low, representing no more than 10 per cent of the production cost on average, with no incentives for consumers to save water (World Bank 2005).

Water and the MDGs

The 1990s witnessed significant progress in expanding access to water supply and sanitation services in the Arab region (see Figures 5 and 6). This progress was not only undertaken to achieve the Millennium Development Goals (MDGs) proposed by the UN General Assembly in 2000 and adopted by the World Summit on Sustainable Development (WSSD) in 2002. It is also the result of water supplies and sanitation issues moving to the top of Arab countries' national agendas as important components of development and human well-being. However, while several Arab countries have achieved commendable progress in providing safe drinking water and sanitation to their populations, there are still many countries lagging behind, as evident in figures 5 and 6.

Currently, approximately 83 million people do not have access to safe drinking water and about 96 million people need access to proper sanitation services in the Arab region. Most of these people live in low-income countries, are under occupation, or are riddled by war and local conflicts. It is estimated that the total financial cost of providing water supply and sanitation services to achieve the MDGs (to half the population by

In the last three decades, rapid population growth and accelerated development in Arab countries have been associated with a substantial increase in water demands.

the year 2015), will be about US$99 870 million and US$60 000 million, respectively (CEDARE and AWC 2005).

This estimate is based on the average actual costs reported by the responsible authorities in different Arab states, but it is worth noting that non-government experts made estimates that were significantly lower (US$13 000 million for safe drinking water and US$47 000 million for sanitation). At this point, low-income Arab countries do not have the financial resources to make this sort of investment. Furthermore, in

Box 3. Growing number of thirsty cities in the Arab region

Water shortage is a permanent problem in some key cities in the Arab region. In Yemen, annual groundwater abstraction rates exceed natural recharge by about one-and-a half times with even higher rates in the Sana'a Basin (World Bank 2008). Rapid population growth (3.6 per cent per year) is outpacing new water supply schemes; consequently, the city of Sana'a faces severe and chronic domestic water shortage (WEC 2001). In Amman, Jordan, shortages have reached the point where many residents receive water only one day a week. The government is undertaking a series of initiatives to address this problem, including piping water to the city from the Disi groundwater aquifer some 325 km away. The sustainability of supply remains a concern, as the aquifer holds non-renewable ground water and hydro-geologic evidence is already showing signs of depletion and increasing salinity (water-technology.net undated, World Bank 2004).

In Syria, Damascus has always had abundant clean drinking and household water, but as the population rapidly grew to about 3.8 million in 2000, domestic water shortages started to be felt slowly and progressively. Currently, the city experiences long periods of daily water shut-offs ranging from 16–20 hours each day for many months, especially in summer. In addition to population growth and severe and persistent drought conditions, water shortages are also attributed to inefficient irrigation and leakage of large volumes of unaccounted-for-water from the municipal distribution network (Elhadj 2004).

some of the financially capable Arab countries, rapid urbanization contributes significantly to the increased percentage of population living without access to these services.

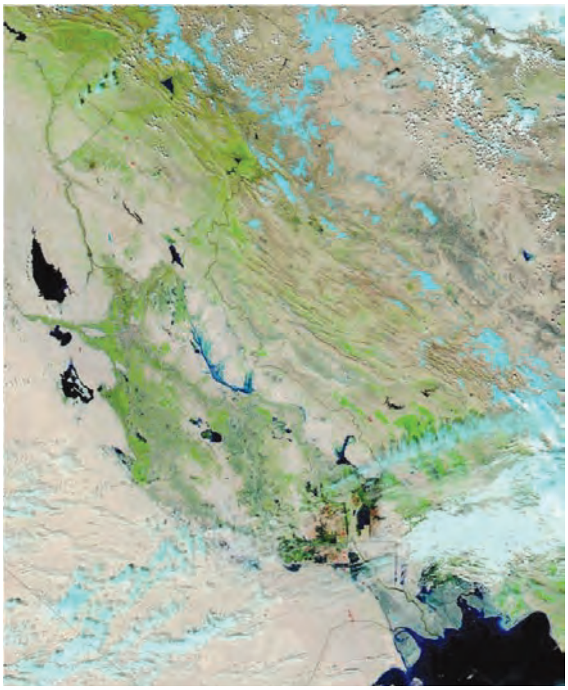
According to an environmental survey in Iraq for 2005, beneficiaries of potable water networks throughout the country, with the exception of Arbel and Dahok governorates, made up about 73.7 per cent of the total Iraqi population. The same survey showed that beneficiaries of sanitary drainage networks, with the exception of the above two governorates, accounted for 25.7 per cent of the total population (Central Authority of Statistics and Information Technology 2006).

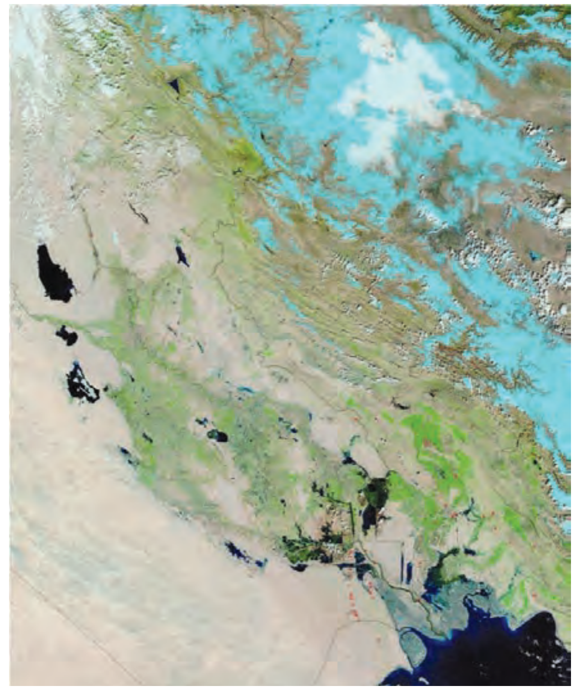
The water/food nexus

For example, in the GCC countries, agricultural subsidies for wells, fuel, agricultural production inputs, price support and trade protection programmes, in addition to lack of control on groundwater extraction, have all drastically increased the area of irrigated land and contributed to the depletion of aquifers. Over the last two decades, the net irrigated areas increased in all GCC countries by 100 to 300 per cent. It is worth noting that in Saudi Arabia, the rapid expansion of irrigation


CEDARE and World Water Council, 2005

Irrigation by inundation in the kingdom of Bahrain





NASA

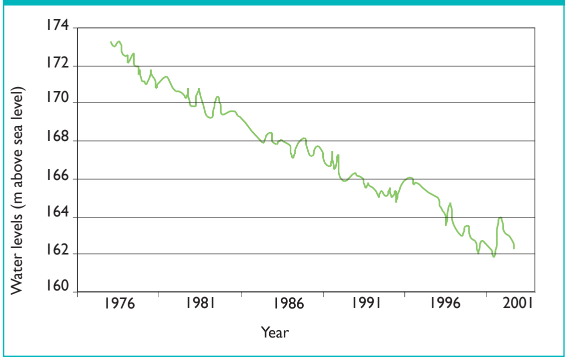
A satellite image showing floods around the Tigris river in Iraq caused by snow and heavy rain events over East of Turkey mountains, 2005

areas, due to generous subsidies, led to nearly a tripling of the volume of water used in agriculture , from around 7 400 million m3 in 1980 to about 20 200 million m3 in 1994. It is estimated that during that period, about 35 per cent of non-renewable groundwater resources in Saudi Arabia were already depleted (Al-Turbak

This unsustainable use of groundwater for irrigation is shown by the continuous decline of water table levels, which in some aquifers dropped more than 200 metres during the last two decades, particularly in the piezometric pressure in the deep aquifers of the Arabian Peninsula and North Africa. The piezometric pressure has dropped 150–200 metres in the continental interfering layer in Tunisia and Algeria and water table levels decreased 50–100 metres in the same layer between 1970 and 2000 (ACSAD and IFAD 2009). As a result, many springs and shallow groundwater aquifers have dried up (World Bank 2005). To rectify the deteriorating water conditions, the Saudi Arabian Government has undertaken serious steps since 2000 which included putting an end to land distribution, cutting agricultural subsidies to reduce groundwater depletion, encouraging the efficient use of irrigation water and reducing national fiscal burdens. It has also focused on directed subsidies and provided incentives for the use of water-saving technologies such as drip irrigation and soil moisture sensing equipment. As a result, wheat production fell from around 4 million tonnes in 1992 to around 1.8 million metric tonnes in 2000. These interventions have led to a decrease in irrigation water demands from about 20 000 million m3 to about 18 300 million m3 in 2000.

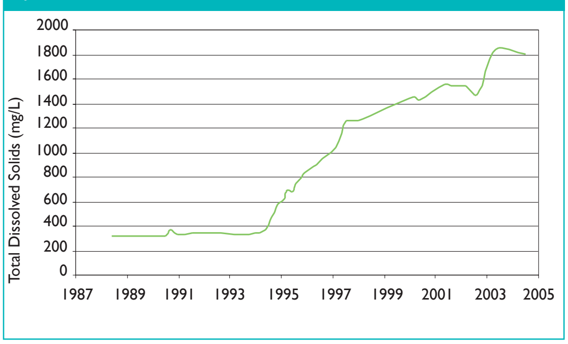
Currently, surface irrigation is by far the most widely used irrigation method in the Arab region, practiced on 80.3 per cent of the total irrigated area. Sprinkler irrigation is practiced

Figure 7. Decreasing groundwater levels caused by over-pumping in Berrechid Basin, Morocco



ACSAD and BGR 2007

Figure 8. Increasing groundwater salinity in Azraq Basin, Jordan



Hadidi 2005

To rectify the deteriorating water conditions, the Saudi Arabian Government has undertaken serious steps since 2000 which included putting an end to land distribution, cutting agricultural subsidies to reduce groundwater depletion, and encouraging the efficient use of irrigation water.

on 22.8 per cent, while drip irrigation on only 2.8 per cent of the total area (Dabour 2006). It is estimated that approximately 50 per cent of water used for irrigation is wasted due to the inefficiency of irrigation methods used (Abu-Zeid and Hamdy 2004). These inefficient methods, including deep percolation, evaporation, and surface run-off, represent foregone opportunities for water use. In the period between 1995 and 2003, agricultural water use in the Arab region increased from about 160 000 million m3 (CEDARE and AWC 2004) to about 200 000 million m3 (FAOSTAT 2008). Despite this high increase in water use, agricultural performance and food production remain unsatisfactory in many Arab countries (Dabour 2006, LAS and others 2007).The Arab region still imports more than 50 per cent of its food while 80 per cent of its agricultural production is located in rain-fed areas (AOAD 2007) (see Chapter 8).

Impacts of overexploitation of groundwater resources

Currently, both renewable and non-renewable groundwater resources in the Arab region, particularly in the Arabian Peninsula, are exposed to critical conditions due to overexploitation and pollution caused by human activities. Renewable groundwater in the region is generally present in the form of shallow alluvial aquifers recharged by the main rivers or directly by precipitation. This groundwater is being used extensively for domestic and irrigation purposes at rates that far exceed natural replenishment rates. This has led to continuous and sharp decline in groundwater levels and severe salinity due to seawater intrusion and saltwater up-flow from lower strata (UN-ESCWA 1999, FAO 1997). For example, in Berrechid Basin near the city of Casablanca, Morocco, overexploitation has led

Furthermore, the over-pumping in most of the groundwater basins in the Arab region has had significant environmental impacts that included drying up of many springs particularly in desert areas, decline in water levels, and in some cases water salinity. It has also led to the drying up of natural springs, the degradation

to groundwater decline of roughly 10 metres over the past 25 years along with an increase in groundwater salinity (ACSAD and BGR 2007) (see figure 7). In the meantime, excessive pumping of water in the Gaza Strip has led to seawater intrusion of about 70–80 per cent of the total coastal aquifer (Al-Yaqubi and Al-Jamal 2002). In the Azraq basin in Jordan, salinity increased from less than 400 mg/L in 1994 to 1800 mg/L in 2004 (Hadidi 2005) (see Figure 8).

In the Arabian Peninsula, where the groundwater dependency ratio is high and reaches more than 80 per cent in countries like Saudi Arabia and Oman, all coastal aquifers are experiencing water level decline and salinity due to seawater intrusion and saltwater up-flow as a result of overexploitation. These include Sana'a Basin in Yemen (ACSAD and BGR 2005), Dammam aquifer in Bahrain (Al-Zubari 2001) and Kuwait (Sayid and Al-Ruwaih 1995, Al-Murad 1994), Umm Er Radhuma aquifer in Al Ehsaa in Saudi Arabia (Al-Mahmood 1987). Other resources include Al-Dhaid, Hatta, Al-Ain, and Liwa areas in UAE (Rizk and others 1997), coastal plain aquifers in Al Batinah and Al-Khawd in Oman (Macumber and others 1997).

and destruction of the surrounding habitats and ecosystems, as well as the loss of their historical and cultural value. An illustration of this is the drying up of Afka spring in the Syrian desert near the city of Tadmor where the historical Kingdom of Zanobia once flourished, leading to the deterioration of the oasis that surrounded it (ACSAD and BGR 2005).

A similar case is the natural ground and sub-marine springs of Bahrain which have dried up as well. In addition, Al Ahsa oasis in Saudi Arabia, most of the oases of the Egyptian Western Desert, Al Kufrah oasis in Libya, the natural springs used to irrigate Tozeur city in southern Tunisia, and the South Algerian oases (See Chapter 3), have all been lost due to excessive pumping and the lowering of groundwater levels. In the United Arab Emirates, intensive groundwater abstraction in the eastern coastal plains caused a widespread increase in water salinity, which led to abandoned irrigation wells and loss of date plantations that were abundant in the area (Al-Asam and Wagner 1997).

Non-renewable groundwater resources, or fossil aquifers, are present in vast areas in the Arab region, namely in the Sahara Desert, North

Africa and the Arabian Peninsula, and are mostly shared by many Arab countries. Examples of these aquifers include the Nubian Sandstone Aquifer (in Egypt, Libya, Sudan, and Chad), the Eastern Arabian Aquifer (in GCC countries), and the Disi Aquifer (in Saudi Arabia and Jordan). These are located in relatively deep geological formations that date back thousands of years and store significant amounts of water. Nevertheless, this water has a finite life and quality limitations. Currently, the majority of the reserves of these basins are being utilized by many countries for agricultural development (see Box 4). With very few exceptions, the use of these non-renewable resources is unplanned and groundwater is being rapidly depleted (Al-Zubari 2008a). Exploiting water resources of these enormous aquifers requires coordination between countries sharing them (see Box 5).

Water resources pollution by anthropogenic activities

In addition to overexploitation and salinity, groundwater and surface water resources in the Arab region are being threatened by numerous sources of pollution generated from agricultural, industrial, and domestic activities. As the quality of water resources deteriorates, utilization diminishes, thereby aggravating water supply deficit and intensifying the problem of water scarcity in the region. Water quality deterioration also increases health risks and damages the environment, particularly fragile ecosystems.

A number of cases illustrate the gravity of the situation in the Arab region. In the Gaza Strip, nitrate levels have increased to 600–800 mg/L from agricultural and wastewater pollution in groundwater. This level is much higher than the adult-drinking water maximum allowable limit of 50 mg/L, as per World Health Organization specifications, posing a serious health risk to the population of the area (Al-Yagoubi and Al-Jamal

Box 4. Sustainability of non-renewable groundwater resources

The issue of "sustainability" of non-renewable groundwater resources is problematic to decision-makers and requires a clear definition. The sustainability of these resources needs to be interpreted in a socio-economic as well as a physical context used with renewable resources.

Full consideration must be given not only to the immediate short-term benefits, but also to the negative long-term impacts of utilization after depletion. The question of what the situation will be like following the exhaustion of these resources should also be considered. So it is advisable to create and apply strategies that include balanced socio-economic choices on the use of aquifer storage reserves, on the transition to a less water-dependent economy, and on the provision of alternative water resources following the depletion of these non-renewable resources (Al Zubari 2008a).

Nabih Saleh Island, Bahrain- 1998

Nabih Saleh Island, Bahrain – 1954

2002). This phenomenon has also been witnessed in the region of Ra's Al Jabal in North Tunisia where the concentration of nitrates resulting from agricultural pollution has reached about 800 mg/L (ACSAD and BGR 2005).

In the Maghreb countries, examples of human-induced pollution include pollution of water resources as a result of untreated wastewater effluents, nitrate pollution of groundwater by fertilizers, cadmium-rich water releases from phosphate mines, and eutrophication of dam reservoirs as a result of organic pollution, particularly in Morocco.

In Egypt, the Nile River experiences more oxygen depletion further downstream, which presents a potential hazard for aquatic organisms. In fact, the northern wetlands of the Nile are experiencing eutrophication at many locations. The excessive agricultural application of nitrate and phosphate fertilizers represents another source of pollution, as do excessive amounts of nutrients that cause the flourish of water hyacinth downstream of waterways (see Chapter 6).

In Sudan, alarming levels of phytoplankton, water hyacinths and high sediment loads carried by surface waters constitute major problems for water management and treatment, and result in high reservoir siltation rates. Furthermore, insufficient potable water supplies and wastewater collection and treatment facilities lead to potential health hazards (CEDARE and AWC 2004).

In North Africa, water quality has received increasingly considerable attention. For example, Egypt, Tunisia, Algeria, and Morocco began to regularly monitor groundwater quality as of the 1990s. Furthermore, Egypt has banned the direct disposal of untreated industrial effluents in the Nile since 1999 (CEDARE and AWC 2004).

In the Mashriq states, the dumping of raw and partially treated wastewater from agriculture, industry and municipalities into water courses has caused deep concern over health impacts, and has subjected agricultural lands and water resources to severe pollution, especially during low discharge periods (during summer when rainfall stops). Contamination of the underlying aquifers was evident as well (CEDARE and AWC 2004). Moreover, river basins in the countries of this sub-region have shown similar symptoms of pollution (Hamad and Others 1997). For example, the nitrate concentration in some domestic wells in the West Bank and Gaza could reach 40 mg/L (Zarour and others 1994).

A pilot project carried out during 2002–2003 highlighted groundwater nitrate contamination in the Mashriq countries pinpointing its gravity as a cause of illness to infants. Most small villages in the region lack adequate wastewater disposal systems, and rely on individual household cesspits. This contributes to the contamination of groundwater, often a source of untreated drinking water. Furthermore, extensive use of manure as fertilizer aggravates the problem as run-off seeps with surface water into aquifers. Nitrate causes methaemoglobinaemia (blue baby syndrome) in infants, a condition that can result in death or mental handicap (UNU 2002).

Once groundwater becomes polluted, it is difficult and usually very costly to remove contamination, especially with the low groundwater recharge

Box 5. Regional programme for the development of the Nubian Sandstone Aquifer System

The Nubian Sandstone Aquifer System (NSAS) is a transboundary groundwater basin in the North Eastern Sahara in Africa. The international waters of this aquifer are non-renewable and shared between Chad, Egypt, Libya and Sudan. The area occupied by the Aquifer System is 2.2 million km^2 and extends between Latitude 14° and 33° and longitude 19° and 34° to cover nearly 828 000 km^2 in Egypt, 760 000 km^2 in Libya, about 376 000 km^2 in Sudan, and 235 000 km^2 in Northern Chad. The volume in storage represents the largest fresh water mass in the whole world. Increasing demographic growth and lack of renewable water resources in this arid region have directed attention towards investing the groundwater potential represented in the NSAS.

In 1998, the Centre for Environment and Development for the Arab Region and Europe (CEDARE) joined forces with the International Fund for Agricultural Development (IFAD), the Islamic Development Bank (IDB) and the riparian countries to initiate a regional programme for the development of the Nubian Sandstone Aquifer System.

Within the regional programme, agreements were signed between the four countries for regular monitoring and continuous exchange of information. The capacity of the four countries was empowered for better management of the aquifer. Regional thematic maps, a regional mathematical model, and a regional information system were developed. This programme provides a model for the management of transboundary water resources in general and shared aquifers in particular. It also enables the environment and paves the way for utilization of the aquifer within the principles of rationalization and regional perspectives.

The Nubian Sandstone Aquifer System (NSAS) is a trans-boundary groundwater basin shared between Chad, Egypt, Libya and Sudan. The international waters of this aquifer are non-renewable.

rate in the area. Currently, several countries in the Arab region have acknowledged the problems associated with polluted groundwater and have launched a number of initiatives to protect these valuable resources from further degradation. For example, in 2001, the Sultanate of Oman issued the Law on Protection of Drinking Water from Pollution, and has since developed drinking water well-field protection zones for all of its groundwater basins (Sultanate of Oman 2001). Additionally, with the help of the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD), the UN Economic and Social Commission for West Asia (UN-ESCWA), Germany's Federal Institute for Geosciences and Natural Resources (BGR) and the German development cooperation (GTZ), the countries of Syria, Jordan, and Yemen have mobilized technical and financial resources to address these challenges. These have included formulating water quality management policies, specifying required legal procedures and defining responsibilities in institutional frameworks that allow for effective coordination between all concerned parties.

The increased reliance on non-conventional water resources

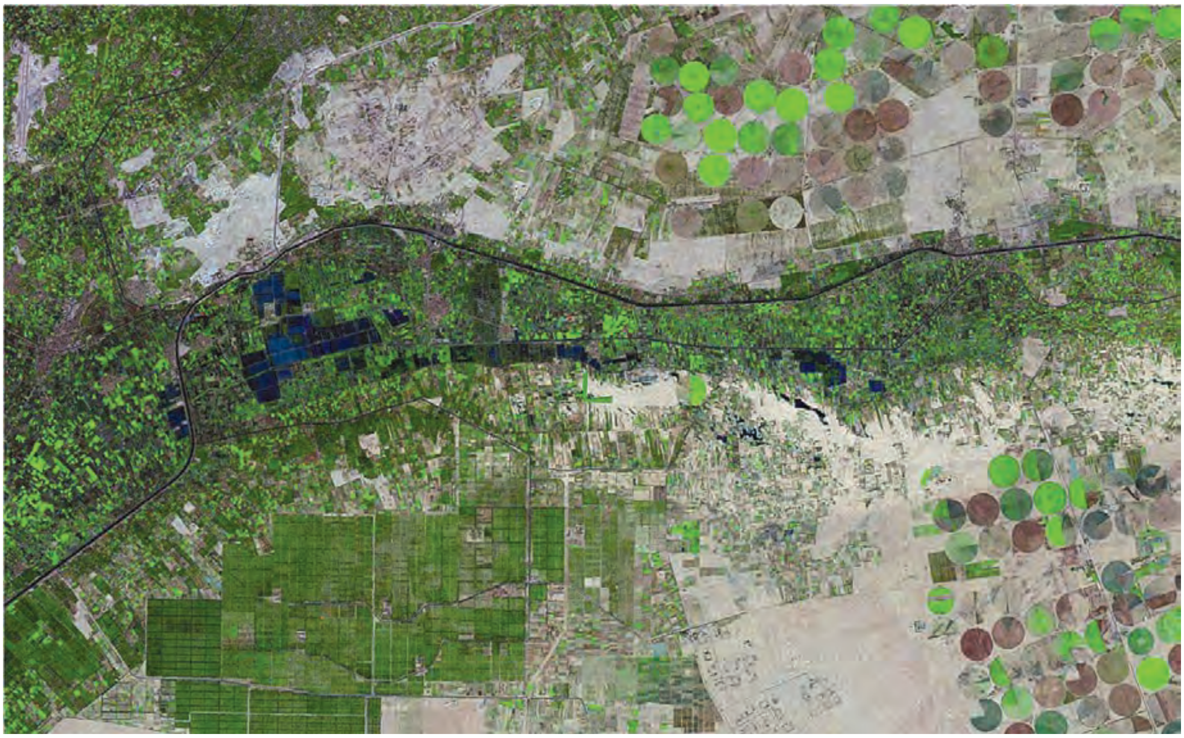
To meet the growing demands and the limited supply of conventional water resources, non-conventional water supplies have been widely adopted by several Arab countries. Some of these non-conventional supplies include, desalinated water processed through desalination plants, treated wastewater produced through re-use programmes, and irrigation water generated from mixing agricultural drainage water with fresh water. Contribution of these various resources to meet growing demands have increased in the Arab region. In terms of non-

Box 6. The role of public-private partnership in Arab countries

The implementation of sound water policies requires the allocation of necessary funds. Often the implementation of water and agricultural projects requires large sums of money. The World Bank estimates the investment required for the water sector in the Arab region for the next ten years to be from US$45 000 million to US$60 000 million (CEDARE and AWC 2004). Currently, the financial capacity of the public sector in most Arab countries is limited and unable to provide all the necessary resources to invest in water, a condition which has been exacerbated by the current state of the world economy. As a result, many Arab countries are encouraging private sector participation in various water projects, such as extending transport networks, upgrading and managing drinking water networks and sewage systems, as well as building treatment plants and developing irrigation systems.

The cooperation between the public and private sectors not only raises the economic efficiency of water services, but also increases the speed of accomplishing various water projects, which accelerates the improvement of sanitary and environmental conditions in society. Therefore, it is necessary for Arab states to reduce (even if partially) their control of the national water sector and to allow the private sector to contribute to financing water projects, under the supervision and regulation of governmental institutions. A number of countries have started implementing this experiment including Morocco, Tunisia, and Jordan, while Saudi Arabia has also begun involving the private sector in building water desalination units.

However, to maintain such cooperation, the presence of adequate institutional structures and trained national cadres capable of monitoring and evaluating recent technological developments is indispensable. Additionally, to ensure the success of these experiments, the participation of water users, who play a great role in the success of projects, is highly necessary. Thus, the private sector's participation should not be considered as a singular goal, but as a part of a comprehensive strategy to increase economic efficiency and improve services (Al-Zubari 2008b).


Landsat 2000

Different irrigation types in Egypt

conventional irrigation water, Egypt and Syria consume the most among Arab countries, as their total volume of agricultural drainage is about 5 700 million m3 and 2 300 million m3 per year, respectively (UN-ESCWA 2007). In these countries, agricultural drainage water is mixed with fresh water to provide agricultural water requirements.

The GCC countries are by far the largest users of desalinated water (either seawater or brackish water), with a rate of 79 per cent of the total consumed in Arab countries. In the GCC, desalination technology was introduced in the mid 1950s, and has developed very rapidly in the past 20 years to offset water shortage and quality deterioration in groundwater resources and to meet quality requirements for domestic water standards and the industrial sector. The expansion of desalinated water, which can be costly to produce, has been made possible by the financial and energy resources of the GCC countries. At present, municipal water supplies in the GCC countries rely mainly and strategically on water produced by desalination plants, which is either used directly or blended with groundwater.

The total capacity of the current desalination plants that are still under construction in the Arab region is more than 3 400 million m3 per year, with an average share of more than 56 per cent of domestic water supply (World Bank 2005). This share is expected to increase in the future as population grows.

While the financial cost of desalinated seawater from recently completed large plants has decreased to around US$0.45-0.70 per m3 in the United States and other countries, the average water production cost in the GCC countries remains somewhere between US$1-2 per m3

(World Bank 2005). This can be attributed to many factors, including the dominance of the public sector over the desalination industry. Although the GCC countries account for more than 45 per cent of the world desalination capacity, desalination remains an imported technology for these countries, with very limited investments in this field. In addition, the desalination industry provides limited added value to the economies of GCC countries in terms of localizing operations and maintenance, plant refurbishment, manufacturing of key spare parts, and qualifying local labour to work in the desalination industry (Bushnak 2002).

More importantly, the construction costs of any new desalination plant capable of supplying water for the rapidly growing population with high per capita consumption rates are enormous. The total construction cost of desalination plants installed in the GCC countries until the year 2003 was estimated at US$21 000 million (UN-ESCWA 2007).

Public-private partnerships, particularly with the national private sector can play a significant role in increasing the operational efficiency of the desalination and municipal sectors, improving technical and managerial expertise, constructing and managing large-scale projects, reducing public expenditures for subsidies, and rendering the water sector more responsive to user demands. Many countries are currently considering the use of public or semi-private corporations to manage water distribution services and to render this sector as independent as possible from any bureaucratic governmental institutional structures (see Box 6).

Although increasing the capacity of desalination plants in GCC countries as well as in some other states is inevitable, it is imperative to alleviate their negative environmental impacts as well. These impacts include: air pollution from oxides emitted during production, seawater and marine life pollution by increased salt concentration from effluents, and emission

Box 7. Impacts of global climate change on water resources in the Arab region

Ras Mohamed National Park , a fissure in the ground - impacts of the 1992 earthquake, Sinai, Egypt

Climate change is now an agreed upon reality. For some time, the manifestations of climate change were attributed to random climatic cycles that affected various parts of the world, particularly the Arab region in which drought cycles prevailed and could not be related to any particular system.

Recent studies, including the 2007 IPCC assessment report, indicate that the Arab region, despite its bare 5 per cent contribution to gas emissions, will be significantly affected by climate change. Future projections suggest a decrease in rainfall in the region according to most global climate models and across all gas emission scenarios (Meslemani 2008). In the Eastern Mediterranean in particular, there is a consensus that climate change and the increased frequency of some extreme weather events like drought and floods will continue to rise (IPCC 2007a).

The current water scarcity will be intensified by a further decrease in water availability due to reduced rainfall, which is projected to decrease by 20 per cent over the next 50 years (Khordagui 2007). Meanwhile, water demand will increase as a result of rising temperatures (IPCC 2007b), leading to increase in evapo-transpiration from irrigated agriculture and natural ecosystems. A decrease in rainfall and an increase in temperatures are projected to contribute to increased evaporation and decreased groundwater recharge. With the growing population, demand for groundwater will increase to secure additional water resources for irrigation and domestic use.

Repercussions of climate change will aggravate water scarcity in the Arab region since projections indicate that Nile water will increase by about 30 per cent, contrary to other projections that expect a decrease of 70 per cent. For both the Euphrates and the Tigris, it is expected that their discharge would decline at a rate of 30–50 per cent (Khourdagui 2007).

Results from an EU Mediterranean project (EU MICE) indicated that there will be general and continuous drought conditions with increase in water deficits in the Mediterranean region (Hanson and others 2007). It is expected that such dry conditions and rainfall decrease will put more pressure on available water resources, especially in the major river basins of the region, which will also be influenced by the increase in water demands in the upstream areas of these rivers as a result of climate change. These phenomena will trigger more competition over water resources, especially in the case of the Tigris and Euphrates, where there is an absence of signed agreements between riparian countries.

Finally, increased temperatures and the associated sea- level rise will result in seawater intrusion into some coastal areas in the Arab region. This will lead to a number of socio-economic impacts in the Nile Delta region in Egypt, and the inundation of some parts of the Bahraini coast. The archipelago of Bahrain has a limited area of about 745 km2, and with sea-level rise it is estimated that an area of 36–70 km2, the equivalent of 5–10 per cent of the total area of the Kingdom will be covered with seawater. This will result in major socio-economic losses, since 80 per cent of the population and infrastructure are located on this coast (GCPMREW 2005).

Probably, the biggest impact of climate change in the Arab region will be its threat to food security, due to the projected decrease in the available water resources and agricultural production. It is therefore vital to consider these potential negative impacts (many of which have already materialized) by planning and integrating appropriate adaptation measures in the national water policies and programmes of Arab countries.

Box 8. IWRM status in the Arab region

Despite progress in water development activities during the last three decades, water management has lagged behind in the Arab world. In order to improve water management practices, efficient development and management of the region's limited water resources is necessary. This will require each country to focus its efforts on the application of a water management approach that is appropriate to the context of its socio-economic development. Endeavours should also aim at meeting the IWRM objectives set forth in chapter 18 of Agenda 21 and the recommendations of the 2002 Johannesburg World Summit on Sustainable Development (WSSD). These recommendations called for the establishment of clearly defined long-term policies and strategies supported by flexible, comprehensive and enforceable institutional and legal frameworks, to ensure effective implementation.

As of 2005, most Arab countries have set policies and strategies for implementing IWRM plans, as per the Johannesburg summit recommendations. However, the level of preparation required for a national IWRM plan varies from one country to another. Some countries including Egypt and Saudi Arabia established a timeline for the finalization of their IWRM plans. Other countries including Algeria, Bahrain and Lebanon intended to create a national IWRM plan but have not yet announced their schedules for action. Several other Arab countries have not expressed their intention to develop an IWRM plan.

There is an urgent need to put integrated water management high on the political agendas of Arab countries in order to enable concerned decision-makers to act effectively in the interest of sustainability as well as provide needed financial and human resources.

UNESCO 2005

of residual treatment chemicals and trace elements picked up within desalination plants (Abderrahman and Hussain 2006) (see Chapter 4). As the capacity of desalination in the GCC countries, as well as other Arab countries is expected to increase in the future, efforts should be exerted to mitigate these impacts on the surrounding environments.

Re-use of treated wastewater in Arab countries constitutes another source of water driven by escalating municipal water consumption in urban areas. Treated wastewater is now considered a potential non-conventional source of water that could supplement other available sources and alleviate pressure thereof. Currently, a total of more than 10 000 million m3 of wastewater is produced in Arab countries (Khouri 2001). If properly treated, this quantity could provide some sectors with a good portion of their water requirements, especially that only 40 per cent of this amount is currently either primarily or secondarily treated (UN-ESCWA 2007).

The remaining quantity is discharged untreated to open water channels, to the sea, or to ground reservoirs, which raises concerns about their risks and negative impacts on human health and the environment (Al-Zubari 2001). If properly treated, wastewater could provide additional resources to support water demands of some sectors, such as the agricultural and industrial sectors, and prevent health concerns as well.

In almost all of the GCC countries, modern treatment plants are operating with tertiary and advanced treatment capabilities. In 2000, treated wastewater in the GCC represented about 20 per cent of the total municipal water volumes consumed (World Bank 2005). This clearly indicates the magnitude of wastewater discharge problems and impacts on public health as a result of the contamination of shallow groundwater and marine and coastal environments. Additionally, wastewater discharge contributes to the problem of shallow water table rise in urban areas, such as the case in Riyadh, Doha and Kuwait, and is associated with health hazards and corrosion of the foundations of buildings, as well as flooding of basements and pipe networks (UNEP 2003, Morris and others 2003). The re-use of treated municipal wastewater does not exceed 12 per cent of consumed municipal water, and nearly 60 per cent of treated wastewater, indicating the magnitude of water loss as a result of non-use of this volume of water after treatment.

Remaining unused wastewater is discharged in valleys eventually reaching shallow groundwater or the sea. Treated water is mostly used in the forestation of urban areas, irrigation of public parks and for growing fodder, which undermines its economic value under the present water-stressed situations in the region. Currently, all of the GCC countries have ambitious plans for expanding their use of reclaimed wastewater to meet future demand for irrigation water and to reduce groundwater abstraction for agricultural use (Al-Zubari 2008b).

There are many advantages to the re-use and treatment of wastewater in Arab countries, such as meeting the increased need for water by the growing population (coupled with urban expansion), and alleviating water scarcity in the region. However, there are many obstacles to the development of water re-use capacity. These include social barriers (such as psychological disinterest and religious beliefs) as well as technical (microbiological pollutants, potential heavy metal accumulation in irrigated soil, and industrial waste mixing).

Mila Zinkova

The successful and efficient re-use of treated wastewater, particularly in irrigation, depends on a multitude of strategies, which include increasing the reliability of reclaimed wastewater as an alternative to groundwater in irrigation, raising public awareness regarding its utilization, and setting national standards for wastewater re-use and protection of public health. Strategies should also comprise implementing effective plans to increase crop value and conserve groundwater (Al-Zubari 2001). As with desalination technology, coordinated research and development in wastewater treatment technology is very limited in the Arab region.

Future water demands and water availability

If current drivers of water use and low levels of management intervention continue in the future, Arab countries are expected to face serious challenges in providing sufficient water to meet development requirements. In fact, based on current population growth trends and food self-sufficiency policies and studies, the Arab region will experience acute water deficits in the near future (ACSAD 1986, 1997a, Khouri 2001, Abu-Zeid and Hamdy 2004, CEDARE and AWC 2005,

Box 9. Examples of IWRM initiatives in Arab countries

Reforming water services in Yemen: In Yemen, institutional reform in water supply and sanitation has taken place with clear organizational responsibilities and roles, while in the past it was "centralized" and without participation of the local authorities or the users. To this end, the Water Law of 2002 is being implemented by the National Water Resources Authority (NWRA) to develop, regulate, and rationalize water resources. Urban water supply and sanitation are the responsibility of the National Water Supply and Sanitation Authority (NWSSA). The General Authority of Rural Water Supply (GARWS) coordinates rural water supply, in partnership with the local councils responsible for the construction and management of water projects. The Board of Directors has been expanded to include water users and other stakeholders in the water and environment sector. New water policies include the introduction of water meters and the raising of tariffs.

Applying water regulations in Jordan: The Ministry of Water and Irrigation adopted a stepwise approach to introduce several new strict regulations over the last 15 years. For example, the prohibition of new well drilling in depleted aquifers and an inventory of groundwater utilization led to a significant reduction in abstraction between 1993 and 1997. The imposition of charges for groundwater was initially resisted by domestic, industrial and commercial users, but has resulted in the installation of water saving devices and a 10 per cent reduction in demand. Farmers fiercely opposed the introduction of irrigation meters, but now a 95 per cent compliance rate has been achieved.

Promoting water awareness in schools and universities in Lebanon: To celebrate the International Year of Freshwater 2003, ESCWA and UNESCO Cairo office collaborated on two projects. An art competition was held for primary school children throughout Lebanon (ages 6–12 years), in cooperation with the Educational and Social Council and a national newspaper. Twenty-five schools participated and over 600 pictures were received. The Lebanese Minister of Energy and Water presented the awards. Additionally, an ESCWA Water Research Prize was awarded to an undergraduate student for the most original work on a critical water resources management issue in the region.

UN-ESCWA 2004

UN-ESCWA 2007). Using variable population growth rates (Khouri 2001), it is estimated that by the year 2025, water requirements will increase to 500 000–550 000 million m3, meaning that about an additional 242 000–292 000 million m3 of water will be needed to maintain current policies and practices.

The estimated water deficits will be exacerbated because of climate change and the recurrence of drought cycles and their potential impacts on water resources in the Arab region. These impacts are expected to reduce renewable water resources and increase precipitation variability as well as agricultural and domestic water consumption (see Box 7). This is notable for countries located in the Mediterranean Basin and Southern Sudan, which are the most agriculturally productive areas in the region.

Many of these countries rely on surface water resources shared with countries outside the Arab region. While some of these surface water resources, such as the Nile, are governed by international conventions, others are still without final agreements on the equitable sharing of resources. As riparian countries intensify water development efforts to meet their growing demands, competition over shared resources will increase and impact water availability at the lower reaches of rivers. Under these unfavourable and uncertain conditions, it is expected that food self-sufficiency ratios will decrease with time, leading to failure of adopted agricultural policies.

The need for institutional and policy reforms

To meet rising demands, water authorities in many Arab countries have focused their efforts mainly on the development and supply augmentation aspects of water resources management. Increasing water demands are being satisfied by the extensive use of groundwater, expansion in the installation of desalination plants, treatment and re-use of wastewater as well as the construction of dams to collect, store, and re-use surface water.

However, the supply-driven approach to water management has demonstrated an inability to deliver water sustainability or security in many water-stressed Arab countries. Despite the strenuous efforts made by these countries to augment and develop their water supplies, they still face serious water deficits due to continuously increasing water demands that exceed their limited water resources. Indeed, whether adequate supplies can be sustained without negative socio-economic impacts is questionable. The supply augmentation approach, coupled with inadequate attention to improving and maximizing the efficiency of water allocation and use, has led to the emergence of a number of unsustainable practices in these countries. These include: low water use efficiency, growth of both sectorial and per capita water use, increase in costs of water production and distribution, and deterioration of water quality as well as land productivity. The situation is further aggravated by the lack of comprehensive

Water resources are scarce in the Arab region mostly located in arid/hyper arid ecosystems.

long-term water policies and strategies based on considerations of supply and demand in most Arab countries. This is accompanied by institutional weakness, insufficient institutional and human capacities, overlap of water agencies, and inadequate involvement of civil society in water management.

As pressures continue to converge on the limited water resources in the Arab region and other parts of the world, the need for innovative approaches in water management has become quite urgent. The international community has recognized this fact, and over the past decade has decided that the integrated water resources management (IWRM) approach is an appropriate method of addressing the threats posed to water resources. Within the framework of sustainable management of water resources, IWRM takes into account a broad spectrum of social, economic, and biological factors and their linkages. Furthermore, effective coordination and participatory decision making processes are insured throughout IWRM and include collaboration and partnerships at all levels, from individual citizens to organizations. IWRM is based on political commitments and a wider societal awareness of the need for water security and sustainable management of water resources. To achieve an effective IWRM policy, there is a need for coherent national and regional policies to promote good governance of water resources management (see Box 8).

Fortunately, most Arab countries have realized that efficient development and management of water resources require water policy reforms that emphasize supply and demand management measures and the improvement of legislative and institutional provisions. Appropriate water policy reforms should address the key issues of reliable assessment of water supply and demand; water quality deterioration and protection; public health protection; water use efficiency and allocation; private sector involvement; cost recovery policies; stakeholder participation; improved institutional support; food security; and growing water scarcity problem When addressing these key issues, water policy reforms should also take into consideration specific requirements and prevailing social, economic, and cultural conditions in the region.

Deficient educational and technical levels, institutional inefficiency and inadequate human capabilities, particularly in planning and management are major constraints facing countries in water resources management. It is essential to intensify development and building capabilities, and training in these fields in the Arab region.

The management of any economic sector, such as the water sector, is based on three major interrelated components: institutional structures, human resources, and the enforcement of policies and legislation. The water sector in the Arab region is well developed in some countries which have the necessary institutional framework and human capacities capable of effectively managing water resources. On the other hand, other countries are far from meeting the requirements of sound water management due to: lack of coordination among multiple water agencies, outdated water legislation, non-enforcement of sound water laws, as well as shortage of eligible scientific and technical cadres. These features still characterize many of the institutions concerned with the water sector in Arab countries.

While many Arab countries possess significant technical expertise in carrying out hydrological/ hydrogeological surveys, technical studies, laboratory testing, and numerical modelling, they seem to have less strength in the fields of integrated water resources management and planning (see Box 9). Furthermore, cooperation between water institutions and universities or research institutes is very limited (which is a general problem in most Arab countries).

Zab river, one of the most significant water resources in Karkouk , Iraq. It is an important source of potable water.

Integration of water and agricultural policies

It is clear that population growth pressures and agricultural policies constitute the core obstacle to the development and conservation of water resources in the Arab region. Water demand rates in these two sectors far exceed water resources availability and development. The deficit in food production is growing and escalating due to the scarcity and degradation of the already depleted land and water resources.

In the last quarter of the 20th century, the Arab League advocated for regional agricultural integration, in which countries having comparative advantages in land and water resources (Sudan and Iraq), human resources (Egypt), and financial resources (the GCC countries and Libya) would combine their efforts to achieve food security by using advanced agricultural methods. However, for many reasons, the so-called "Arab Food Security" slogan has shifted gradually from its regional outlook to a narrow individual perspective, from which individual agricultural policies have emerged. These policies relied on horizontal expansion in agriculture to achieve maximum food production without taking into consideration national constraints to agricultural production, specifically water resources. Despite efforts and generous subsidies, the agricultural policies adopted by many Arab countries have not achieved their desired goals. In some countries, agricultural sector performance indicators are very low and agriculture is considered unsustainable due to the continuous deterioration of limited water resources and the limited capacity of arable lands, many of which have low productivity per unit area.

Employing about 30 per cent of the total population and contributing nearly 9.1 per cent to the total GDP of Arab countries, agriculture plays a significant role in most of the economies of these countries. This is particularly true for Arab countries in the Nile Basin and Maghreb where the agricultural population is 42.8 per cent and 27 per cent of the total population respectively. Moreover, agriculture accounts for about 19.5 per cent and 11.3 per cent of GDP of Nile Basin and Maghreb countries respectively (Dabour 2006).

In contrast, agriculture plays a limited role in the economies of countries in the Arabian Peninsula, where with the exception of Yemen and Oman, it accounts for less than 10 per cent of GDP. In many Arab countries, agricultural production has not kept pace with the rapidly increasing demand for

Port Sudan sea port, Sudan

food, resulting in a widening food gap that is filled by imports. The Arab region is therefore becoming increasingly dependent on imported food products (Dabour 2006) (see Chapter 3).

Clearly, there is a need to integrate agricultural policies with water policies in the Arab region in order to take into account the availability and capacity of water resources and maximize agricultural productivity. Efficient irrigation systems in Arab countries have a vital role to play in the conservation and sustainability of water resources, as well as the sustainability of food production and agricultural development. A shift to modern irrigation and agricultural techniques, and demand management tools is imperative. The application of demand management tools and conservation measures in the agricultural sector – where the largest proportion of water resources are used and where irrigation efficiencies are low – will result in effective and real water savings. A recent study indicates that raising irrigation efficiency, from its current average levels of 50 per cent to 70–80 per cent, could increase irrigated areas by about 50 per cent, and significantly reduce the Arab region's water deficit (Sadik and Barghouti 1997).

Arab countries need to adopt water policies that can achieve a balance between the cost of water inputs to the agriculture sector and the revenue of agricultural production. Investing in crops that are both high yielding and high value-added should also be considered. By doing so, countries can continue to import basic food products, while guaranteeing that funds necessary for these imports are sustainable.

Therefore, water and agricultural policies should be revised to allow the flexibility needed to adjust to the demands of global markets. These policies should also be able to improve production inputs to raise water use efficiency and achieve higher revenues per unit area of water used.

The water and agricultural policies adopted in the Arab region during the past decades did not take into account current environmental considerations, including the principles of sustainability and equity in distribution. The absence of a comprehensive concept in managing the water sector, in addition to frequent drought cycles, led to the depletion and pollution of water resources, which are incapable of meeting the increasing demands of growing populations in the region and their escalating needs for food.

Until recently, water and agricultural policies in Arab countries were characterized by centralized decision making, minimal consultation with local populations and other water users, with no consideration to available facilities. Consequently, these policies were implemented and followed by farmers without the full understanding of their objectives. For many farmers, the policies did not take their interests into account. These gaps in knowledge and practices resulted in an imbalance between input and production.

Food imports in the Arab region are necessary to compensate for water resource deficiencies, and should be considered a complementary part of the food security formula. Agricultural policies can benefit from the use of the "virtual water" concept in terms of its water saving potential when used as a practical policy tool. The virtual water concept can determine what should be produced locally and what should be imported based on water consumption, taking into consideration political, social, economic and environmental factors.

Challenges and opportunities

Population pressures and current agricultural policies constitute the core challenges to the development of water resources in the Arab region, where water demand in the municipal and agricultural sectors exceeds water resource development. Currently, many Arab countries are experiencing large water deficits, which they compensate for by mining and depleting groundwater resources, relying on expensive desalination plants, and expanding the re-use of treated wastewater.

The encompassing nature of water (with health, agriculture, food security and environment) requires new methods to integrate the technical, economic, environmental, social, and legal aspects of this resource into a coherent framework of IWRM. A balanced approach between supply and demand management needs to be achieved, closely linking water security and food security. With water consumption in the agricultural sector reaching 88 per cent of total water use, it has become vital to integrate agricultural and water policies. The development of water use efficiency by improving irrigation techniques and agricultural systems is one of the most urgent administrative prerequisites for sustainable food production in the region.

Arab food security could be achieved through regional agricultural integration, where countries having comparative advantages in land, water, human as well as financial resources would combine their advantages to achieve food security. This could be done through mega projects coupled with the use of advanced techniques supported by agricultural research and development for food production.

Management of shared water resources is one of the main challenges facing the Arab region. This challenge is associated with threats to regional stability, water and food security, and overall water resources planning in Arab riparian countries. Surface and groundwater resources shared between riparian states should be given high priority in order to reach agreements and form treaties regarding water allocation, including quality considerations according to International Water Law. A framework for cooperation in the management of shared water resources should be developed to convert the potential conflict into a cooperation potential. In this regard, many lessons can be learned from the Egyptian experience in the Nile Basin Initiative (NBI).

The current critical water situation in the Arab region is expected to be further aggravated by the impacts of global climate change. It is anticipated that water scarcity and quality deterioration will increase, with consequent negative impacts particularly on food production. These impacts need to be addressed in water resources planning and management, and appropriate adaptation measures need to be integrated into water strategies and programmes.

Conclusion

The effective management of water resources depends on several factors including appropriate institutional arrangements, competent human resources and enforced legislation. Without appropriate policies, water institutions cannot function; without appropriate institutions, policies and legislation will not work; and without a working set of policies and institutions, management tools are irrelevant. The water sector has been well developed in some Arab countries that possess necessary institutional arrangements and human capacities capable of effectively managing water resources. However, there are many other Arab countries that suffer significant weakness that impedes the sound management of water resources. Many of the institutions concerned with the water sector in Arab countries are currently characterized by overlapping responsibilities, lack of effective coordination, weak water legislation enforcement and inadequate human resources, in addition to low scientific and technological competence.

Major constraints to water resources management in Arab countries are represented in human and institutional deficiencies, particularly in the field of management and planning, non-provision of necessary funding for water projects in addition to weak environmental and water awareness. Hence, strenuous efforts are necessary in the fields of training and capacity building in the region.

In many countries of the Arab region, the present imbalance between available water resources and water demands is chronic and is expected to escalate in the future unless serious positive steps are taken to rationalize water use, manage its demands, increase supplies, and impose appropriate controls on water use. Thus, a major review of and shift in water policies, emphasizing conservation and demand management, is urgently needed. The overall objective of these policies is to secure long-term water supplies while meeting strict criteria for socio-economic,

financial and environmental sustainability as well as public health requirements.

The successful implementation of water policies will be the basis for coping with water scarcity in the arid Arab region. Failure to achieve set targets will result in deterioration of both the quantity and quality of water supplies, widening food deficits, and a deteriorating standard of living for citizens. Unless there is a major shift in the population policies of the region, the water problem will continue to be a major constraint to its future development.

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Chapter 3

LAND RESOURCES

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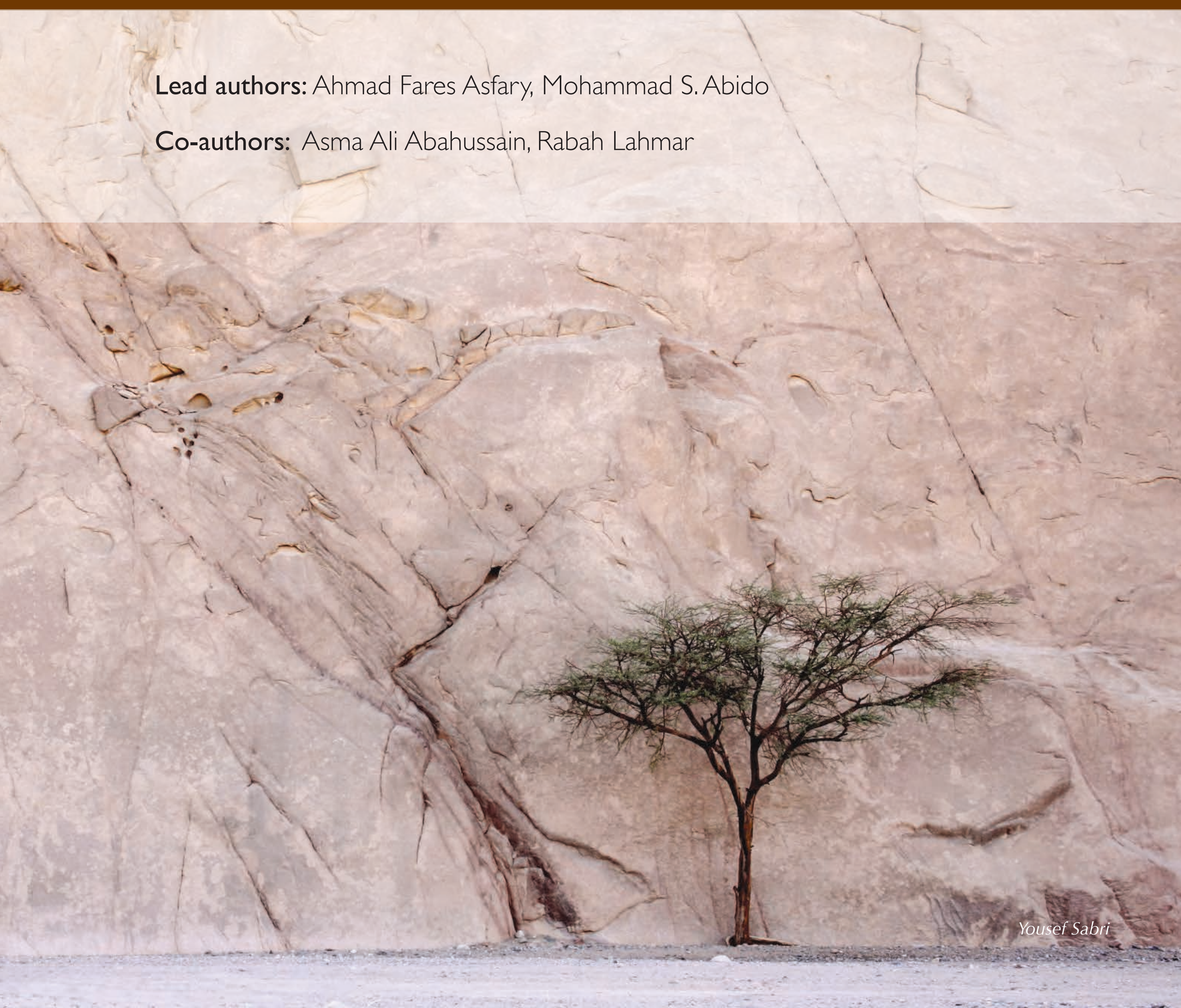


Yousef Sabri

Main messages

Land is one of the most important natural resources in the Arab region. It supports the agricultural environment, forests and rangelands and acts as the basis for production where most ecosystem cycles and functions take place. The following are the main messages of this chapter:

- Unsustainable management of land resources, associated with population growth and socio-economic activities in the Arab region, has led to changes in land-use patterns, and has raised doubts about sustainability. A tremendous change has taken place in land-use patterns in the Arab region due to population growth, existing economic policies, increase and diversity of consumption patterns, and the decline of total land area per capita by 50 per cent during the last 25 years (from 8.2 ha in 1980 to 4.2 ha in 2007). This has exerted extreme pressures on land resources to meet the growing demand for food and other products. Moreover, human activities have led to degradation of almost 68 per cent of land in the region. This degradation can be reversed through changes in policies and human behaviour.

- The critical situation of food security in the Arab region, particularly during arid years, requires formulating an integrated and comprehensive strategy that enables countries to overcome food security challenges. The expansion of agricultural production has not been accompanied by effective agricultural policies, appropriate techniques or planned urban development. This has resulted in further degradation of land resources, while agricultural production remained inferior to the region's capabilities and energy inputs. This is partially due to the fact that current cultivated area is far less than the total area of arable land. In addition, current surface irrigation techniques are inefficient and need to be developed in order to increase water supply for agriculture and other purposes. Given the importance of food security in the region, the scarcity of water resources and the linkages between sustainable water management and land and agricultural policies, the need to adopt an integrated management approach in the agricultural sector should be seriously considered. Managing irrigation water can be achieved through improving water policies, irrigation nets and systems, capacity building and through working with farmers to develop more convenient and sustainable agricultural techniques. As these issues are transboundary, the commitment of governments to joint Arab action will lead to further sustainability throughout the region.

- Rangelands hold a fundamental environmental wealth, full of plant and animal resources that can contribute to achieving food security, provide support for the national economy, and meet people's needs for animal protein and products through sustainable management. Rangelands provide 25 per cent of the forage ratios in the region in addition to other environmental services. Unfortunately, they are being degraded at an alarming rate as the individual's share has declined by almost 33 per cent between 1980 and 2005. Moreover, early and excessive grazing, and rangeland cultivation have already reduced species diversity and density, and has led to an increase in soil erosion, formation of sand storms, and sand dune encroachment on range and agricultural lands. Therefore, the need arises for sustainable management responsible for rehabilitating degraded rangelands, cultivating new areas, and organizing animal capacity.

- Forests are a renewable environmental resource of great economic value, and a source of energy and timber products. Many countryside inhabitants depend on forest activities for their livelihood. Forests occupy only 6.3 per cent of the total area of the Arab region, a figure that has been steadily declining as the individual's share has decreased by almost 35 per cent between 1980 and 2005. This is due to unsustainable woodcutting, destructive fires, overgrazing, unsustainable management of resources and unplanned urbanization. Sustainable forest management is therefore considered a challenge that requires incorporating updated forest policies into national plans, reviewing and enforcing land tenure regulations, managing water resources, putting legislation into effect, as well as building capacities among institutions and stakeholders.

- Desertification, with its various forms, is one of the most significant aspects of land degradation that is related to misuse of resources and is therefore considered one of the challenges that impedes sustainable management. Desertification in the Arab region remains a serious problem, and one that could become aggravated with climate change. The major hazards are sand encroachment, salinity and erosion of cropland, and formation of sand storms. Like other environmental and land resource challenges, desertification transcends national boundaries. Consequently, integration of national land management policies will be a productive and necessary step in minimizing this threat.

- Drought is the most serious natural disaster affecting the Arab region. This is due to its socio-economic and environmental implications which threaten people's livelihoods, especially the young, forcing them to migrate to cities in search of better opportunities. Drought is one of the main causes of desertification and desert encroachment when accompanied by inappropriate resource practices. It is also expected that climate change will exacerbate drought implications and negative impacts on the economies of Arab countries. In this context, there should be clear vision responsiveness based on prediction of drought risks and elimination of its negative impacts by providing an enabling framework to confront crop failure cases. This is to be accomplished through establishing funds to support farmers and applying new techniques in agricultural technology, irrigation, and rainwater harvesting, in addition to adopting the relative advantage in allocating agricultural lands.

- An enabling environment helps to overcome the degradation of land resources and enhances prospects of producing safe food in the Arab region. This should be accompanied by formulating efficient policies and strategies for the sustainable management of land resources and undertaking necessary measures that facilitate and increase their efficiency. Consequently, legislation regarding land-use and tenure should be updated, building capacities should be enhanced and guiding services and research for different aspects of land-use and management should be supported. Arab initiatives related to sustainable agricultural development will form the practical political framework for this enabling environment.

INTRODUCTION

Land resources are of vital importance to the existence and well-being of human beings. These resources provide essential components required for the health and prosperity of human societies, including fresh water, food, fibre, and timber. The sustainability of these land resources is very much affected by human activities at the individual, household, and community levels (Blaikie and Brookfield 1987). The local domain is influenced by national, regional and global strategies of production and development, in addition to population growth, lifestyle changes and consumption patterns (UNEP 2007a, Jordan and others 1988).

The acceleration of population growth and consumption patterns across the Arab region, as well as the increased demand for commodities, has exerted extreme pressures on the sustainability of these resources. These pressures have been accompanied by the intensive use of inappropriate technology, poor regulation of common property resources, ineffective agricultural policies and unplanned urban development. This has resulted in widespread land-use change, degradation in rangelands, forests, and deserts, and desertification of agricultural land. This, in turn, jeopardized food and water security, and endangered the well-being of the population. The adverse impacts of climate change are expected to increase pressures on resources and reduce agricultural production which threatens human well-being in the region.

This chapter will address conversion of forests, steppe and farmlands, environmental desert systems, in addition to degradation and desertification issues in the Arab region. Particular sections are designated for degradation, changing trends, environmental socio-economic pressures including issues of food security, the impact of climate change on food security and land degradation, as well as challenges and opportunities for sustainable use of land resources in the region.

Environmental and physical setting

The Arab region encompasses five main agro climatic zones: hyper-arid, arid, semi-arid, sub-humid, and humid (ACSAD/CAMRE/UNEP 2004, Celis and others 2007). The dominating ecosystem is harsh, fragile and easily degradable (UNEP 1986), with areas that are hyper-arid to semi-arid most vulnerable to degradation. The average annual precipitation varies between countries, from 5–500 mm in Libya to 50–2000 mm in Morocco (Shakhatra 1987). The climate is erratic for long periods within and between seasons, and includes short intervals of severe droughts (Cardy 1993). On average, 52 per cent of the land area in the region receives less than 100 mm of precipitation per year, 22 per cent of the area receives a range of 100–200 mm per year and 8 per cent receives a range of 200–300 mm per year. Moreover, 7 per cent receives a range of 300–500 mm per annum, 5.5 per cent receives a range of 500–800 mm per annum, and another 5.5 per cent receives an average of above 800 mm per annum. Drylands constitute 90 per cent of the total area of the Arab region (ACSAD/CAMRE/UNEP 2004).

The dominating soils are loose, shallow, of low fertility, and have developed on a calcium carbonate base prone to degradation. Though other parent materials prevail and different climatic conditions have influenced the formation of the soils in the region, the main soil types are Aridisols, Entisols, Inceptisols and Vertisols, in addition to limited areas of Mollisols (ACSAD/CAMRE/UNEP 2004).

Land-use

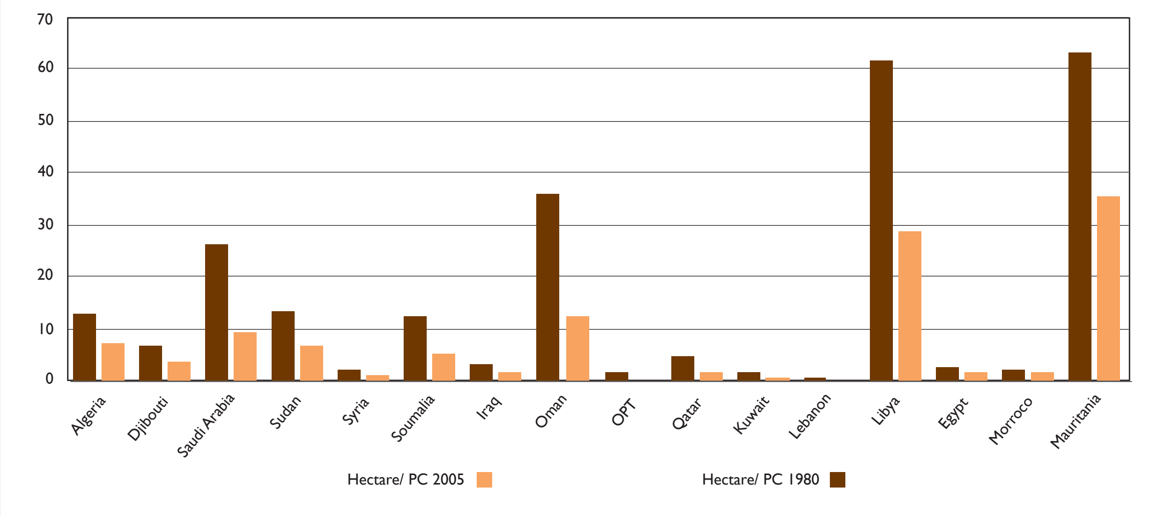
In 2005, nearly 32.9 per cent of the total area of the Arab region was rangeland; 19.1 per cent desert; 14.1 per cent land suitable for cultivating crops – of which only 34 per cent was under annual and permanent crops – and 6.3 per cent was forest land. The remaining surface area was comprised primarily of surface lakes, rivers and mountains. Statistics in 2005 revealed that land usage percentage was continuously changing (Al Kassas 1999, ACSAD/CAMRE/UNEP 2004, AOAD 2007, FAOSTAT 2008).

The type of land can vary substantially among countries. For example, Lebanon doesn't have any drylands whereas the United Arab Emirates is comprised of roughly 99 per cent drylands. In Djibouti, arable land and land capable of producing permanent crops constitute a mere 0.04 per cent, while this percentage rises to as much as 35.8 in the Occupied Palestinian Territories (OPT).

Until the 1970s, natural resources provided sufficient food and agricultural commodities for people throughout the region. However, burgeoning population growth over the last 25 years reduced total land area per capita by around 50 per cent, from 8.2 ha in 1980 to 4.2 ha in 2007. This has exerted severe pressures on land resources to meet the increasing demand for food and other agricultural commodities in the region (AOAD 2008) (see Figure 1).

Pressures were exacerbated by the liberalization of economic policies, the spread of unsustainable consumption patterns and lifestyles across the region, and insufficient domestic agricultural production. Furthermore, land-use patterns significantly changed during this time and the per capita arable land area declined in all Arab countries, from 0.28 ha per capita in 1980 to 0.14 ha per capita in 2005. Similarly, the area per capita of rangelands declined from 2.2 ha in 1980 to 1.5 ha in 2005 and 1.44 in 2007. Forest land area per capita

Figure 1. Changes in land area (ha) per capita in some Arab countries between 1980 and 2005



AOAD 1982 and 2008, FAOSTAT 2008, UN Population Division 1997

also decreased, from 0.81 ha in 1980 to 0.28 ha in 2005 and 0.278 in 2007. As for the area per capita share of annual and permanent crops, it reached 0.21 ha in 2005, which is less than the global average of 0.24 ha (see Figure 2) (AOAD, FAOSTAT 2008–2009). Land area per capita varied from one country to another. In some countries it remained unchanged; whereas in others, it increased.

The total forest area in the region declined from 9.5 per cent in 1980 to 6.3 per cent in 2005, with variations among countries. For example, forest area increased in Egypt, Bahrain, Kuwait, Lebanon, Oman, Saudi Arabia, and the UAE, while it decreased in other Arab countries. Changes in rangeland area also varied among countries, decreasing in Algeria, Jordan, OPT, and Syria, and increasing in other countries (FAOSTAT 2008, AOAD 1982, 1985 and 2007).

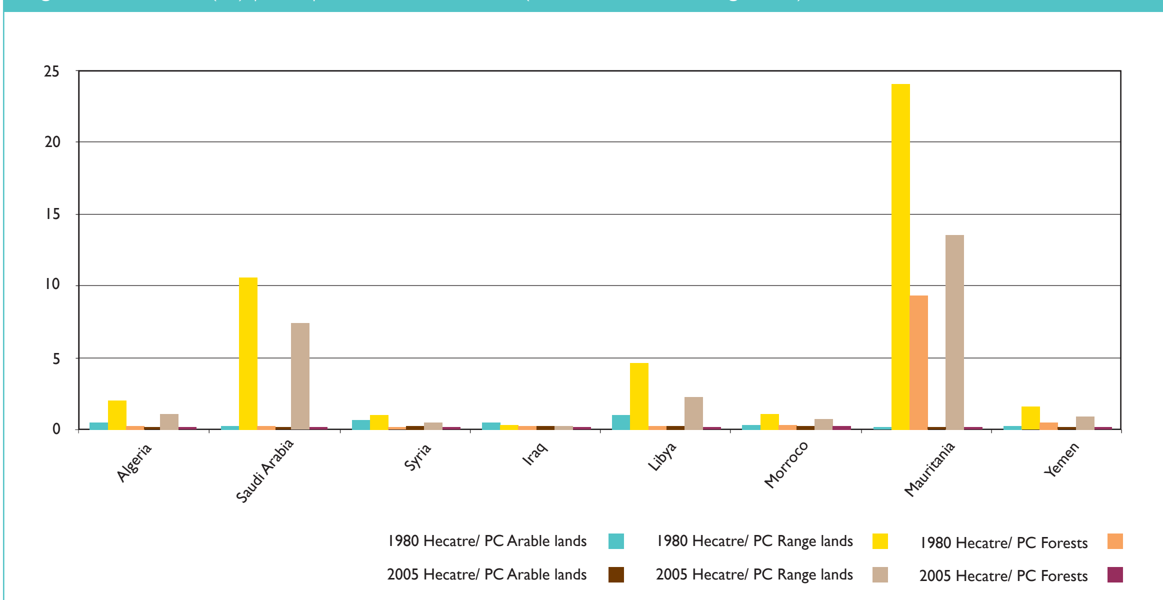
Conversion of forest and steppe lands to farmlands has further hampered the sustainability of the ecosystems. To some extent, this degradation is irreversible, particularly in those areas that are dry or have become dry. Deforestation and cultivation of forest lands and excessive farming have increased the decomposition rate of organic matter in the soil and have decreased the organic matter from crop residues as compared to forests. This has led to an increase in the emission of greenhouse gases, such as carbon dioxide and methane in addition to soil erosion as a result of the decline of vegetation cover density and its absence for some time following harvesting and land cultivation. Another factor that has contributed to the decline in water quantities is the replacement of low or moderate water-requiring crops with crops that have high water requirements. These crops increase the need for irrigation water and place additional pressure on groundwater reserves. This, in turn, affects the whole agricultural production system, making it less productive and less stable in a short period of time, especially in dry areas where water resources are limited. Thus, the livelihoods of people in the area may be severely impacted (see Box 1). The impact of land-use change on land degradation and desertification is even more severe and critical in dry conditions where the climate is harsh and the ecosystems are fragile compared to other humid ecosystems. According to recent global forecasts, rainfall scarcity and drought events may be exacerbated by the impacts of climate change.

Arable land

Arable land refers to the land under annual crops. It represents 5.1 per cent of the total area of the Arab region, which is less than the global average estimated at 11.5 per cent (AOAD 2007). It only constituted 23.1 per cent (46.3 million ha) of the land suitable for cropping in 1980, of which 36.3 million ha were rain-fed, 9.8 million ha irrigated, and 0.2 million ha were left bare fallow. In 2005, the rain-fed arable land decreased by 3.2 million ha, whereas irrigated land increased by 0.8 million ha, and 19.4 million ha were left bare fallow (AOAD 2007). The area of land that is left bare fallow varies from one year to another depending on the amount of rainfall, soil fertility conditions, and availability of irrigation water (AOAD 2007). While leaving land bare fallow is being practised to conserve water and accumulate nutrients in the soil, it also exposes the land to soil erosion for the period it remains plant-free, usually between 6 to 15 months (see Figures 3 and 4). Unfortunately, the expansion of arable land in the region has not been accompanied by sustainable and appropriate practices. Rather, there have been excesses in cultivation; the use of agrochemicals, excessive irrigation; the use of inappropriate farming machinery and technology; monocropping or unsuitable cropping sequences. This exacerbated the degradation and desertification of land in the region and reduced arable land per capita (see Figure 5) (ACSAD/CAMRE/UNEP 2004).

Countries vary in the proportion of rain-fed and irrigated lands. Countries like Saudi Arabia, Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates, and Egypt depend totally on

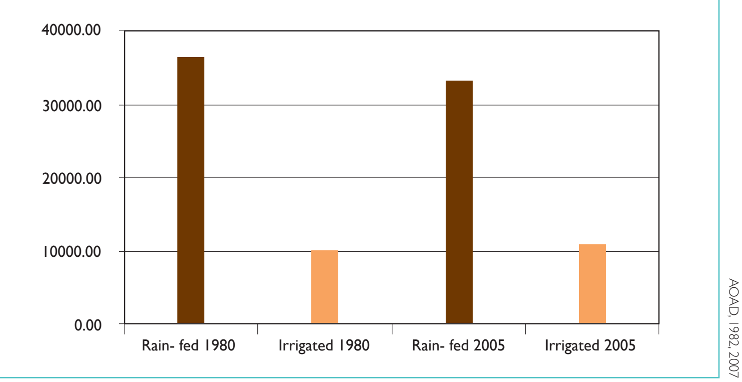
Figure 2. Land area (ha) per capita in Arab countries (arable, forest and rangelands) in 1980 and 2005



AOAD, 1982, 1985, 2008, FAOSTAT 2007

irrigated agriculture, whereas other countries rely on a mixture of both rain-fed and irrigated agriculture. Approximately 70 per cent of agricultural production comes from irrigated lands, even though it only makes up a small percentage of the rain-fed cropping territories (FAOSTAT 1998). The estimated volume of water used for irrigation in Arab agriculture is 169 000 million m^3 (89 per cent of total water use), 147 000 million m3 of which are used for surface irrigation. The water use efficiency of surface irrigation is only 38 per cent, which translates into annual water losses of 91 000 million m^3 (Belloum 2008). These water losses constitute 38 per cent of the total available annual surface water and the allowable usable amounts of groundwater. This improper management of irrigation water requires a drastic change of water policies; irrigation systems and networks, capacity building, as well as development of suitable and sustainable agricultural options for farmers (see Figure 5).

Figure 3. Total area of land under annual crops, irrigated and rain-fed (1 000 ha)



Changes in areas of rain-fed and irrigated arable lands (1 000ha) in Arab countries in 1980 and 2005

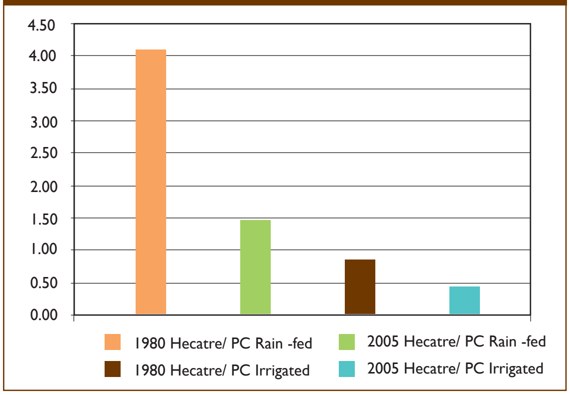
Until the late 1970s, cultivated land in the region provided sufficient food for the population with minimal adverse impacts on the environment. Since then, while differences have persisted among Arab countries, population growth has risen with an annual average of 2.6 per cent in the region (UN Population Division 2005, AOAD 2007). As a result of population growth, the demand for goods and services has steadily increased. Agricultural production has significantly increased in response to this trend, by using modern technologies, farm machinery, herbicides and pesticides, fertilizers, expanding greenhouses and aquaculture. However, this increase in production has put substantial pressure on land resources, which has been accompanied by the intensive use

Box 1. Salamieh agricultural area: a historical perspective

Until the 1950s, Salamieh, affiliated to Hamah governorate, was among the most productive agricultural areas in Syria. Groundwater had always been the most important source for irrigation, and until 1950 crop irrigation did not affect the groundwater balance. However, after 1950, economic incentives, mechanization, and government policies encouraged cotton production, a water intensive crop (requiring 1 000 mm of water per crop cycle) that strained groundwater resources. The irrigated cotton area increased from 1 500 ha in 1948 to 14 000 ha in 1956. The extensive use of groundwater overwhelmed the annual recharge capacity of the area and the well water level dropped between 1–3 m per year. The Increased amount of extracted water also led to water salinity, further hampering agricultural sustainability. Consequently, most farmers shifted from the intensively irrigated cropping systems of cotton/wheat/vegetables to the rain-fed barley systems. As a result, the cotton cropped area decreased from 15 129 ha in 1975 to 6 715 ha in 2001. This resulted in the deterioration of socio-economic conditions for approximately one-half of the inhabitants of Salamieh. A large number of these citizens faced hardships, 67 000 of whom migrated in search of better opportunities (ICARDA 2002). Ngaido 1997, ICARDA 2002

Ngaido 1997, ICARDA 2002

Figure 4. Changes in land area per capita (land under annual crops) in Arab countries (ha/pc) in 1980 and 2005



FAOSTAT 2008, UNDP 1997, AOAD, 1982, 2007

of unsuitable technology, poor regulation of resources, ineffective agricultural policies and unplanned urban development. These pressures and inappropriate agricultural practices resulted in land-use changes and land resources degradation. Over the last 25 years, agricultural and food productivity indicators for different food commodities have shown trends of both gradual and varied self-sufficiency rate (SSR) increases and decreases in basic commodities (see Table 1). Nevertheless, figures show alarming increases in the rate of food imports as well as agricultural and food trade deficits for the countries of the region, especially the GCC countries and the Nile Valley (World Bank 2005). Arab countries now import a large proportion of some of their main staples, including wheat, maize, rice, and barley requirements, respectively. There are additional food items that Arab countries import in large quantities as well. Unfortunately, the gap between production of agricultural commodities and people's needs is expected to widen in the Arab region due to increasing food demand as a result of high population growth and the adverse impacts of climate change on agricultural production. Global models assessing possible climate change impacts indicate that, on average, the Arab region will face a reduction in the availability of water by up to 40 mm per year (IPCC 2007). On the other hand, increases in water availability of up to 40 mm per year are possible in specific areas, such as the stretch of land between southern Algeria and southern Egypt, most of Sudan and Somalia, and the southern parts of the Arabian Peninsula. Moreover, production of main crops, such as wheat and barley is expected to decrease by 5 to 35 per cent in Arab countries in West Asia. This will increase the present food gap in the Arab region, which will have a severe effect on food security. Those countries with the highest population growth rates will be the hardest hit, as their socio-economic infrastructure is most vulnerable to decreases in agricultural productivity.

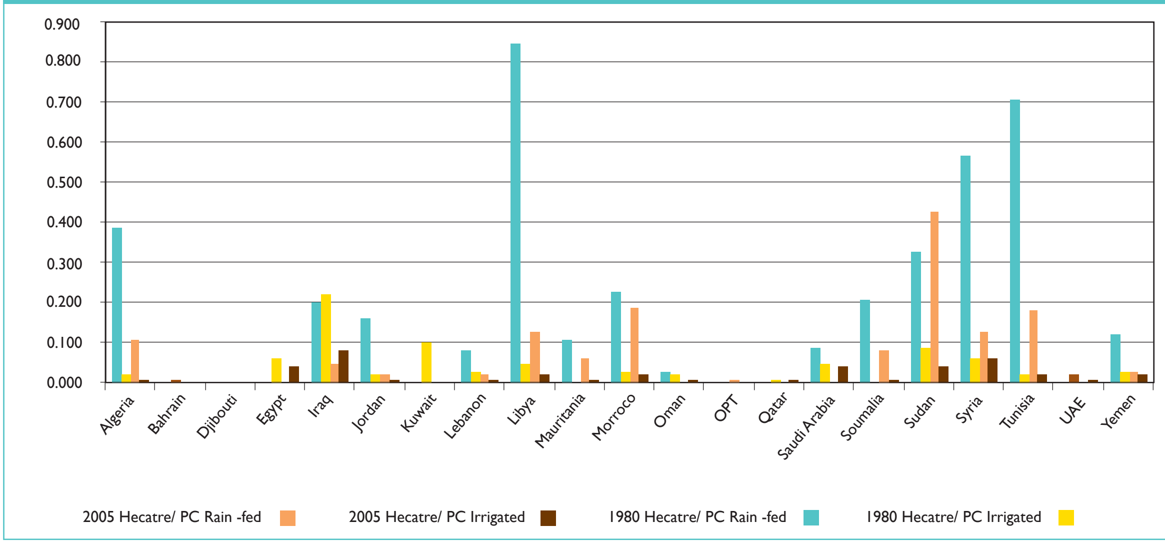
Rangelands

Rangeland is the main form of vegetation cover in the Arab region. Its area is estimated at approximately 62.3 million ha which is around

Mohamed S. Abido

Cultivation on "mastabas" in slopped areas.

Figure 5. Area per capita (ha/pc) of rain-fed and irrigated arable land in Arab countries in 1980 and 2005



AOAD 1982, 2007

33 per cent of the total area of Arab countries and 13.5 per cent of the rangelands area worldwide, which amounted to 474.8 million ha in 2005. However, the doubling of the population over the last 25 years has reduced the area per capita of rangeland by nearly 33 per cent – from 2.24 ha in 1980 to 1.5 a in 2005 (see Table 2). The variation of rangeland areas among Arab countries is substantial, from around 4 per cent of the area in Egypt to 13.8 per cent in Algeria, 38.1 per cent in Mauritania (39.25 million ha) and 79 per cent in Saudi Arabia (170 million ha) (AOAD 2008). Most of the rangeland is degraded, with only 20 per cent of the area rated as good quality steppe land and 10 per cent rated as very good steppe land (AOAD 2004). For example, 82 per cent of the rangelands in the eastern part of Saudi Arabia are degraded due to the presence of a large number of cattle and the related rapid transportation movement (Al Rowaili and others 2008). The carrying capacity of rangelands changes annually according to the distribution of rainfall as well as the prevailing temperatures. Though these lands are considered a major source of green fodder for farm animals, and contribute as much as 25 per cent of forage ratios in the Arab region, they are low in productivity due to harsh climatic conditions and poor management (AOAD2004). They are becoming less capable of meeting the region's overall fodder requirements due to the increase in the number of dependent farm animals, including 61.3 million heads of cattle and 4.1 million heads of buffalo (ACSAD/CAMRE/UNEP 2004, AOAD 2007).

To bridge the fodder gap, forage crops are grown on 2.6 million ha of the region's arable land (AOAD 2007). In some countries, fodder crops are subsidized for herders, such as barley in Saudi Arabia (see Box 2). The gap between the amount of fodder needed for animal production and the amount of fodder produced in the region has created SSR deficits for animal production. However, although there is still a gap, the SSR has increased from 82.3 to 85.8 per cent for red meat, from 52.8 to 74.8 per cent for white meat, from 76.4 to

96.4 per cent for eggs, and from 65.3 to 70.9 per cent for milk between 1980 and 2005 (see Table 1).

Throughout Arab countries, the impacts of heavy and early grazing, rangeland cultivation and recreational activities have significantly reduced species diversity and density and have led to an increase in soil erosion and sand dune encroachment on agricultural lands (Al-Dhabi and others 1997). To combat this degradation, rangeland conservation measures are being undertaken, and include protection, rehabilitation and management of grazing practices. The results of these measures have demonstrated that the potential productivity of rangelands is greater than the present measured values, and that the plant cover is denser and more diverse than previously thought. For example, after three years of rehabilitation and protection in the Al Beshrri area of the Syrian steppe, fodder production increased from 90 kg/ha to 320 kg/ha and bare soil decreased from 91 to 32 per cent. Furthermore, the diversity of plants increased from 27 to 83 species, and the density of palatable shrubs increased from 0.02 to 4 per m2 (Kattach 2008).

Forests

The forests of the Arab region represent only 2.4 per cent of the area of forests worldwide but they make up 6.3 per cent of the total area of the region, which is far less than the global average of forested areas estimated at 30.3 per cent (AOAD 2007). Most of the forests of the Arab region are protective. Forests have decreased over the last 25 years from 133.5 million ha (9.5 per cent of the total area) in 1980 to 88 million ha in 2005. Despite the limited area of forests in the Arab region and their modest wood potentials, they provide, along with

The enormous carrying capacity of rangelands is one of the causes of their degradation.

Table 1. Food production and its requirements (1 000 T) and Self Sufficiency Rates in the Arab Region during 1980 and 2005						
Commodities	1980			2005		
	1000 Tons		%	1000 Tons		%
	Production	requirements	SSR	Production	requirements	SSR
Wheat	10 189.9	20 189.4	50.5	31 264.7	53 910.2	58
Maize	3 883.8	6 324.9	61.4	7 789.4	20 420.2	38.1
Rice	2 608.8	3 897.9	66.9	7 271.5	9 754.4	746.6
Barley	5 884.1	8 047.9	73.1	6 638	15 960.9	41.6
Total cereals	26 358.8	45 104.4	58.4	62 025.5	110 185.5	56.3
Potatoes	3 120.5	3 334.5	93.6	10 791.5	10 628.6	101
Pulses	1 090.6	1 182.2	92.2	1 496.4	2 501.6	59.8
Total vegetables	19 633	19 622.7	100.0	47 338	47 485.7	99.7
Total fruit	11 402	11 131	102.4	31 344.3	32 378	96.8
Sugar	1 255.8	4 787.3	26.2	2 755.8	8 239.2	33.4
Edible oil & fat	754	2 033.2	37.1	1 572.3	5 664.6	27.8
Red meat	1 322.9	1 608.1	82.3	4 284.2	4 991.3	85.8
White meat	666.4	1 261	52.8	2 642	3 529.9	74.8
Total meat	1 989.2	2 869.1	69.3	6 926.2	8 521.2	81.3
Fish	1 163.8	1 158.9	100.4	3 484.9	3 356	103.8
Eggs	448.8	587.7	76.4	1 294.2	1 342.7	96.4
Milk	8 258	12 646.8	65.3	24 322	34 303.1	70.9

AOAD 1982, 2007

trees outside forests, non-wooden products that are known for their great economic value such as frankincense and gum. They also provide ecological services such as preventing land degradation, combating desertification, protecting waterfalls, improving the environment and setting carbon rate. In addition, wood provides a source of energy and creates job opportunities for countryside inhabitants (FAO 2008).

Significant increase in population growth has led to the decline of forest land area per capita from 0.81 ha in 1980 to 0.28 ha in 2005 (see Figure 2). A number of factors contribute to forest loss and degradation in the region. Forests are impacted by: unsustainable woodcutting, numerous and vague ownerships, overgrazing, mobile agriculture, fires, natural resources, shortage and forest cultivation (FAO 2008–2001, and FAOSTAT 2004). Moreover, absence of a clear forest policy contributed to aggravating the situation in many countries. Large tracts of forests in different parts of the Arab region are experiencing severe resource pressure. For instance, in the southern part of the Arabian Peninsula and North Africa, juniper

Box 2. Al-Hema system: The traditional practice of rangeland use


ACSAD

Saudi Arabia has a long history of herding and grazing on its vast rangelands, which make up the largest proportion of rangelands in the region at 35.8 per cent. The condition of the rangelands could be classified according to their annual average dry material production into 4 categories (ACSAD/CAMRE/UNEP 2004): 8.4 per cent is very good (180 kg/ha), 31 per cent is good (120 kg/ha), 32.5 per cent is medium (88 kg/ha), and 28.1 per cent is poor (35 kg/ha). Traditionally, herders managed the grazing of their herds under the tribal Al-Hema system (Jaubert and Bocco 1994, Draz 1969). This system restricted the frequency, intensity and timing of grazing practices on the vegetation cover of the drier areas of rangeland, and successfully sustained the productivity of the rangeland. Usually, each tribe had a communal grazing territory, and when drought occurred tribes were allowed to share other tribes' grazing territories under specific conditions. However, political and socio-economic changes disrupted the tribal Al-Hema system in the 1950s (Al-Rowaily 1999), and provided unrestricted access to all grazing areas. For example, government policies were established to increase meat production and financial incentives were offered to sheep and camel herders which drastically increased the number of animals, exerting severe pressure on the rangelands. In 1980, the government had to change the financial incentives for herders into subsidized feed such as barley grain (MAW 1984). The financial incentives and subsidies made it possible for herders to transport subsidized feed and water, using the vehicles they were able to buy with subsidies, to semi-permanent rural populations and livestock in more remote areas (Leybourne 1994, Abdulla and Al-Hajooj 1995). As a result, overgrazing and extensive wood cutting for fuel were enhanced, causing severe degradation of vegetation and increasing soil erosion. The Al-Hema system has since then disappeared among herders, with the exception of some Bedouin communities who still prefer to use limited secure areas and employ the traditional grazing system.

AOAD 2007, IFAD 2000, Leybourne 1994, Abdulla and Al-Hajooj 1995, Jaubert and Bocco 1994, Draz 1969, Al-Rowaily 1999, MAW 1984, ACSAD/CAMRE/UNEP 2004

forests are in a state of decline due to intensified human activities, spread of pests and diseases, in addition to frequent and persistent droughts (Gardner and Fisher 1996, Fisher 1997, Herzog 1998, PME 2005, Gauquelin and Others 1999).

The changes in forest cover differ between countries: from 37 per cent in Sudan in 1980 to 27 per cent in 2005 with an average annual loss of 0.8 sq km (see Box 3). The degree of loss in Arab countries is varied. For example, Djibouti has lost 8 per cent of its forest land, whereas Mauritania has lost 98.2 per cent of its total forest cover over the past 25 years. Some Arab countries have experienced no change, while many others have experienced increases in their forested areas.

Significant changes in forest area have occurred in Yemen, where forest area decreased by 50 per cent during the 1990s. Meanwhile, in the United


Environment department, Kingdom of Morocco

"Al Jabal Al Akhdar" is one of the most beautiful natural places in Libya. It is distinguished by various forms of wild life, reserves and national parks such as "Wadi el Kouf" Park.

Forest land fractures in the Syrian mountainous chain.

Arab Emirates, plantation forests increased forest area to 32 per cent of the total area of the country (FAO 2001).

However, the already limited area of forests in the OPT decreased by 50 per cent during the 1980s and 1990s due to deliberate destruction of forests by Israeli forces (MENA 1999, FAOSTAT 1998). Although Jordan had lost nearly 15 per cent of its private forests and about 500 ha of public forests since 1961, its total forested area increased by 20 per cent during the 1980s and 1990s (FAOSTAT 1998).

The loss of forests is not only confined to the reduction of their area. It also implies the deterioration of their environmental system and the decline of vegetation, ultimately becoming secondary forests with no major role in environment protection, in addition to the loss of valuable indigenous species. Aside from the loss of valuable indigenous species, the loss of natural plant cover in forest areas, primarily in elevated and sloped lands, enhances water erosion. Flash floods are one consequence of water erosion and often have significant adverse impacts on the natural resource base, including soil, water and biota, as well as on investments, tourism installations, urban areas and transportation. Research today underlines the necessity of conserving and developing forests to alleviate carbon dioxide emission and contribute to adaptation for the future (FAO 2009).

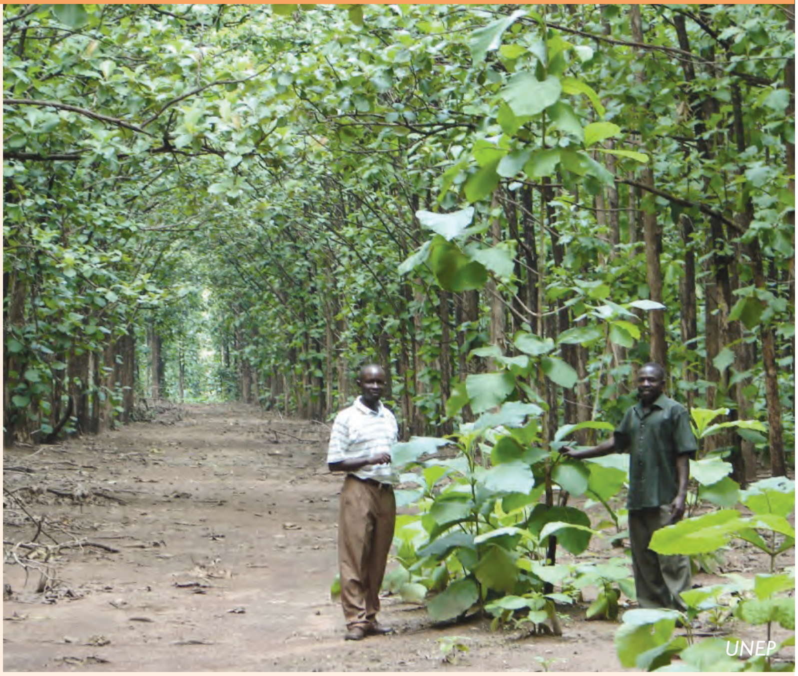
The major constraints to sustainable forest management are scarcity of water resources and low rainfall, drought, forest fires as well as inadequate resources and expertise (these issues have been raised during the last ten years but have not been seriously considered). Other challenges to sustainable forest management include: incorporating forest policies into national plans, building the capacity of institutions and stakeholders, reviewing forest laws and land tenure regulations, managing water resources, enforcing legislation, providing financial resources, in addition to enhancing people's participation in resources management (FAO 1997, UN-ESCWA 2002).

Various activities should be encouraged to support the United Nations Convention on Biodiversity (UNCBD), the United Nations Convention to combat Desertification (UNCCD) and the United Nations Framework

Box 3. Forest resources in Sudan

Sudan's forest resources have shrunk from 91.5 million ha in 1980 to 67.5 million ha in 2005. Although the size of Sudan's forest area decreased, the percentage of the region's forest resources increased from 68.5 to 76.7 per cent due to the relative decrease in the forest resources of other countries.

Today, the main types of woody vegetation in Sudan include: 1) Desert and semi-desert trees and shrubs; 2) Riverine forests; 3) Low rainfall woodlands/savannah; 4) High rainfall woodlands/savannah; 5) Montane and gallery forests; 6) Tropical forests; and 7) Cultivated forests. Fully closed forests are only found in a few of the most humid areas in the South.



Revenues from forests constitute approximately 13 per cent of the country's GDP. However, these resources remain threatened by the following unsustainable activities: 1) extensive fuelwood (wood or charcoal) collection; 2) fires set by pastoralists to destroy trees and suppress the re-growth of trees and shrubs, so that grass growth is enhanced; 3) repeated droughts in the 1970s and 1980s which led to the inability of many tree seeds to germinate, shifting the tree line 50–200 Km south; 4) direct impacts caused by conflicts; and 5) expansion of arable land by using unsustainable practices, which caused extensive forest and land degradation as well as desertification.

UNEP 2007b

Convention on Climate Change (UNFCCC) since there is a growing trend today towards the conservation of forest ecosystems and services.

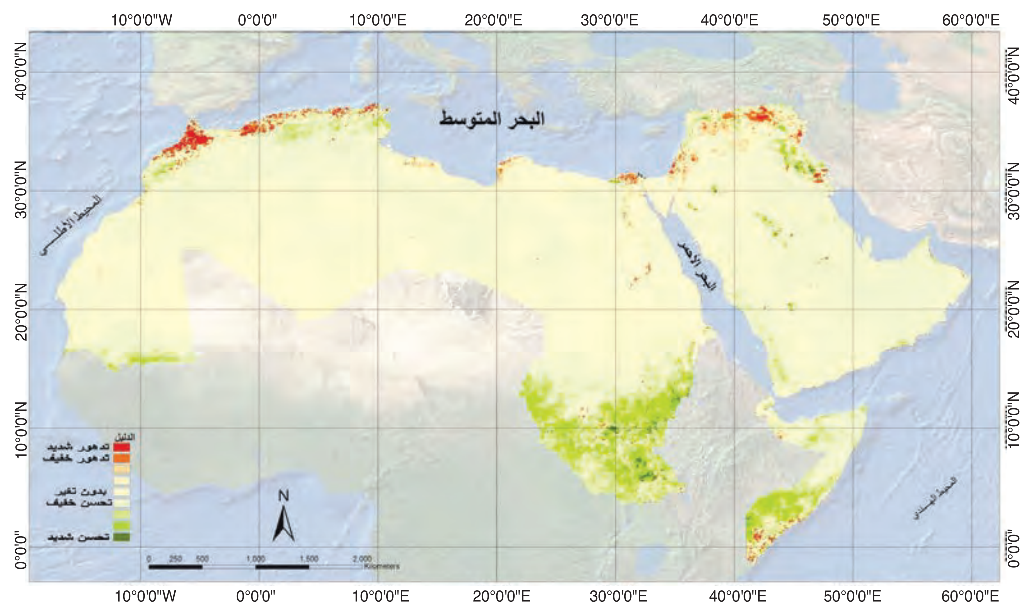
Deserts

Arab deserts, like other world deserts, are natural ecosystems that have evolved as a result of certain environmental conditions over the last 2 million years. They are defined as hyper-arid areas with an aridity index of less than 0.2, where lack of water is the main factor responsible for the biological processes that occur throughout their ecosystems. The total area of the Arabian deserts constitutes 7.5 per cent (270 million ha) of the world's deserts, and has a flat landscape of sand and rocks with diverse land cover.

The Arabian Desert in North Africa has the highest aridity among the world deserts, whereas the portion in the Arabian Peninsula ranks second (UNEP 2006).

The Arabian Desert has provided unique ecosystem services and life support to the population in the region for millennia (ACSAD/

Figure 6. Land cover changes 1982–2005



ACSAD

CAMRE/UNEP 2004). However, over the last three decades pressures on desert resources, particularly water and vegetation cover, have increased with population growth, lifestyle changes, consumption patterns and recurrent drought. Water has begun to be extensively extracted from ground reserves for food and fodder production, in addition to the intensive use of heavy transportation and the growth of oil mining industry and extraction.

The most dangerous consequences of these changing patterns are soil salinity and sand encroachment. Additional consequences include the degradation of many oases that are no longer productive, soil erosion responsible for increasing dust storms, the diminution of biodiversity, and groundwater depletion (ACSAD/CAMRE/UNEP 2004 and 2006).

Land degradation and desertification

The lands of the Arab region are critical by nature, composition and history of use. Approximately 68.4 per cent of the land in the region has been degraded, 97.8 per cent of which is human induced (ACSAD/CAMRE/UNEP 2004). The degree of degradation varies among countries and sub-regions. It is estimated that 89.6 per cent of lands in the Arabian Peninsula are degraded, 35.6 per cent in the Mashriq, 77.7 per cent in the Maghreb and 44.5 per cent in the Nile Valley (ACSAD/CAMRE/UNEP 2004).

Based on the interpretations of satellite images (GIMMS NDVI) of non-desert land cover changes in the Arab region between 1983 and 2003, lands have experienced varied changes. Images illustrated that some lands were degraded while others improved. The degraded lands constituted 31.4 per cent of total land, with differences among countries (see Figure 6 and Table 2). The degradation, however, was accompanied by only 12 per cent of land aggradations, with variations among countries; reaching 36.8 per cent in Sudan. The degree of degradation varied drastically

Table 2. Land cover change per cent in the Arab region between 1983 and 2003					
Country	Area (1 000 Ha)	Negative trend (%)	Positive trend (%)	Net change (1 000 Ha)	Net change (%)
Algeria	238 174	38.40	1.64	-87 536.3	-36.75
Bahrain	66.5	0.18	0.18	0.00	0.00
Djibouti	2 300	9.86	16.23	146.7	6.38
Egypt	100 145	44.53	0.81	-43 782.6	-43.72
Iraq	43 707.2	22.24	20.41	-801.0	-1.83
Jordan*	9 230	73.32*	0.57	-6 714.8	-72.75
Kuwait	1 782	4.47	15.46	1 96.0	11.00
Lebanon	1 040	27.95	28.49	5.6	0.54
Libya	1 75 954	32.95	0.24	-57 551.1	-32.71
Morocco	44 655	44.78	8.59	-27 315.2	-36.19
Mauritania	103 070	59.24	9.86	-50 896.5	-49.38
Oman	21 246	1.20	3.44	476.2	2.24
Qatar	1 143.7	2.25	3.37	12.9	in
Saudi Arabia	196 058.2	15.78	4.04	-23 006.1	-11.73
Somalia	63 765.7	7.11	20.79	8 726.9	13.69
Sudan	250 581	33.34	36.81	8 748.8	3.47
Syria	18 518	34.85	24.44	-1 928.4	-10.41
Tunisia	16 361	23.25	12.18	-1 811.6	-11.07
United Arab Emir-ates	8 288	5.71	11.50	479.9	5.79
Yemen	52 797	15.27	9.68	-294.8	-5.58
Total	1 296 085	31.38	12.02	250 849.6	-19.35

***Some negative trends are attributed to the impact of green houses**

ACSAD/GTZ 2007

among sites, where 0.04 per cent of the degraded areas are considered hot spots and the most degraded, 1.3 per cent severely degraded, and 31.7 per cent moderately degraded (ACSAD and GTZ 2007). There was no change of land cover in 55.2 per cent of the land in the region, and the improved areas were rated as bright spots at 0.01 per cent, having significant improvement at 2.7 per cent, and having moderate improvement at 9.02 per cent.

The net apparent estimated degradation in the region is about 19.3 per cent, with countries like Bahrain, Djibouti, Kuwait, Lebanon, Oman, Qatar, Somalia, Sudan, and the United Arab Emirates counteracting degradation through their land rehabilitation activities, whereas other countries in the region have failed to do so. Despite improvements, the economic toll of degradation remains high. A recent estimate valued economic losses from land degradation

Effective policies and strategies should be developed for land resources management in the Arab region.

in the Near East – including non-Arab countries – at approximately US$1 500 million per year (Sarraf 2004).

Studies show that losses from land degradation vary from one country to another. Degradation annual losses, expressed as a percentage of GDP, were estimated at 1.2 per cent in Algeria, 1.2 per cent in Egypt, 0.6 per cent in Lebanon, 0.4 per cent in Morocco, 1 per cent in Syria and 0.5 per cent in Tunisia (Sarraf 2004). Where land resource policies exist, a number of factors interfere with proper implementation, including centralized governance, low profile expertise, arbitrary planning, lack of public participation and single approach oriented management.

Degradation assessment studies (ACSAD/UNEP 1989) reported that the primary impacts of land degradation in the Arab region, expressed as percentage of total degraded land (316.64 million ha) are: salinity of cropping land (42.2 per cent), wind erosion (32.7 per cent) and water erosion (13.7 per cent). The secondary effects are soil water logging (6.7 per cent), fertility degradation as a result of pollution (3.8 per cent), and soil crusting (0.8 per cent) (ACSAD/CAMRE/UNEP 2004).

Land deterioration types

Soil salinity

Soil salinity is the process that leads to the accumulation of water-soluble salts in the soil to a level equivalent to an electrical conductivity of 4 ds per metre or above, and may continue to form a salt layer on the soil surface. Consequently, plant production will decrease with the degree of increase of soil salinity to an extent that the land may no longer be suitable for cultivation or may become only suitable for certain high salt tolerant plants. Soil salinity in Arab countries, like anywhere else, could be a natural geomorphologic process or may be caused by any process that affects

Palm oases degradation in south Algeria as a result of soil salinity

the soil-water balance, which in turn affects the movement and accumulation of salts in the soil. The natural encroachment of marine and lake saltwater into coastal soils and water aquifers, along with water evaporation (especially in dry areas), increases salt concentration in the soil.

Arab countries vary in their natural and human induced salt affected areas. Some examples of natural saline land areas in Arab countries include: 3 300 ha in Jordan, 2 million ha in Saudi Arabia, 113 000 ha (including cultivated areas) in Qatar, 85 000 ha (including cultivated land) in Kuwait, 2 million ha in Egypt, 0.502 million ha in Libya, 0.558 million ha in Tunisia, and 5 per cent of total land in Djibouti. The areas of land affected by induced salinity are: 8 million ha in Iraq, 8 600 ha in Jordan, 237 000 ha (40 per cent of cultivated land) in Saudi Arabia, 9 340 ha in Bahrain, 113 000 ha (including natural salinized areas) in Qatar, 1.26 million ha in Egypt, 2.1 million ha in Sudan, 4 000 ha in Somalia, 32 per cent of the cultivated coastal plains in Djibouti, 190 000 ha (including waterlogged areas) in Libya, and 1.5 million ha in Tunisia (ACSAD/CAMRE/UNEP2004/AOAD 1991, Abahussain and others 2002, Adelgawad 1997).

Soil salinity leads to exclusion of lands and reduction of their production. For example, due to soil salinity in Egypt, crop production decreased by 25 per cent for cotton and 47 per cent for rice (Gehad 2003). As for Syria, it witnessed a 50 per cent decrease of the production of 100 000 ha of irrigated land, in addition to the exclusion of production of more than 60 000 ha with an annual rate ranging from 3 000 to 5 000 ha of irrigated lands (ACSAD, CAMRE, UNEP 2004, Khalifa and others 2002, Engle, 2004, Grecu 1980, Central Bureau of Statistics 1978).

Biodiversity is affected by soil salinity as several kinds of vegetation, animals and micro-organisms face the threat of extinction due to

Sand dune encroachment risks.

the absence of one of the components or levels of the nutritional network. Biodiversity loss is an extremely sensitive issue in environmental sustainability since it is one of the pillars of the environmental system. Biodiversity degradation leads to the diminution of the effective sustainable options required to secure human needs (see Chapter 6).

Soil erosion

Soil erosion throughout the Arab region occurs due to the warm, dry, windy and rainstorm climatic conditions and the erodible nature of most soils. It has been escalated by the degradation of natural vegetation cover, rangeland cultivation, fuelwood gathering and cutting, forest clearing, and improper agricultural practices. For example, 90 per cent of the rangeland in Jordan was cultivated at an annual rate of 120 000 ha per year (ACSAD/CAMRE/UNEP 2004), while in Syria, steppe cultivation reached 0.5 million ha in 1990; an increase of 14 fold since 1982. In central Tunisia 3.5 million ha of rangeland were converted to cereal crops and fruit trees during 1920 to 1997 and in Oman wood cutting of large areas of range and forest lands took place. In the OPT, 9 626 ha were converted to a military base and settlement areas by occupation forces in addition to the clearing of 18 040 ha of land (including 4 000 ha of forest on sand dunes) for military and settlement uses. In Mauritania, tens of square kilometres of plant cover surrounding the capital were degraded (ACSAD/CAMRE/UNEP 2004).

Wind erosion affects 110 million ha of land in West Asian Arab countries and at least 110 million ha in North African Arab countries including Sudan (ACSAD1998/CAMRE/UNEP 2004). The affected areas vary among countries as follows: 1 million ha in Syria, 776 000 ha in Iraq and 107 080 ha (with an annual loss of 8 000 ha) in Tunisia. Other impacted areas include most of the land in Libya and 45.5 million ha of cultivated areas and rangelands at a rate of 100 000 ha per year in Morocco (ACSAD/CAMRE/UNEP 2004).

Water erosion impacts 1 058 million ha in Syria, 4 691 million ha in Iraq, 2 525 million ha in Tunisia, 896 700 ha in Libya and 60 per cent of the Northern areas in Yemen. Also affected are 12 million ha mainly in the highland steppe and sloped lands of Algeria, where 120 million tonnes of soil per year are lost to the sea. Furthermore, water sediments have reduced the energy efficiency of dams by 50 per cent, with 25 per cent reduction in their annual water storage capacity (ACSAD/CAMRE/UNEP 2004).

Despite limited measurements of soil erosion rates in the region, some studies reported that wind erosion rates were 10–50 tonnes of soil/ha in Jordan and 50–200 tonnes of sand/ha in Tunisia. Others reported the range of water erosion rates between 10–200 tonnes of soil/ha in Jordan; and 20 tonnes of soil/ha in the Atlas Mountains in Algeria, depending on land slope degree and the type and condition of plant cover.

Furthermore, in Jordan, water erosion rates were 30 m3/ha under woods, 23 m3/ha under dense vegetation, 61 m3/ha under degraded steppe, 40 m3/ha under degraded agricultural land and 46 m3/ha under barren land (ACSAD/CAMRE / UNEP 2004).

Desert encroachment

Sand encroachment on agricultural lands, oases and other infrastructure services is another growing problem in Arab countries. Currently, the movement of sand dunes in the region is estimated at 20–80 metres per year. In North Africa, sand encroachment is widespread in Egypt's western desert, the north western regions of Sudan, and in vast areas in Libya, southern Tunisia, Mauritania, and southern Morocco. It is also abundant in Algeria; where deserts are moving north at the rate of 2 km per year (ACSAD/CAMRE/UNEP 2004, AOAD 2004). Consequently, countries like Algeria, Egypt, Libya, Morocco, Mauritania and Tunisia, which border the Sahara Desert, have lost an estimated 65 million ha of fertile land during the last 50 years (FAO 1993). However, the severity of the problem varies among countries. In Egypt, some sand dune areas move 20–100 metres per year and in some cases have covered entire villages or oases. In southern Morocco, sand encroachment destroys tens of hectares of date orchards every year, while in Mauritania, sand encroachment has covered 2 030 ha surrounding the capital and some sand dunes have even entered the city.

Sand dune encroachment risks.

Sand encroachment affects 2 per cent of land in Syria and more than 1 million ha in Iraq. Moreover, 21 000 ha of irrigated land and rangeland have been degraded by sand encroachment in Qatar where the annual average expansion of sand dune areas has been estimated at 150 000 ha throughout the last 13 years. In Saudi Arabia, sand encroachment advances 12–13 m every year along a 25 km front at Al Ehsa oasis, damaging 25–30 ha of agricultural land annually (Barth 1999). In North East Yemen, sand encroachment has reached a height of 100 m and has affected most of the land, including cropping areas, while sand drifts are impacting 80 per cent of the total area of Kuwait and UAE (ACSAD/CAMRE/UNEP 2004, Fryberger and others 1984).

Desertification is a major impediment to agricultural productivity, land conservation and development. The desertified areas in the Arab region are estimated at nearly 9.8

million km2, representing 68 per cent of the total area of the region (AOAD 2007). These areas are concentrated in countries of the Arabian Peninsula at a rate of 89.6 per cent of their total area whereas the rate is 78 per cent in North African Arab countries. The Nile Basin and the Horn of Africa countries suffer from desertification of 44.5 per cent of their lands and the problem is at its minimum in the Mashriq states. In addition to the deteriorated lands at present, there are expectations that 2.87 million km2 – representing 20 per cent of the area of the Arab region – are prone to desertification. This raises the proportion of desertified lands to 88 per cent of the total area of the region with variations among different Arab countries (AOAD 2007).

Natural disasters and wars

Wars (review chapter 9) and natural disasters like droughts, floods, tsunamis and grasshopper infestations contribute to land degradation and their impacts may be irreversible.

Drought is one of the most hazardous disasters facing the Arab region as it has serious socio-economic and environmental implications that threaten people's livelihoods, particularly in drylands or agricultural sites. This may lead to migration of citizens –especially the young – to cities in search of better opportunities.

Drought is considered one of the major causes of desertification when accompanied by inappropriate natural resources practices (ACSAD/CAMRE/UNEP 2004). Severe incidents of drought lead to the deterioration of natural vegetation to a level where trees and bushes disappear and can never be restored, particularly in fragile ecological systems. Drought recurrence and its adverse impacts vary among Arab countries. In the 1950s, drought led to the death of most rangeland animals in the northern and eastern parts of the Arabian Peninsula. Furthermore, in Jordan, the average agricultural production declined by 25–50 per cent in 1999–2000 and agricultural production entirely failed in vast areas of land. In addition, wheat production declined by 12–20 per cent of the total average, and the productivity of rangelands declined by 50 per cent. In that season, agricultural production losses as a result of drought were estimated at around US$57 million (ACSAD/CAMRE/UNEP 2004).


UNEP

Meanwhile, Somalia was hit by 12 droughts between 1961 and 2004, killing 19 671 people and injuring 4 million (UNEP 2005), whereas Sudan was hit by 5 incidents of drought between 1984 and 1993 affecting vast areas of the north in 1984, with the impacted agricultural area amounting to 618 million ha (Ministry of Agriculture 1993). Meanwhile, 6 incidents of drought swept Morocco between 1972 and 1981 during which annual rainfall ratio decreased by 55–60 per cent of the normal ratio. Mauritania has been suffering from recurrent droughts since the early 1970s where 25 million ha of its agricultural lands were affected in 1972 and drought led to the degradation of 12 000 ha during 1984–2004 (ACSAD/CAMRE/UNEP 2004).

Desertification remains the most hazardous form of land degradation in the Arab region. Its most important aspects are sand encroachment and salinity of agricultural lands.

Somalia is the Arab country most impacted by natural disasters (UNEP 2005). In addition to severe droughts that hit the country, 18 floods also occurred during that period, killing 2 671 people and affecting 1.8 million others (CHRR undated). In addition to the death of millions of livestock, soil was severely eroded, particularly of those forests and steppe lands whose plant cover was degraded by wood-cutting and overgrazing (IRIN 2004, UNEP 2005). In 1997–1998 about 80 per cent of the country's banana plantations were severely hit by the El Niño rains, and 100 000 families lost their main source of income (EU undated, UNEP 2005). Climate change is expected to exacerbate drought impacts in the Arab region.

Special attention should be given to drought due to its adverse impact on the economies of countries that rely on agricultural production, considering that it is a frequently recurring phenomenon. In this context, there should be a clear-vision response based on drought prediction, taking into consideration its prospective severity as a result of climate change. It is also necessary to provide an enabling framework to confront crop failure cases through establishing funds to support farmers, developing agricultural systems such as conservation agriculture, and applying new techniques in agricultural technology, irrigation, and rainwater harvesting. Adoption of the relative advantage in agriculture should also be considered.

Challenges and opportunities

Considerable efforts have been made to put an end to land-use conversion and improve the status of degraded lands. They have

Rangelands are a fundamental environmental wealth effectively contributing to consolidating national economy through their animal and plant wealth that could achieve food security.

dynamics and their responses to land-use changes and degradation.

The critical food security situation in the Arab region, especially during periods of severe drought, underlines the need for a comprehensive and integrated strategy to enable countries to overcome present and future food security challenges. Introducing Conservation Agriculture as a sustainable and more productive system to replace present agricultural practices is a promising option to achieve food security, adapt to climate change and combat desertification in the region (Stewart and others 2008). Conservation agriculture is a concept of agricultural production that is based on mimicking the natural ecosystems of forests and steppes, where the nutrients, water, carbon and energy cycles are semi-closed, and are used in more efficient and sustainable manners.

included using efficient methods for land and water management, rehabilitating degraded rangelands, increasing protected areas and reforestation, in addition to enforcing legislation. However, these efforts have so far affected less than 2 per cent of the total land area of the Arab region, totalling 2.8 per cent of degraded lands in the Arabian Peninsula and 13.6 per cent of the Mashriq sub-region (ACSAD/CAMRE/UNEP 2004). Therefore, endeavours should be intensified and projects should be enlarged to rehabilitate the remaining degraded lands in the region.

Measures to mitigate the impacts of land degradation are often well defined in National Action Plans (NAP) to combat desertification in the region (ACSAD/CAMRE/UNEP 2004). However, the complexities of land resource problems require commitment on the part of governments to devise improved strategies and design and implement effective policies. Intensive scientific efforts are also necessary to improve people's understanding of ecosystem

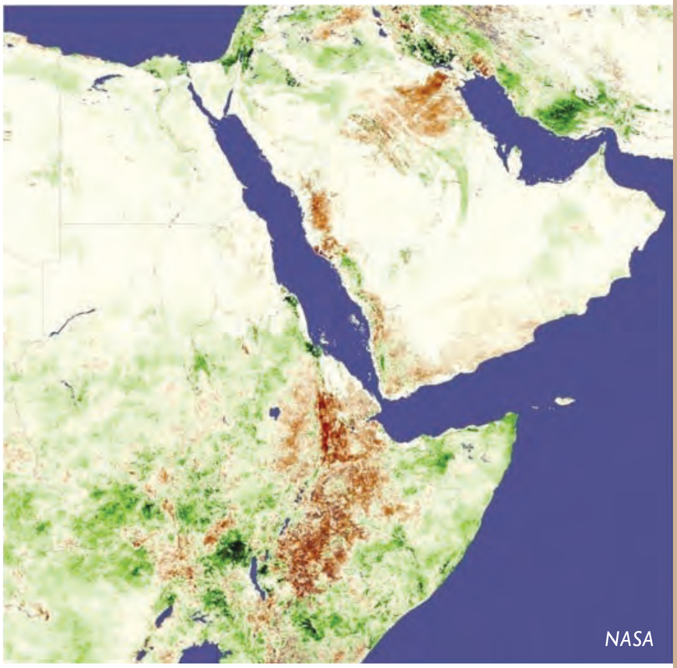
The big challenge ahead is to sustain and optimize the use of natural resources to improve agricultural production and people's livelihoods. It is the responsibility of governments, scientists and citizens at the local, national, and regional levels to develop more productive and sustainable options for agriculture, forestation, herding and production of goods. Agricultural production is still below the region's capacity and energy inputs. This is due to the fact that the area currently being exploited for cropping is still far less than the total area suitable for cropping. Surface water irrigation methods are inefficient and should be improved in order to increase the water available for agriculture and other purposes, as well as to protect underground water sources from unsustainable depletion.

Consequently, irrigation water can be better managed with improved water policies, irrigation systems and networks, capacity building, and by working with farmers to develop more suitable and sustainable agricultural techniques. Developing new varieties of crops that are more drought-tolerant and efficient in converting sunlight into dry matter will also serve to safeguard agricultural livelihoods. Scientific and technological techniques should also be developed to upgrade agricultural methods and improve production.

Moreover, an integrated, interdisciplinary, and participatory approach to land conservation should be adopted at all levels, based on deep knowledge and understanding of the nature of land and agricultural production. It should depend on real indicators that reveal land resource status and the pressures that led to it, along with an assessment of its impact on humans and the environment.

Mitigating land degradation and desertification, within complicated and interrelated socio-economic climatic dynamics, requires serious commitment from all stakeholders. These commitments should support scientific efforts to understand human-environment interactions, build institutional capacities, adopt holistic ways of thinking and actions to address land degradation, such as developing policies and productive systems to sustain and optimize the use of resources.

While challenges exist, there are also innovative ways to overcome them such as utilizing uncultivated lands, employing improved technologies – especially with regard to advanced irrigation systems and networking – in addition to knowledge sharing among diverse stakeholders. Other solutions include: adopting conservation



The critical food security situation in the Arab region requires a comprehensive strategy to enable countries to overcome current and future food security challenges. The picture illustrates grasshopper swarms in Africa and the Arabian Peninsula in March 2007

agriculture; using or developing improved varieties of crops; improving animal rearing and reproduction techniques, making use of expertise as well as exploring scientific and technological methods in agriculture.

There are great opportunities to overcome degradation of land resources and increase food production in the Arab region. To achieve this, an enabling environment must be created which requires formulating effective policies and strategies to manage land resources. Furthermore, it is essential to mobilize and mainstream the use of financial resources to protect natural resources, modernize farm management and apply proper techniques and technology in production processes. It is also vital to adopt integrated management practices to assess and manage arable, range and forest lands as well as to combat desertification. Finally, capacity building, and supporting research and extension services for various aspects of land use are fundamental to the sustainable management of land resources.

Initiatives pertaining to sustainable agricultural development in the Arab region are the basis for achieving sustainability of Arab natural and agricultural resources and rationally investing them. These initiatives are based on: the Cairo Declaration of Arab Cooperation Principles Regarding Use, Development and Protection of Arab Water Resources (1997), the Abu Dhabi Declaration on Agricultural Development and Combating Desertification (2002), the Arab Initiative for Sustainable Development (2002), in addition to the Statement released by the Tunisian Summit on Sustainable Agricultural Development and Food Security (2004). Initiatives are also inspired by the resolutions adopted by the Riyadh Arab Summit, regarding the Strategy for Sustainable Arab Agricultural Development for the coming two decades (2007), and the Kuwait Declaration on Uplifting the Living Level of the Arab Citizen, issued by the 2009 Arab Economic Summit.

CONCLUSION

The Arab region comprises five main agro-climatic zones: Hyper-arid, Arid, Semi-arid, Sub-humid and Humid. Arid and semi-arid lands constitute 90 per cent of the total area of the Arab region. These lands are divided into rangeland (30 per cent), deserts (19.1 per cent), land suitable for agriculture (14.1 per cent) and forests (6.3 per cent).

Land resources are of vital importance to the existence and well-being of human beings. Resource sustainability is significantly affected by human activities and threatened by the increased demand for commodities. The issues of land degradation and land-use change in the Arab region have emerged as major challenges, with environmental, socio-economic reflections that require responsible actions. These challenges are an overarching priority as they involve food security issues and climate change impacts on water and agriculture.

Considerable change has taken place in land-use and forest vegetation cover and the total area of forests has declined. Rangeland has been degraded, several areas of land have undergone desertification and ecosystems have deteriorated in various places. Land degradation is expressed in terms of soil salinity, water erosion, wind erosion, and sand encroachment on agricultural lands, oases and infrastructure services in many Arab countries. This has been exacerbated by scarcity of water resources and rainfall, severe drought as well as shortage of resources and expertise.

Arab countries have exerted tremendous efforts to stop land-use conversion and mitigate degradation. Nevertheless, this requires intensifying endeavours to alleviate the impacts of land degradation on the environment and human well-being. This is to be accomplished through formulating a comprehensive strategy based on existing initiatives to enable countries to maximize the use of natural resources and achieve sustainability. This will help overcome food security and development challenges in the Arab region.

As a result of the dominant economic policies, population growth, diversity and increase of consumption patterns, the land area per capita and the total area of forests decreased while the arable and the rangeland area per capita increased. Human activities led to the degradation of nearly 68 per cent of the total land area in the Arab region.

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Chapter 4

COASTAL AND MARINE ENVIRONMENTS

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Main messages

Marine and coastal ecosystems provide essential products and services for several countries in the Arab region. Arabian seas hold a vast wealth and their shores house diversified resources. The following are the main messages of this chapter:

- The Arab region's coastal and marine ecosystems hold a wealth of potential for environmental and economic growth and are known for their diverse geographical structures. They support highly productive coastal habitats, such as coral reefs, extensive intertidal mudflats, seagrass beds, algae mats, mangrove stands as well as wetlands and water bodies. However, these ecosystems experience severe pressures, namely pollution, overfishing, urbanization, and unsustainable tourism that ultimately degrade these resources and undermine their biological features.

- Pollution resulting from human activities in terrestrial and coastal areas is a threat to the health, productivity and biodiversity of coastal and marine ecosystems. Most of the pollution found in sea depths in the Arab region is the result of maritime transport operations and related ship accidents. The pollution load of the shores, including municipal, industrial and agricultural wastes and run-off, emanates from such land-based activities and affects the most productive areas of the marine environment, including estuaries and near-shore coastal waters.

- Fish resources constitute a major source of animal protein and income for many Arab countries. Decline in fish stocks, catches, and average size of fish in marine areas threatens food security and increases poverty in coastal communities in Arab countries. Depletion of marine and coastal resources and degradation of their ecosystems and biota are among the critical issues facing the Arab region today.

- Coastal areas are a valuable environmental and economic resource and their loss cannot be compensated. These areas should be properly managed in a way that takes into consideration their environmental and socio-economic dimensions. Integrated coastal zone management provides a dynamic framework to tackle permanent changes in communities and the natural environment. Implementation of this framework should be allied with capacity building to develop economic tools and financial mechanisms that serve the planning process and implement related coastal development integrated projects.

- Coastal tourism plays a vital role in the economies of many Arab countries. Unfortunately, environmental pressures resulting from unsustainable development in coastal areas could hurt the tourism sector as well as the environment. Integrated coastal zone management is an effective mechanism that enhances sustainability of tourism and conserves the environment.

- The prevention and mitigation of natural disasters along coastlines is an important challenge facing the Arab region. The potential impacts of sea-level rise (SLR) due to climate change must be assessed and accurately estimated by using scientific evidence. This is considered one of the pillars of coastal development and it requires undertaking necessary measures to adjust to impacts of SLR and manage its risks. Ecosystem management, risk management and strategic environmental assessment, in addition to integrated coastal zone management constitute the basis for the protection of these areas.

- Adhering to international laws and regional conventions to curb coastal and marine pollution is fundamental. Maritime pollution, in its various forms, is transboundary. It has to be counteracted through bilateral and regional cooperation among countries, in addition to enforcing laws and abiding by international conventions concerning risk prevention. Despite the commitment of Arab governments to address the issues of coastal and marine pollution, as well as overfishing, and coastal development, there is still an urgent need for more resolute decisions, urgent measures, and mobilization of resources.

adel farid abd el kader

INTRODUCTION

The Arab region holds a vast wealth of coastal and marine environment ecosystems that support potentials for economic and environmental growth. These systems maintain highly productive coastal habitats, such as extensive intertidal mudflats, sea grass, algae beds, mangrove stands and coral reefs in addition to rich fish wealth. The Red Sea and Gulf of Aden are both sources of economic and social prosperity; providing subsistence and commercial food supplies. They also represent domestic and international tourist attraction sites, strategically important transport routes for shipping, and rich and varied sources of cultural heritage. The Mediterranean Sea contains a rich biodiversity accounting for 8—9 per cent of the total number of species in the world's seas. The ROPME Sea Area (RSA) is home to diverse marine habitats although it experiences severe human pressures.

Marine and coastal ecosystems are experiencing continuous pressures due to human activities. A major issue that needs immediate attention is pollution resulting from inland sources and oil-related activities like mining operations, industry and transport. Moreover, declining fish stocks represent another problem in the region as fish resources are a major source of animal protein and national income for many Arab countries. Consequently, the decline in fish stocks could have a significant impact on food security in some countries.

Coastal zone management is one of the most important environmental issues in the region. Large scale coastal development jeopardizes the safety and well-being of coastal environments. Over the last thirty years, coastal development has been accelerating in most Arab countries in the form of sea front housing, resorts and mega projects, especially along the coasts of the RSA and the Arabian Sea since the 1990s. Along the coasts of the Red Sea, Gulf of Aden and the Mediterranean Sea, where seaports, resorts, and new cities are being built, the same trend is evident. This chapter will address the status of coastal and marine resources and key issues, such as pollution, depletion of fish stocks as a result of overfishing, in addition to coastal and marine development in the Arab region.

BACKGROUND

The Arab region is surrounded by coastlines whose lengths exceed 22 000 km. Coastline length varies among countries, ranging from 26 km in Jordan on the Gulf of Aqaba to 3 325 km in Somalia (Al-Rousan and others 2007, 2008 AOAD). Arab coastlines are located on a number of major water bodies including the Atlantic Ocean (Mauritania and Morocco), the Mediterranean Sea (North African countries, Syria, Lebanon, and the Gaza Strip (Occupied Palestinian Territories – OPT), the Red Sea (Egypt, Saudi Arabia, Sudan, Jordan and Yemen), the Indian Ocean (Somalia, Djibouti, and the Comoros Islands), and the ROPME Sea Area (Iraq, and the Gulf Cooperation Council States). Populations in the Arab region are concentrated along coastal areas. For instance, the proportion of the region's population located within 100 km of coastline is estimated to be more than 63 per cent (UN 2006).

The categorization of the Arab region's water bodies in this chapter is based on the UNEP Large Marine Ecosystem (LME) classifications. The ROPME Sea Area countries border the Oman Gulf and the Arabian Sea and include Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates (UAE) and Iran. The Red Sea and Gulf of Aden area includes Jordan, Egypt, Sudan, Yemen, Somalia, Djibouti, and Saudi Arabia. The Mediterranean Sea Area countries border the south and east of the Mediterranean Sea and include Morocco, Algeria, Tunisia, Libya, Egypt, Syria, Lebanon, and the Gaza Strip (OPT).

Natural resource overview

The coastal and marine ecosystems of the Arab region comprise a wide variety of habitats that include coral reefs, seagrass beds, mangrove stands, tidal flats, algae mats, coastal lagoons, sand dunes, sabkhas, and islands. Table 1 illustrates some data related to the marine area, reef area, fish species, and seagrass species in a number of Arab countries.

The ROPME Sea Area countries accommodate diverse marine habitats, ranging from intertidal exposed rocky shores, sand, mudflats and mangroves to open sea areas with seagrass beds and coral reefs. Shallow bays, lagoons, coastal sabkhas and small coralline islands are all features of the RSA (Sheppard and others 1992, ROPME 2004). These shallow waters are productive, supporting whole marine food chains, including the world's second largest population of dugong (Dugong dugon), and resident populations of killer whales, the largest predator in these seas. The presence of these large carnivores is an indication of the productivity of these shallow water habitats (Loughland and others 2007).

The Red Sea and Gulf of Aden are also rich in habitats and biodiversity. Their coastal ecosystems of mangroves, salt marshes, and rocky, sandy, and muddy shores border shallow seas, sea grass beds, coral reefs and abyssal depths. In the Gulf of Aden, the upwelling that occurs during monsoons supports a valuable


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fishing industry. The water in these coastal bodies is enriched with nitrate, phosphate, aluminium and silicate nutrients that enhance the growth and production of phytoplankton. This phytoplankton, in turn, is an important staple for many marine organisms (Hariri 2000).

The Mediterranean Sea area has a relatively small number of organisms living within its waters when compared with other regional marine bodies. However, its surrounding coastal lands are characterized by a high degree of biological diversity. Among the ecosystems that occupy the coastal marine areas are rocky intertidal, estuaries, and seagrass meadows, which are of significant ecological value. The Mediterranean's fauna includes several endemic species and is considerably richer than that of the Arab region's Atlantic coasts. The continental shelf of the Mediterranean coast is very narrow. The narrowness of the continental shelf means that most of the marine resources in the Mediterranean are confined to the territorial waters of the coastal states. Furthermore, while central zones of the Mediterranean are low in nutrients, coastal zones benefit from telluric nutrients that support higher levels of productivity.

Major environmental issues

Pollution

Coastal and marine pollution changes the physical, chemical, and biological characteristics of ocean water and sediments. Pollution has many sources and forms, and much of it is the direct result of human activities. Pollution from maritime transport is posing a growing threat to the Arab region seas due to the enormous quantities of oil transported through these

Tagora Beach, Libya

Table 1. Marine and Coastal Area Habitats of Selected Countries							
Area	Marine area km2	Reef Area km2	Reef Fish Species	Coral Spe-(cies (CITES	Reef At Risk per cent	Sea grass Species	Marine Fish Species
Jordan	-	50	153	-	75	-	203
UAE	21 200	11 900	92	30	65	1	182
Bahrain	8 000	570	110	-	82	3	204
Djibouti	7 000	540	294	69	100	-	393
Saudi Arabia	82 000	6 660	312	187	60	5	458
Sudan	91 600	2 720	267	106	32	2	335
Somalia	-	710	559	59	95	4	847
Oman	487 400	530	588	71	51	-	976
Qatar	31 000	700	81	-	66	-	161
Kuwait	5 000	110	94	30	93	2	192
Comoros Islands	175 000	430	385	-	99	4	477
Egypt	185 300	3 800	437	126	61	9	734
Yemen	465 000	700	258	-	73	8	459

waters. For example, out of the world's total exported oil, 60 per cent is transported through the Strait of Hormuz alone. In many countries, coastal pollution comes from oil-related, industrial, and desalination plant spills and discharges.

In addition, human wastes contaminate coastal and marine environments in the region, affecting the health and survival of all forms of life, and degrading the natural quality of these environments. In some countries, pollution comes primarily from major rivers that discharge domestic and municipal human wastes, agricultural chemicals (most common along the southern and eastern shores of the Mediterranean) and hazardous industrial substances (along the northern shores of the Mediterranean) into the sea. Demographic shifts from rural to urban areas, coupled with dense concentrations of people living along the

Google

The Gulf of Aden

coastlines (both residents and tourists), increase the amount of waste produced and further threaten coastal environments. Mass tourism, land filling, and the dumping of untreated waste are additional pressures that could cause irreversible damage to coastal marine ecosystems and human health.

The impacts of all of these forms of pollution are multi-fold. For instance, fish mortalities have been observed over recent years along some coasts in the region. Eutrophication has been reported in seas, along coasts and sea lagoons in many places as well (see Box 1).

The RSA sub-region represents a highly stressed environment due to a combination of prevailing natural conditions and development pressures along its coastline. This sub-region currently accounts for approximately one-fourth of the world's oil production (Khan 2002), which makes it more vulnerable to problems associated with pollution from oil and other resources than other Arab regions (Munawar and others 2002). For example, more than 25 000 tankers carrying about 60 per cent of the total oil exports to the world travel through the Strait of Hormuz annually (ROPME 2004).

About 2 million barrels of this oil are spilled in the ROPME Sea Area every year from the discharge of ballast water (UNEP and EEA 1999). Naturally, some oil related activities produce greater amounts of pollution in the region's marine environments than others. The highest inputs of oil originate from war related activities, tanker accidents, the discharge of dirty ballast water and other oily water, and shipping traffic. Oil from terrestrial sources, which include refineries and factories, also pollutes the coastal environment and the same applies to natural seepage (Ahmed and others 1998, Zainal and others 2008, de Mora and others 2004, Al Madany and others 1998, Khan and Al-Ajmi 1998).

One of the Red Sea shores

The considerable development in the RSA sub-region, and the consequent urbanization and industrialization of port areas and refineries, represent a major source of pollution for the marine environment as well. Open sea cruises, undertaken since the early 1990s contribute to pollution on land, and in the ROPME Sea Area and the Arabian Sea (Butayban 2005).

Domestic sewage discharge from urban and rural areas of RSA countries has major impacts on the coastal and marine environment. This sewage is either partially treated or untreated. The volume of domestic sewage is increasing, due in part to population growth and lifestyle changes (see Chapter 5: Human settlements). The estimated


Mila Zinkova

capacity of sewage treatment plants exceeds 2 million cubic m/day. Bahrain, Kuwait and the UAE are the only countries in the RSA that properly treat domestic wastewater prior to discharge, and a certain amount is recycled (ROPME 2004). Across the area, about 20–30 per cent of sewage discharged into the sea remains untreated or only partially treated. This untreated discharge poses the threat of eutrophication in enclosed shallow areas like bays (ROPME 2004). Additionally, a large quantity of treated wastewater is discharged unused to the sea. This causes a multitude of sewage related problems with effects that include:

- Disturbances in the ecosystem, including destruction of habitats, damage to biota and biodiversity, as well as possible eutrophication (such as green, brown and red tides and algal blooms)
- Effects on human health from polluted water during activities such as swimming and eating contaminated aquatic foodstuffs
- Impacts on economic activities, mainly fisheries and tourism.

Sewage treatment plants exist in GCC countries, but the level of treatment varies and the capacity is not sufficient to deal with existing loads (UNEP/GPA 2006). The volume of reused wastewater is still far less than the volume of treated wastewater. Figure 1 displays

Box 1. Eutrophication as one of several consequences of water pollution

Urban wastewater discharges contain high nutrient loads, especially when left untreated. These discharges can find their way into coastal and marine water bodies in the vicinity of large towns or cities, causing a build-up of nutrients that can lead to eutrophication. Eutrophication, in its most generic definition, applies to both fresh and marine water, and is the process of enrichment of water with plant nutrients, (primarily nitrogen and phosphorus) that stimulate aquatic primary production. The most serious manifestations of eutrophication are algal blooms (red tides), algal scum, enhanced benthic algal growth, and at times massive growth of submersed and floating macrophytes. Sometimes, these manifestations are accompanied by, or alternate with, cycles of visible bacteria blooms and fungal developments.

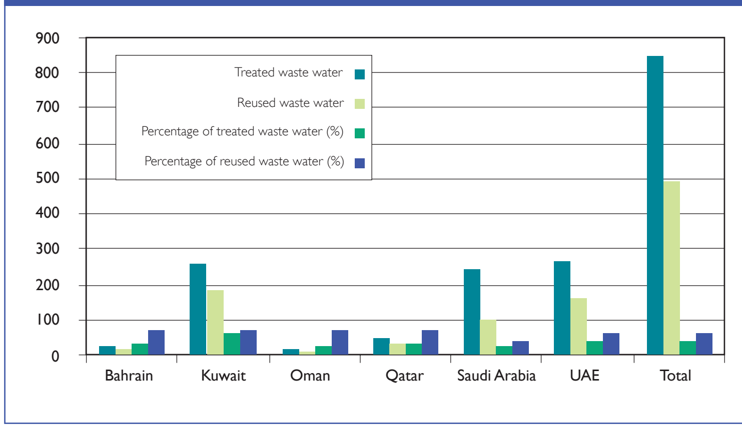
This phenomenon has several side effects including: proliferation of plankton biomass, water discoloration, decline in water transparency, and dissolved oxygen in deeper waters, in addition to the propagation of toxic algal species in extreme cases. The main effects caused by eutrophication can be summarized as follows:

- Species diversity decrease and dominant biota change
- Increase in plant and animal biomass
- Increase in turbidity
- Increase in sedimentation rate, shortening the lifespan of lakes
- Anoxic conditions may develop (LennTech undated)

Human society is impacted as well because eutrophication decreases the value of river resources, lakes, and estuaries, hindering recreation, fishing, hunting, and aesthetic enjoyment. Health-related problems can occur where eutrophic conditions interfere with drinking water treatment (Bartram and others 1999).

the treated wastewater and its reuse in GCC countries during 1990 and 2000 (Kreimer and others 2003).

Figure 1. Treated Wastewater and Reuse of RSA Countries (million m3/y)



Kreimer and others 2003

Untreated liquid wastes from coastal cities, villages and resort areas in the RSA sub-region are often discharged into the sea, causing eutrophication. Recreational sites along coasts also contribute to eutrophication problems, especially along the north-western section of the RSA (ROPME 2004). There is strong visual evidence that localized problems exist in some areas. For example, dense algal mats on the northern coast of Bahrain may be associated with nutrient discharges from methanol/ammonia plants, oil refineries, slaughterhouses and other livestock related activities, and sewage treatment plants. Additionally, pelagic algal blooms in the offshore waters and red tides have also been observed, which may be signs of eutrophication (Khan and Al-Ajmi 1998).

Since 1986, the Gulf region has been experiencing massive fish and other marine mortalities. Consequently, the economic losses to the fishing sector were substantial (ROPME 2004). These deaths were attributed to various

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Infilling operations along the shores for urban expansion

factors, including anthropogenic contaminants, increased temperatures, disease agents, and bio-toxins.

The Arab region's industrial sector has grown rapidly in the last two decades and most facilities have developed in coastal zones. This development can have major environmental consequences as industries located along the coast usually discharge their effluents directly into the sea. Examples of coastal industries include refineries, petrochemical complexes, power plants, and desalination plants. Light industries include agricultural and livestock production, and food and beverage processing, which is the major contributor to organic carbon load in the marine environment and the main source of oxygen demand compounds (ROPME 2004).

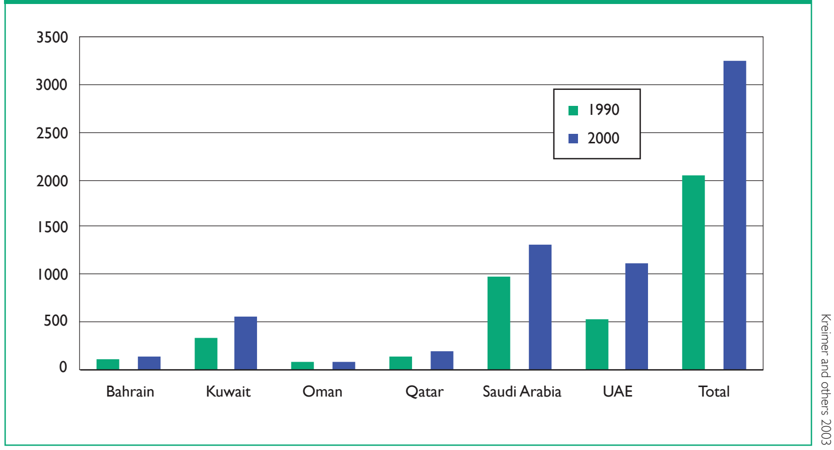
Eight refineries and more than 15 petrochemical complexes are located in the ROPME Sea Area. The petroleum refineries have been reported to contribute 28 per cent of total waste volume. They are major contributors to the COD, oil and metal load.

The desalination and power plants discharge around 48 per cent of the total industrial effluent volume in the region, which contributes to the BOD and suspended solids (SS) load in the marine environment. Petrochemical and other industries contribute 19 per cent, and all other industries account for 5 per cent of the total discharge into the RSA region, respectively (SOMER 2000 as cited in ROPME 2004).
Most industries, such as cement plants, oil refineries, fertilizer plants, iron and steel industries, and urea and ammonia plants are a major source of solid and hazardous waste in the RSA region.

A comprehensive survey on the heavy metal contamination of coastal waters in the Gulf Arab states was carried out in 2000 and 2001 (de Mora and others 2005). This study found that the petroleum hydrocarbon levels were lower than those reported in 1991 after the Gulf War. A steady decline in the level of petroleum hydrocarbon was reported in sediments examined along the east coast of Bahrain from 1993 to 1998 (ROPME 2004). Moreover, the survey showed that chlorinated hydrocarbons and trace metals in marine fish were within acceptable levels, but sediments near some industrial facilities and harbours indicated higher levels of heavy metals (de Mora and others 2005, ROPME 2004) (see Table 2).

Due to increasing shortages in non-renewable water resources over the past thirty years, GCC countries have supplied the bulk of needed water from the desalination of seawater. This

Figure 2. Desalination Capacity of Some RSA Countries (MCM/Year)



technology was introduced into the region during the 1960s, and since that time more than 68 power and desalination plants have been operating in the GCC countries, which currently produce nearly 43 per cent of the world's desalinated water (ROPME 2004, UNEP 2002) (see Figure 2). As population growth continues to rise, there will be an increase in reliance on this mode of water supply (Kreimer and others 2003) (see chapter 2: Water Resources).

Currently, consumption of desalinated water in GCC countries accounts for over 60 per cent of the world's total production. The total daily water production capacity of desalination plants was estimated at around 8.22 million m3 in 2005. It is worth mentioning that Al Jubail on the eastern coast of Saudi Arabia is considered the world's largest seawater desalination plant, with daily production capacity of more than 2 million m3 of water. These plants are discharging their brine waste in excess of 5.48 million m3 per day into the coastal areas of the GCC countries (Purnama and others 2005).

Brine, or highly concentrated saltwater (which reaches 70 000 ppm near the outfall) is the unwanted by-product of the seawater desalination process. The continuous discharge of brine into the sea is the most cost-effective disposal method for desalinization plants, leading many plants to use this method despite its significant environmental impact (Purnama and others 2005). The discharge of concentrated hot brine from desalination plants constitutes a great environmental stress in the RSA. This is because the thermal effluents produced are generally 5°C higher than the receiving water and contain residual chlorine used as an antifouling agent (ROPME 2004, Khan and Al-Ajmi 1998).

To counteract pollution, ROPME introduced satellite receiving stations to detect coastal activities and monitor the impact of pollutants on the marine environment (Butayban 2005, ROPME 2004). The results of this monitoring provide information on the impacts of pollution in the region and assist governments to adopt policies and action plans to protect the marine environment. Furthermore, a specific regulation was introduced recently in most Arab countries requiring an environmental impact assessment prior to any coastal or marine activity or development project (GCC 2004). In addition, there has been a significant reduction in oil spillage due to the creation of new systems to contain oil pollution (ROPME 2004). The ratification of the International Convention for the Prevention of Pollution from Ships (MARPOL) will help reduce pollution within the coastal and marine environments of the region. However, not all GCC countries have signed this protocol (GCC 2004). The introduction of reception facilities for ship-generated waste


ahmed saad

is another potential solution for decreasing the amount of effluents released into the sea environment.

In the Red Sea and Gulf of Aden sub-region, more than half of the world's exploration, production, processing and transportation of oil reserves take place. Most of this oil, produced from both inland and offshore wells, is exported using large oil tankers. Over 100 million tonnes of oil is transported through the Red Sea annually, half of which enters the region via the Yanbu Petro-line from the Gulf (PERSGA 1998). The transport of large volumes of oil can be disastrous for local ecosystems when there is spillage or leakage of tanker contents. The worst oil spill in the North Red Sea occurred on 23 March 1982, during the loading of the tanker Nabila at Ras-Shukheir. Within four to six hours, tens of thousands of tonnes of crude oil were released into the sea (Hanna 1995).

The Red Sea generally suffers from oil pollution along its coasts. While each km2 in the world's oceans receives 9.17 kg/year of oil, each km2 in the Red Sea receives 14.61 kg/year (Awad 1989). The effects of oil spills can be far-reaching, from an environmental as well as a socio-economic perspective. Seabirds, marine mammals, fish, shellfish, and bottom-dwelling animals may be affected. Coastal habitats, wildlife species, tourist and recreational activities, and local industry, are

Table 2. Quantity, Source and Type of Solid Waste in RSA Sub-region Countries

Country	Quantity of solid Waste (tonnes/annum)	Source and type of solid waste
UAE	327 086	Oil sludge, organic waste and inorganic waste
Bahrain	35 000	Grit and silt from sand blasting
Saudi Arabia	12 000 000	Waste from petrochemical plants, cement plants and oil refineries
Oman	49 172	Petrochemical waste
Qatar	280	Oil sludge, iron dust and solid waste from steel industries, power and desalination plants
Kuwait	1 742 688	Industrial sludge, trace metals such as chromium, tin and lead
Total	14 154 226	

GRC 2006

among the resources and sectors that can be negatively impacted by oil spills, particularly near the coast (Fucik and others 1984).

Other forms of ship-generated waste include oily sludge, bilge water, garbage, and marine debris. The risks of oil well blow-outs, spills and other production accidents associated with the offshore oil industry constitute significant threats to human and wildlife resources (PERSGA 1998). As a result, National Oil Spill Contingency Plans (NOSCPs) were adopted in many countries bordering the Red Sea to counteract their harmful effects. For instance, the NOSCP was adopted and updated by the Egyptian Environmental Affairs Agency (EEAA) in 1998. Regional and bilateral agreements to alleviate pollution are in effect between the riparian countries of the Red Sea as well. The Jeddah convention is an example of regional cooperation to contain and mitigate pollution in the sea. The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), established in 1996 and based in Jeddah, is a forum for the cooperation of riparian countries with the primary aim of protecting the marine environment in the region.

Desalination plants along the Red Sea coasts, like other plants elsewhere, have the potential to adversely affect the environment in many ways. The desalination effluent that is returned to the sea is a heavily concentrated brine solution, containing a high salt concentration and several chemical products which have the potential to kill marine organisms due to the high concentration of salt, which interferes with the lower levels of salt concentration to which marine life is accustomed. Another concern is that the effluent discharged has the potential to raise the temperature of coastal waters near to where it is discharged. In general, the environmental impacts of desalination plants vary depending on factors, including the

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location of desalination plants and the method of waste disposal (UNEP/PERSGA 1997, Sommariva and others 2004, SCCG undated).

Moreover, the pollution from sewage discharges in tourist facilities has increased in resorts, like the case in the northern part of the Gulf of Suez (EEAA 2009). The spillage of phosphate dust, which occurs during the loading of phosphate minerals onto ships, contaminates coral reef areas, or the adjacent places in the Gulf of Aqaba. As a result, the rate of death of Stylophora pistillata coral colonies was found to be 4 to 5 times greater in polluted areas than in control areas (Walker and Ormond 1982).

The use of fertilizers and pesticides is widespread throughout some of the Red Sea and Gulf of Aden sub-region countries including Yemen, Somalia and Sudan. These chemicals are introduced into the marine environment by agricultural run-off and drainage and, to a lesser extent, by atmospheric depositions (Saleh 2007). The Jordanian coast of the Gulf of Aqaba has been exposed to relatively high metal concentrations (for example, cadmium, lead, copper and zinc) since the mid 1960s, corresponding to the onset of urbanization and the development of maritime human activities in the area (Al-Rousan and others 2007).

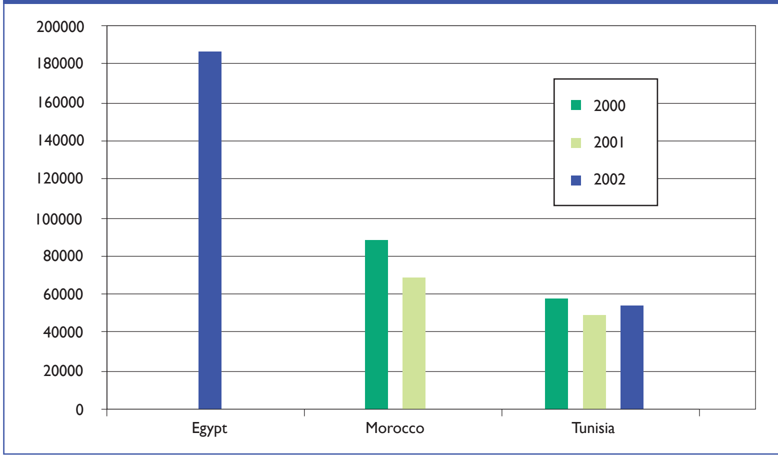
The Mediterranean Sea is the major transportation route for crude oil from fields in the Middle East and North Africa. It is the most important oil traffic lane (90 per cent of total oil tanker traffic) which connects the Suez Canal and the Sidi Krir terminal of the Sumid pipeline in Egypt with Gibraltar, passing between Sicily and Malta, and then along the coasts of Tunisia, Algeria and Morocco. It is estimated that some 2 000 vessels cross daily, including 250 to 300 oil tankers. Each year, approximately 220 000 vessels cross this sea, weighing more than 100 tonnes each, and discharging 250 000 tonnes of oil. This discharge is the result of normal shipping operations, such as tank washing, dry-docking, in addition to fuel and oil leakage in the region. It takes place in a spot that has been declared "a Special Sea Area" by the MARPOL 73/78 convention.

Many countries, such as Algeria, Tunisia, Libya, Egypt and Syria have oil loading ports, while Lebanon and Morocco are close to oil shipping routes. Due to the intense oil traffic in the region, spills are frequent. On average, 15 accidental spills are reported annually while the threat of a major spill is a possible reality at any time.

Sewage generation from coastal cities is one of the major pollution problems on the Mediterranean coast (EEA and UNEP/MAP 2006). During the tourist seasons there is an enormous increase in the amount of disposed wastewater and sewage. As a result of fluctuations in waste and disposal, biochemical oxygen demand (BOD) was found to range from 54 000 kg/day to 180 000 kg/day in 2002 (WRI 2007) (see Figure 3). The major pollutants in wastewater are organic matter, suspended solids, nutrients and pathogenic micro-organisms. Other pollutants, such as heavy metals, petroleum and chlorinated hydrocarbons are also present in wastewater (EEA and UNEP/MAP 2006). Furthermore, the direct discharge of untreated sewage on shores and into coastal waters is common practice in all Mediterranean countries (METAP Secretariat 2002).

Even after primary or secondary sewage treatment, remaining nutrients can significantly impact sensitive areas like those where aquaculture is practiced (Simmonds and Nunny 2002). Sewage has an influence on the coastal environment as it affects human health, the stability of the marine ecosystem, and the economy of the coastal zone (through its impact on tourism and fisheries in seas and coastal lagoons in the region) (EEA 2007) (see Box 2).

Figure 3. Organic pollutant emissions in Egypt, Morocco and Tunisia (kg/day)



WRI 2007

Solid wastes produced in urban centres along the Mediterranean coastline also present a serious threat to both human health and the marine coastal environment. Solid wastes are disposed of, untreated, at dumping sites. These uncontrolled dumping sites are often within town limits or literally on the waterfront, and are therefore sources of disease in the surrounding areas. In many cases, no measures have been taken to control and treat leachates which can pollute groundwater and coastal and marine environments with organic pollutants and heavy metals from the dumping sites (EEA and UNEP/MAP 2006).
Desalination is another source of pollution within the Mediterranean Sea. The total number of desalination plants in Mediterranean Arab countries is 103, 57 per cent of which are located in Libya (see Figure 4).

Rivers are important transporters of nutrients and suspended solids since they are close to agricultural activities and urban centres. The average nitrogen concentration in the Nile is 3 000 mg/l (EEA 2007). The Mediterranean is a nutrient-poor sea and so a moderate amount of nutrient discharge (uncontaminated by toxic wastes) can be beneficial. This must happen within reason, because if left unchecked, it could lead to eutrophication of coastal areas (Simmonds and Nunny 2002). This has become a chronic problem in shallow waters near the Nile Delta and major urban cities where low concentrations of soluble oxygen (2 mg/l) were recorded in Al Dekheyla and the eastern port close to Alexandria in Egypt (the Egyptian Environmental Affairs Agency 2009). Moreover, Sfax in Tunisia suffered from excessive phosphates (Benoit and Comeau 2005).

Persistent toxic substances (PTSs) are especially worrying because of their enduring toxic effect on animal and plant life when concentrations exceed certain thresholds. Although the trend has been recently reversed, industrial heavy metals, created by artificial processes, increased by 300 per cent between 1950 and 1990 (Benoit and Comeau 2005). Heavy metals in the Mediterranean Sea arise mainly from natural processes with a limited contribution from human activity. As metals tend to precipitate after their introduction into the coastal marine environment, they accumulate in sediments and biota. This occurs especially in sheltered areas such as harbours and semi-enclosed bays (EEA 2007).

The main trace metals found in the Mediterranean Sea are cadmium, mercury, lead, tin, copper and zinc. Trace metal levels can vary greatly depending on the time and place (inshore, offshore, eastern or western basin) that the samples are taken from. These levels can also be affected by: industrial and mining activity, agricultural and

Box 2. Coastal lagoons: Environmental Changes in Lake Manzala, Egypt

Coastal lagoons constitute a main component of coastal ecosystems. They provide humans with various environmental services, the most important of which are fish resources. In addition to their role in purifying and conserving water, lagoons have a cultural and recreational purpose. During the last few decades, lagoons in the Arab region have undergone decline in area and state mostly due to pressures caused by human activities, eventually undermining their role in providing people with diversified services. Ultimately, there is deterioration of lagoon environmental fabric and biota as well as biodiversity loss (Abdel Kader 1982).

The Millennium Environmental Assessment Report indicated that lagoons are the most deteriorated ecosystems. According to RAMSAR's estimations, 84 per cent of wetlands recorded in RAMSAR are vulnerable to environmental changes. Climate change is expected to have adverse impacts on several Arab lagoons, such as Egypt's northern lagoons, which are in danger of being submerged by the waters of the Mediterranean Sea. This could impact the quality of groundwater and the biodiversity of these ecosystems (Millennium Environmental Assessment 2005).

Lake Manzala, which has undergone some environmental changes, is a model for coastal lagoons in some Arab countries. It is considered an attraction spot for migrating birds as well as an important food (fish) source, as it accounts for around 50 per cent of total fish production of fresh water and coastal lagoons in Egypt. It is also a source of natural and artificial salt, and an arboretum for incubation of Mediterranean fish. In addition to the diversity of its hydrological and biological systems, Lake Manzala has a strategic security dimension because of its geographic location and the presence numerous monumental sites on some of its islands (Amasha 2002).

The lake is exposed to many changes and environmental hazards which could adversely affect its services and resources. Failure to use modern technology to monitor changes, collect data, resolve problems and adopt a sound scientific approach to integrated management will inevitably lead to degradation of the lake. This may result in loss of economic resources, and environmental balance, as well as deterioration of human health. Among the changes that have taken place in the lake during the last three decades was the decline of its coast and water body as a result of infilling operations. The lake is threatened by natural and man-made hazards that have serious impacts on its resources. They are summarized as follows: (Amasha 2002 and Abou El Magd 1995)

1. Unsustainable fishing techniques.

2. Seizure of large areas of the lake for aquaculture farming which led to stagnation and degradation of its waters.

3. Drying up of the lake for agricultural reclamation in addition to carrying out some infilling operations in some parts for the purpose of setting up new communities.

4. Oil and Gas mining operations.

5. Construction of Lake El Salam, one of the vital projects that had adverse impacts on Lake Manzala and the surrounding vicinity with respect to the declining area and the increase in urban and agricultural land.

6. Building roads and constructing

Landsat/NASA

2001

Landsat/NASA

1990

Box 2. Coastal lagoons: Environmental Changes in Lake Manzala, Egypt

waterways, lagoons and navigation canals that affect the quality of the lake water and lead to the deterioration of fish wealth.

7. Contaminating the lake water by liquid and solid waste (human, agricultural and industrial waste) across the drainage networks in various governorates.

The Millennium Environmental Assessment 2005, Amasha 2002, Abdel Kader 1982, Abou El Magd 1995

domestic wastes, the combustion of fossil fuels, and by natural factors such as erosion, volcanic and tectonic activities. Trace metal levels tend to be higher in marine sediments than in seawater (Simmonds and Nunny 2002). Although the Mediterranean basin occupies only 1 per cent of the Earth's surface, approximately 6 per cent of the world's mercury resources are located there. The maximum value of lead measured in marine sediments has reached 358.5 mg/kg in Tartous harbour, Syria (UNEP/MAP 2003, EEA 2007).

Overfishing and Depletion of Fish Stock

A number of Arab countries like the UAE, Oman, Yemen, Morocco and Mauritania are endowed with a wealth of fishery stocks coupled with rich fishing traditions. While production varies greatly among Arab countries, the total fish catch in the Arab region is rising. For example, it grew from 3.49 million tonnes in 2006 to 3.63 million tonnes in 2007, with an average increase of 4 per cent. This constitutes 2.5 per cent of the world's share of fish production (AOAD 2008). Fish production achieved a trade surplus in the Arab region that represented 95.1 per cent of the total surplus of food crops for 2007 (AOAD 2008).

The increase in fish production is due to new fish technology, offshore fishing reaching into international waters, aquaculture and a growing world demand for fishery products. Of the total production in the region in 2005, Morocco and Egypt contributed 58 per cent of the fish catch. Omani total fish catch in the same year reached 157 322 tonnes, or roughly 3 per cent (FAO undated).

The fish consumption per capita in the Arab region, 10 kg per year, is far below the world average of 16 kg per year, due to variations in consumption among countries. For example, average consumption ranges from 2 kg per year in Somalia, Sudan and Syria to 25 kg per year in the United Arab Emirates and Oman (UNEP 2005). Generally, fish are a relatively cheap source of protein for humans and are used as fodder for animals. As such, the fishery sector plays a vital role in nutrition and food security. Fish production constitutes a major portion of the national income in some Arab countries, like Morocco and Mauritania. The total value of fish exports in Mediterranean Arab countries exceeded US$1 200 million in 2005 (FAO 2006) (see Figure 5). Thus, the fisheries sector is a source of employment and income generation in many Arab countries. For instance, the total number of fishermen in Yemen reached 65 198 in 2004.

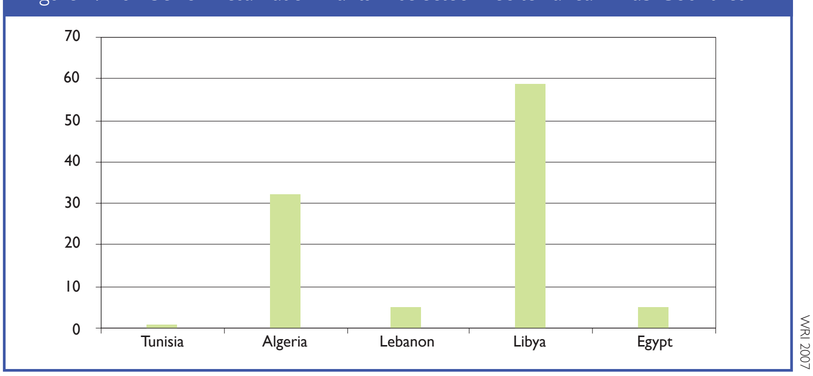
Overfishing is considered a major environmental issue that has substantial impacts on fish stock sustainability. It is a complex phenomenon that is driven by many socio-economic factors as well as physical and biological environmental elements. The

root causes of the problem are the high demand for fish products on a global scale, coupled with insufficient technological capacity and improper management of fisheries resources. Certain fish stocks as well as coral reef species in many Arab countries have declined in the last three years (AOAD 2008). This depletion can affect coastal communities and national economies that rely on fish catches for revenue, jeopardizing food security for those who depend on fish as a source of protein.

The precise status of fisheries in some countries of the Red Sea and the Gulf of Aden is unknown because of lack of fish stock assessments and incomplete fishery statistics. Thus, it is difficult to draw a clear-cut inference regarding overfishing in marine areas in this sub-region. However, the reported decline in catches and average size of fish landed are possible indicators of overfishing (PERSGA 1998). What is evident is that the inadequate management of sea cucumber fisheries has resulted in significant overfishing in many countries, so that natural stocks are showing signs of severe depletion (Hasan 2005).

Demersal fisheries in the Gulf and Arabian Sea are supported by over 350 fish species and 8 shrimp species, where more than 120 000 fishermen are

Figure 4. Number of Desalination Plants in selected Mediterranean Arab Countries




Christing-O -flicker

Nwazibo, Mauritania

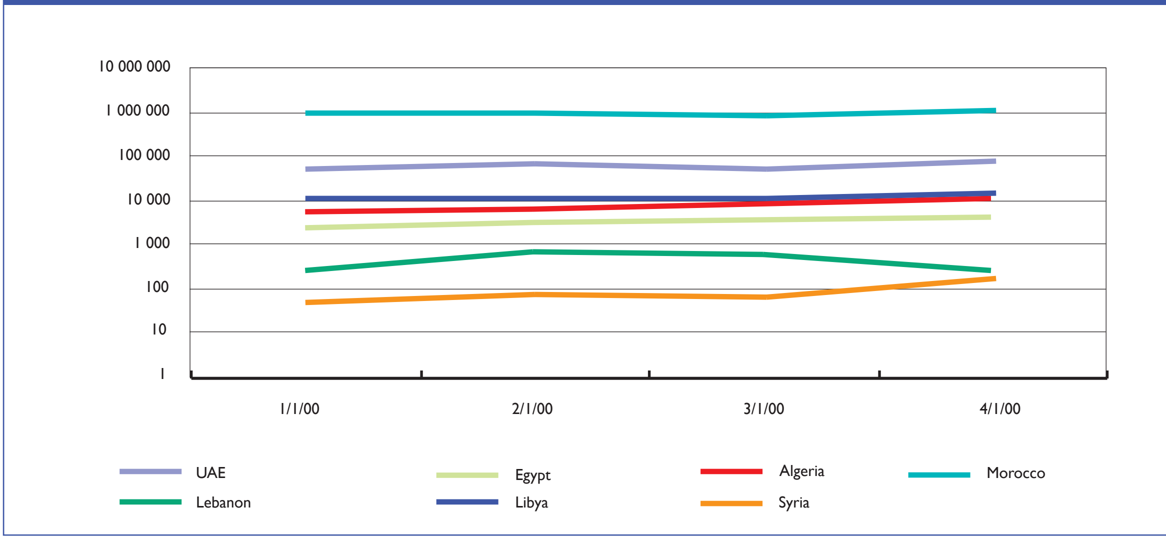
involved in fishing activities (Siddeek and others 1999). Fishery regulations in most Arab countries need enforcement (FAO 2002).

In the Mediterranean, total landings have increased steadily not only due to increased fishing pressure but also increased nutrient input into a formerly low-nutrient sea. Approximately 2 million tonnes of fish were caught in the Mediterranean Arab countries in 2005 (FAO undated). In 1999, Morocco had the highest average catch, 750 000 tonnes, in all of Africa. However, distant-water fleets as well as new technology, including drift nets, contributed to high levels of exploitation. This has been reflected in the decrease in the mean size of fish caught. In response to the increase in demand and fish stock depletion, aquaculture has developed significantly in some Mediterranean Arab countries.

Egypt, for instance, has the highest quantity of aquaculture farming and contributes 92 per cent of the total production from aquaculture in the Arab region. While aquaculture can provide a more sustainable alternative to other fishing methods, it raises concerns regarding whether it will increase nutrient loads in coastal waters or threaten public health. This is due to possible toxic metal and biotic contamination and the consequential biological accumulation (METAP Secretariat 2002).

Overfishing is becoming a crucial problem in Mediterranean waters, and is being driven by both rising prices and demand over the last three decades. This results in the unsustainable exploitation of many fish stocks, and the degradation of their natural habitats. Large fish stocks are overexploited by international industrial fleets, especially red tuna, sponges and red coral. This called for stronger regulations on fishing and collection. Some fishing methods – which are often illegal – including bottom trawling, use of dynamite, long lines, and drift nets, have also contributed to depleting fish stocks. The use of drift nets is responsible for the accidental deaths and incidental catches of whales, dolphins and marine turtles. In addition, species habitats close to the shore are being destroyed.

Figure 5. The total value of international trade for seven fishery commodity groups by countries (US$1 000)



FAO 2006

Proper conservation and management practices are critically needed to optimally exploit fish resources and overcome the issues of overfishing and depletion of fish stocks in the Arab region. Trade agreements, including fish licensing for foreign vessels, must be periodically reviewed to ensure that fish stocks remain viable. Developing institutional research centres and restricting the fishing of high value species during breeding season are examples of ways to decrease overfishing. Moreover, the monitoring of commercial fleets – overseas and near the shores – to ensure that they comply with trade agreements and international treaties, contributes significantly to the promotion of sustainable fish stocks. Pollution of coastal and marine environments should also be dealt with as it is one of the causes of degradation of fish wealth regionally and globally.

Management of coastal and marine development

A large portion of coastal areas in the Arab region has already been developed. Urban projects, including housing compounds, tourist resorts and recreational facilities, roads, and other industrial and service facilities have been expanded and newly developed. New trends in establishing extraordinary waterfronts and coastal mega-projects (such as artificial islands) have recently gained momentum in some countries, especially in the Gulf States. This development trend, financed in many cases by oil revenue, is of environmental concern as population density in these small islands and localities is likely to rise. This may result in a number of problems along these shores including, but not limited to, coastal groundwater depletion, excessive urban growth, mass tourism, pollution of coastal waters, loss of coastal and marine biodiversity as well as coastal erosion. Some of these problems, like pollution, have transboundary consequences. Perhaps the biggest threat to these newly developed areas is their increasing vulnerability to natural disasters like hurricanes or sea-level rise – resulting from global warming – and the related socio-economic and environmental consequences.

By the early 1990s, some of the GCC states had already developed 40 per cent of their coastlines (Price and Robinson 1993). A tremendous amount of money, around US$20 to $40 million per km of the coast, was involved in this coastal development (Fouda 1998). As a result of development, some of the coastal areas were rebuilt and many resorts and residential towns were created in almost all RSA countries. For example, the coastal zone in Bahrain was increased by around 40 km2 in less than 20 years.

The Palm Islands on the coast of Dubai, UAE are the world's largest man-made islands. The project increased Dubai's shoreline by 120 km (Trade Arabia News Service 2004) and used more than 100 million cubic meters of rocks and sand (see Box 3). Immense coastal projects like these raise serious environmental concerns about the impacts of dredging and sand reallocation and other unexpected implications. Effects on the marine habitats and water quality in the area have already been reported (Butler 2005).

Coastal development often includes dredging activities which are taking place in the region (ROPME 2004). For example, more than 200 million cubic meters of sediments were dredged for Jubail city in Saudi Arabia alone (MEPA/IUCN 1987). In general, the dredging and sand reallocation operations associated with urban expansion, industrial development, and tourism along the coasts are a significant source of environmental degradation. Sedimentation from these operations can suffocate the surrounding coral reef communities and adversely affect other ecosystems to which the suspended sediments are transported through currents (PERSGA 1998).

The Red Sea is no exception to this development trend as new projects are being established along its coasts in Saudi Arabia, Egypt and Jordan. Large sectors of the Red Sea, Gulf of Aqaba and the Gulf of Suez coasts have already been developed into beach resorts. Remote sensing images taken between 1984 and 2000 show that 6.55/km2 of the fringing reef between Hurghada and Safaga have been dumped on or filled in to build tourist facilities (Moufaddal 2005).

The impacts of coastal development are also encountered along many Mediterranean coasts. These problems are usually related to urbanization and the development of tourist facilities. It is estimated that coasts under artificial land cover a range between 20 and 100 per cent of the total area, depending on the location, with an overall average of 54 per cent in the Mediterranean Arab countries (EEA 2007).

Unsustainable tourism is a main contributor to coastal development as waterfronts, marinas, and inland and offshore resorts are all built to accommodate tourists. Despite tourism's significant contribution to the economies of many coastal Arab states, when tourist development is not planned on a sound environmental basis, with effective enforcement of environmental regulations, its related activities can constitute a serious threat to the marine environment and tourism industry itself. For example, suspended fine sediments resulting from development activities can inflict widespread damage to coral reefs, seagrass beds, mangroves and other marine life, for up to dozens of kilometres away from the source (Hawkins and Roberts 1996). Additionally, mass tourism has led, in many places, to soil erosion and associated run-off into the marine environment, increased waste discharges

Dredging and infilling associated with urban expansion

into the sea, loss of natural habitats, and higher pressure on endangered species. RSA countries are developing recreational and tourist facilities along the coast at a rapid rate. These include marinas, facilities for water sports, fishing marine parks, archaeological sites and other facilities.

The Red Sea coast and the Gulf of Aqaba are anticipated to attract over one million tourists during the next few years. Ras Mohammed National Park in Sharm el Sheikh, Egypt, now receives over half-a-million visitors annually; while individual dive-boat moorings are estimated to experience up to 20 000 dives per year. However, a number of environmental pressures related to tourism present a major threat to coral reefs (Eid and Fawzi 1991). Damage from divers is now the main cause of coral mortality at the most heavily used sites (Medio and others 1997).

In the Mediterranean Sea, the effects of tourism on coastal development are reflected in the construction of hotels, restaurants, shopping centres, sports facilities, marinas, public services, and buildings. Tourists can multiply a resort's population by several times during the holiday season (Simmonds and Nunny 2002).

Overall, the number of tourists in the Mediterranean coastal regions of Arab countries has increased since 1970 and is expected to more than double by 2025 (see Table 3). Many Mediterranean coastal areas have already been seriously damaged as a result of the effects of tourism and subsequent uses of tourist facilities. The form of damage includes altering coastlines, dredging and reclamation activities and subsequent soil erosion for construction sites. This is especially true in the Mediterranean coasts (Simmonds and Nunny 2002).

Box 3. The Palm Islands of Dubai

The Palm Islands (Jumeirah, Jebel Ali and Deira) are the largest artificial islands in the world (Earth Observatory 2006) and were built on the coast of the Emirate of Dubai, in the United Arab Emirates (UAE). They extend Dubai's shoreline by 120 km and contain a large number of residential and entertainment areas. Each of the Palm Islands in Dubai is constructed in the shape of a date palm tree and includes a trunk, crown with fronds as well as a crescent surrounding the tree-like shape (MapsofWorld.com undated). The Palm Jumeirah consists of a trunk, a crown with 17 fronds, and a surrounding crescent island that forms an 11 kilometre-long breakwater. The island occupies an area of 25 km2 and will add 78 km to the Dubai coastline. The Palm Jebel Ali

ESA 2005

Earth Observatory 2006

is expected to accommodate 1.7 million people by 2020. Once it has been completed, it will be encircled by a waterfront. The project, whose area is 50 per cent bigger than that of the Palm Jumeirah, will include six marinas, a water theme park named Sea Village, homes built on stilts above the water, and boardwalks that circle the fronds of the palm. The Palm, Deira Island will be built on reclaimed land off the coast of Dubai's Deira beach. It will be the largest of the three palm islands covering 14 km in length and 8.5 km in width (The Emirates Network undated).

Sea-level rise (SLR) is a phenomenon that is associated with global elevation in temperature and climate change. It is expected to have a significant effect on many coastal populated areas (see Box 4). SLR may be one of the major problems facing coastal cities in most Arab countries. The potential impacts of SLR will be greatest in low-lying areas, deltas and low coastal cities. Moreover, the negative impacts of SLR will increase socio-economic vulnerability in coastal communities. It is estimated that with a 1 m SLR, nearly 3.2 per cent of the population of Arab countries will be impacted compared to just 1.28 per cent of the worldwide population (Dasgupta and others 2007). Furthermore, 1.49 per cent of the region's GDP, compared to 1.30 per cent worldwide, will be affected.

Substantial efforts have been made in Arab countries to better manage their coastal environments. Some of these efforts have taken both regional and bi-lateral approaches. Although fragmented and isolated in nature, a number of rehabilitation projects and programmes have been implemented to conserve the natural heritage and biodiversity of the region's marine and coastal resources, including the national protection of certain areas (see Box 5). However, in many countries, coastal and marine environments have fallen behind economic development projects and the diversification of the national economy. As a result, integrated coastal management has yet to be developed in many countries. The implementation of integrated coastal zone management, coupled with the enforcement of environmental laws, offers the potential for promoting development and preserving natural resources in coastal areas.

Tourist development along the Mediterranean Coast

Challenges and opportunities

Although governments of the region are committed to dealing with pollution of coastal and marine environments as well as overfishing and coastal management, challenges still exist. Undertaking quick measures and decisions and mobilizing resources are essential for resolving these issues and ensuring sustainability of resources.

The Mediterranean Sea features some pollution hot spots, where high toxicity levels exist for the benthic community in the vicinity of industrial and urban centres and in the mouths of the main Mediterranean rivers. However, the main pollutants have been significantly reduced during recent decades (Gomez-Gutierrez and others 2007) due to several initiatives launched to deal with environmental problems in the Mediterranean Sea.

The proposed Mediterranean Hot Spot Investment Programme and "Horizon 2020" are the latest programmes endorsed (within the framework of Barcelona Process) by the European Union in cooperation with the southern and eastern Mediterranean countries. A number of regional conventions and protocols have also been adopted to encourage cooperation and protect the Mediterranean Sea from pollution. The most prominent of these is the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, known as the Barcelona Convention, which was adopted in 1976. The convention includes six protocols that promote pollution prevention policies, and conservation of the diversity of its biota.

Action plans were also adopted within the framework of these conventions and protocols. The Mediterranean Action Plan (MAP), with its six regional activity centres, addresses issues of environmental sustainability in the Mediterranean. Furthermore, the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) was established, within the framework of the UNEP Regional Seas Programme, in Malta in 1976. The centre played a vital role in responding to the oil pollution that resulted from the destruction of Al-Jiyeh power station in Lebanon in 2006. National action plans have also been adopted in many countries to combat marine pollution from land-based activities. Recently, major stakeholders within the region agreed to implement these national action plans to tackle marine pollution from land-based activities. In addition, a majority of Arab countries have signed international conventions and protocols concerning marine resources. Table 4 shows a list of countries along with the conventions and protocols that they are parties to.

Marine pollution is poisoning fish stocks, rendering environments unhealthy and jeopardizing living marine resources. Overfishing is a threat to fishery stocks and human well-being, as marine resources are sources of food and wealth if properly managed. Eutrophication and poisoning of the coastal marine environment are contributing factors to periodic emergence of dead zones where thousands of fish stocks are suffocated and washed ashore.

Despite the depletion of fish stocks in the Arab region, it is a potential wealth that has not yet been fully developed. The failure to properly exploit these resources in most countries is due to overfishing, degradation of the fishing infrastructure (AOAD 2008), in addition to pollution of marine environments. Therefore, it is necessary to properly manage these resources and conserve them through enforcing necessary

Table 3. Human pressures on coastal regions and on the coastline: baseline scenario and trends until 2025

	Number of urban inhabitants located along the coastline per kilometre of coast (inhabitant/km of coast)			Number of tourists per kilometre of coast during (the peak month (person/km of coast		
Country	1 990	2 000	2025	1990	2000	2025
Tunisia	2 298	2 973	4590	691	1034	2249
Algeria	3347	4150	6238	411	549	1016
Syria	2338	3367	6197	643	677	3994
Palestinian Territories	9530	19073	24364		166	1457
Lebanon	7651	9559	12892		1113	4861
Libya	1353	1985	3070	41	77	526
Egypt	5229	6206	11343	599	591	2102
Morocco	1704	2352	2895	686	775	1761

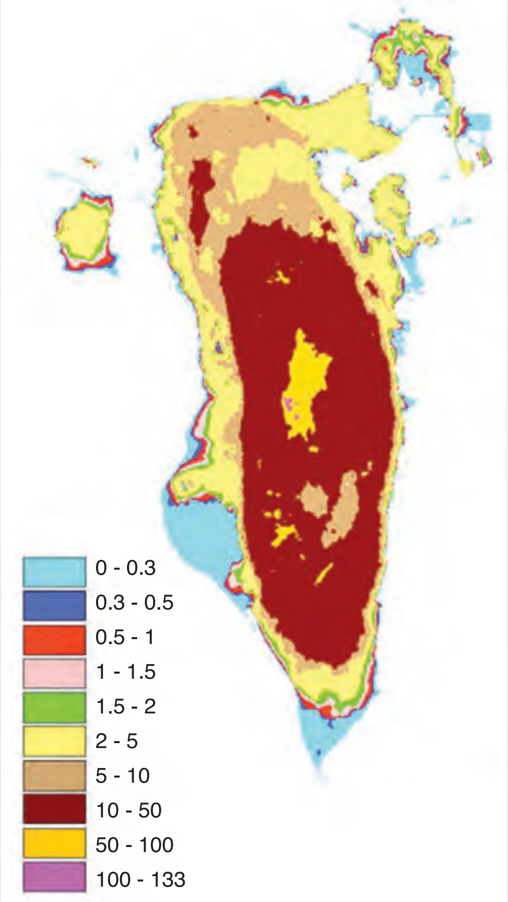
legislation and adopting the principle of "assessing the environmental impact". Furthermore, efforts should also include: implementation of the Marine Environment Status Monitoring Programme, establishment of data bases, endorsement of seawater quality control standards, organization and monitoring of fishing activities, and regional cooperation and information exchange among countries in tackling pollution and overfishing issues. Conservation of coastal areas including wetlands and management of freshwater resources and watersheds, are becoming urgent issues to be dealt with. The integrated coastal zone management approach offers a reliable solution to most issues facing the coastal and marine environment, including tourism pressures.

Conclusion

The Arab region is endowed with coastal environments known for their high productivity,

Box 4. Possible impact of SLR on the Kingdom of Bahrain's Coast

The Kingdom of Bahrain is an archipelago of small islands that might be at great risk of losing significant land mass as a result of sea-level rise (SLR). More than 10 per cent of the total area of the islands' surface ((80 km2) is estimated to be only 0.5 m above mean sea level (MSL). Two-thirds of the population (which totalled 650 604 in 2001) live within 2.0 km of the coastline (CSO 1970-2001). Thus, sea-level rise above the MSL may pose a substantial threat to Bahrain's resources because of their low-lying physiographical setting as well as the infilling activities that have been carried out throughout the years. Critical infrastructure, such as major roads and causeways, along with many industrial and tourism compounds, are concentrated on the newly reclaimed areas. These areas support various economic activities including hotels, resorts and industrial complexes (General Commission for the Protection of Marine Resources, Environment and Wildlife 2005). As a small island state, the Kingdom of Bahrain has a limited capacity to adapt to SLR or relative climate change, which could include resettling coastal habitats and communities farther inland. This is a result of the island's small land mass, high population density, and high population growth rates. Consequently, it may be physically and economically difficult to move coastal habitats, or to establish zoning setbacks in coastal habitats for new development.



The low-lying nature of the coastal zone of Bahrain's islands, coupled with significant land reclamation investments and extensive industrial, commercial, and residential activity, exacerbates the country's vulnerability to climate change induced SLR. Nevertheless, the hazard is often considered minimal. This is mainly due to the lack of relevant studies and the very limited public awareness of the potential impacts of SLR. At present there are no major national plans to assess SLR impacts.

Al-Jeneid and Abido 2004, General Commission for the Protection of Marine Resources, Environment and Wildlife 2005

Box 5. Coral reef investigations in Abu Dhabi and Eastern Qatar

Results of a three-year project entitled, "Coral reef investigations in Abu Dhabi and Eastern Qatar," revealed that the diversity of coral reefs along the coasts of Abu Dhabi and Eastern Qatar in the southeastern Arabian Gulf is still under pressure. However, after years of thermal stress in 1996, 1998, and 2002, corals are generally showing signs of active regeneration. Corals along these coasts currently vary by densities and coverage. Extinctions have been found in the coral

Landsat/NASA

Abu Dhabi 1990

Landsat/NASA

Abu Dhabi 2000

fauna and at least 50 per cent of the 36 species known to be found in the area are now firmly established. Nevertheless, regional coastal development is of concern as it may accelerate coral die-off unless protective and management measures are implemented.

EMS/WWF 2007

along with vast seas that are rich in fish wealth. These resources are a source of prosperity and well-being for Arab citizens; nevertheless, they have been experiencing diverse continuous human pressures that have led to the pollution of vast areas from different sources.

Pollution, in its different forms, leads to the degradation of environments, loss of their productivity and the gradual decline of their services, which negatively impacts human livelihood and well-being. Decline in fish stocks is a crucial problem which jeopardizes food security in Arab countries that mainly rely on the sea as a source of fish wealth. Additionally, overfishing, which is a complex phenomenon, is one of the major pressures which depletes fish stocks in the Arab region.

Consequently, this phenomenon should be primarily addressed through development of fishing infrastructure and proper management and conservation of resources through: enforcing necessary legislation, adoption of the principle of assessing the environmental impact, implementation of the Marine Environment Status Monitoring Programme, establishment of data bases, and endorsement of seawater quality control standards. Furthermore, Arab countries should organize and monitor fishing activities, forge regional cooperation and exchange necessary information with the aim of addressing pollution and overfishing issues.

The upgrading and development process, which has been taking place on a large scale in coastal


EAD

areas for the last three decades, is considered a challenge to the safety and viability of coastal and marine environments. Several coastal areas in some Arab countries have been upgraded for housing, tourism, and industrial purposes, and related infrastructure and service facilities have been developed. Mega projects, like artificial islands, have also been established in some countries. Concern has been raised over the environmental sustainability of these projects and the capacity of fragile ecosystems to absorb them.

Probably the greatest challenge facing coastal areas and their natural environments and urban structures is the adoption of an integrated coastal zone management approach that ensures reduction of pollution and treatment of its causes. Moreover, efforts should aim at creating opportunities for sustainable tourism and mitigating climate change risks and the consequential sea-level rise which poses a real threat to several coastal Arab areas. This should be supported by an enabling environment that assists in achieving these objectives.

Table 4. IMO Convention Status in the Arab World

Convention/Country	Yemen	Mauritania	Morocco	Egypt	Libya	Lebanon	Kuwait	Comoros Islands	Qatar	Oman	Iraq	Somalia	Syria	Sudan	Saudi Arabia	Djibouti	Algeria	Tunisia	Bahrain	U.A.E.	Jordan
Hong Kong Convention 2009																					
Nairobi Convention 2007																					
BALLAST Water 2004																					
ANTI Fouling 2001																					
BUNKERS Convention 2001																					
OPRC/HNS 2000																					
HNS Convention 96																					
OPRC Convention 90																					
SALVAGE Convention 89																					
SUA Protocol 2005																					
SUA Convention 2005																					
SUA Protocol 88																					
SUA Convention 88																					
LLMC Protocol 96																					
LLMC Convention 76																					
PAL Protocol 02																					
PAL Protocol 90																					
PAL Protocol 76																					
PAL Convention 74																					
NUCLEAR Convention 71																					
FUND Protocol 2003																					
FUND Protocol 92																					
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CLC Protocol 92																					
CLC Protocol 76																					
CLC Convention 69																					
INTERVENTION Protocol 73																					
INTERVENTION Convention 69																					
London Convention Protocol 96																					

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London Convention 72			✓	✓	✓					✓								✓		✓	✓
MARPOL protocol 97 Annex VI							✓						✓		✓						
MARPOL 73/78 Annex V		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓	✓	✓
MARPOL 73/78 Annex IV		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓		✓	✓		✓	✓
MARPOL 73/78 Annex III		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓		✓	✓		✓	✓
MARPOL 73/78 Annex I-II		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓
FACILITATION Convention 65	✓			✓	✓	✓					✓		✓				✓	✓			✓
IMSO																					
INMARSAT Amendments 98				✓		✓				✓					✓		✓	✓	✓	✓	
INMARSAT Amendments 94							✓		✓	✓					✓				✓	✓	
INMARSAT OA 76				✓	✓	✓	✓		✓	✓	✓				✓		✓	✓	✓	✓	
INMARSAT Convention 76			✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	
STP Protocol 73	✓			✓											✓						
STP Agreement 71	✓			✓											✓						
SAR Convention 79	✓		✓		✓	✓				✓			✓		✓		✓	✓		✓	✓
STCW-F Convention 95		✓	✓										✓								
STCW Convention 78	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
SFV 93																					
CSC amendments 93																					
CSC Convention 72	✓		✓			✓							✓		✓			✓			✓
COLREG Convention 72	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
COLREG Convention 72	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
TONNAGE Convention 69				✓	✓	✓				✓							✓	✓			✓
LOAD LINES Protocol 88	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LOAD LINES Convention 66																					
SOLAS Protocol 88				✓	✓					✓			✓					✓			✓
SOLAS Protocol 78		✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓		✓	
SOLAS Convention 74	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
IMO Amendments 93			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	
IMO Amendments 91	✓		✓	✓				✓					✓		✓	✓	✓	✓			✓
IMO Convention 48	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

:Ratification :Annulment

IMO-2009

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Chapter 5

HUMAN SETTLEMENTS

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Main messages

Many Arab settlements have witnessed an expansion as a result of rapid population growth and human activity which often strain the environment. This phenomenon has created pressure on the management of these settlements with regard to providing adequate housing and services that improve the livelihoods of Arab citizens. The following are the main messages of this chapter:

- The urban system of many Arab countries suffers from urban primacy, which can exacerbate regional disparities and the inequitable allocation of investments for social services and infrastructure, often at the expense of rural areas and secondary cities.

- Lack of clean, safe, drinking water and proper means of collecting and treating wastewater is partially responsible for the spread of epidemic diseases among the dwellers of poor quarters. Many Arab countries have succeeded in providing their residents with safe drinking water. However, there is still a gap between urban and rural populations with respect to accessing improved water sources. Regionally, urban access to sanitary services is relatively high, with an average coverage of about 90 per cent. Nevertheless, populations in some Arab countries have poor access to proper sanitary services. Moreover, many Arab countries suffer from lack of modern management of solid wastes, whose generation rates are continuously increasing. This may lead to disease outbreaks and other public health problems.

- Air quality in many Arab cities, particularly the major cities of Algeria, Egypt, Iraq, Kuwait and Saudi Arabia, is declining and requires improvement. Human activities, such as manufacturing and transportation, are responsible for this decline, which leads to health problems for many citizens. Noise pollution is another factor affecting human health and welfare. In several major urban settlements of the Arab world, noise levels are increasing rapidly.

- Rural-urban migration and internally displaced persons have led to the growth of informal settlements in the Arab world. These informal settlements lack sufficient living space and durability. Unlike formal settlements, informal settlements lack legal status and cannot be registered. They require infrastructure as well as social services and job opportunities for residents.

- The emergence of informal settlements is not an indication of market failure. Some government interventions and policies, such as rent control, are responsible for disrupting market mechanisms, thus denying poor citizens standard housing. Rent control discourages developers from building dwelling units that the poor can afford. The poor neither have the income nor the credit to demand or purchase standard housing since they lack the initial endowments necessary for them to affect demand. The economy, as well as society as a whole can benefit from informal dwellings if these dwellings are given official property rights.

- The impact of the interaction between the environment and economic/industrial development is diverse in the Arab region. Wealthy oil producing countries have been able to provide their citizens with essential infrastructure and services. Middle-income Arab countries have also been able to improve their situations, whereas low-income countries are still struggling to improve theirs. Urban-rural gaps persist throughout the region, and poverty is still a problem in several countries, which negatively impacts sustainable development. On average, adult illiteracy is declining, though it is still high in some Arab countries, particularly among women. It is worth mentioning that selected health indicators for Arab countries show some improvements.

- Many Arab cities were once cradles of power and civilization. The region is rich in monuments and historical districts that remain in these historical areas. Unfortunately, many of these cities lack the infrastructure necessary to save these monuments from rising underground water levels or informal occupation by slum dwellers. Inadequate housing, lack of social and physical infrastructure and unemployment are challenges for both central and local authorities. Where population is growing rapidly, there is even more pressure on resources, further endangering the cultural heritage of the Arab world. Conservation projects of city centres – with their historical civilization, urban fabric and social construction – won't yield any success unless social dimension is their axis.

- In many cases, the development management of Arab cities and the functioning of local administrations are sectorial due to limited institutional capacities. They often fall under the authority of engineers and architects, which is not conducive to adopting modalities for sustainable human settlement development. Many Arab municipalities have some autonomy, but little strategic decision making power is in their hands. Instead, the key players in development management are usually located in the central government. As a result, the framework for decision making in many Arab countries is highly centralized and sector-oriented, potentially constraining local administrations.

- The mismanagement and inefficient utilization of natural resources, particularly land, can be traced to malfunctioning, distorted or absent markets, inefficient institutional capacities and environmental degradation.

K.Lebtahi, UNEP

Introduction

Human settlements mean the totality of the human community – whether a city, town or village – with all the social, material, organizational, spiritual and cultural elements that sustain it. The fabric of human settlements consists of: a) physical elements, such as shelters and infrastructure; and b) services, such as education, healthcare, culture, recreation and nutrition. Human settlements can have a profound impact on natural resources that provide settlements with inputs for the production of commodities and services, which are then returned to the environment as various waste products that result from the production and consumption of these goods and services.

This chapter attempts to assess the interactions between environmental and developmental elements within Arab human settlements. Settlements throughout the region are currently experiencing expansion as a result of population growth as well as the development of human activities ultimately resulting in environmental pressures. This chapter specifically identifies five interrelated issues that challenge the sustainable development of Arab human settlements. The most significant of these issues is securing access to potable water and sanitary drainage. The second challenge is the need for effective and efficient systems for solid waste management. The third issue is atmospheric and noise pollution. The fourth challenge is the vulnerability of settlements to natural disasters including climate -change related factors. Finally, the issue of managing human settlements is addressed.

Human settlements and population dynamics

Population growth and its attributes are among the parameters used to describe human settlements. Reasons for natural population growth include, but are not limited to: a) sustained high birth rates; b) improved life expectancy at birth; and c) declining mortality rates of infants and children under 5 years of age.

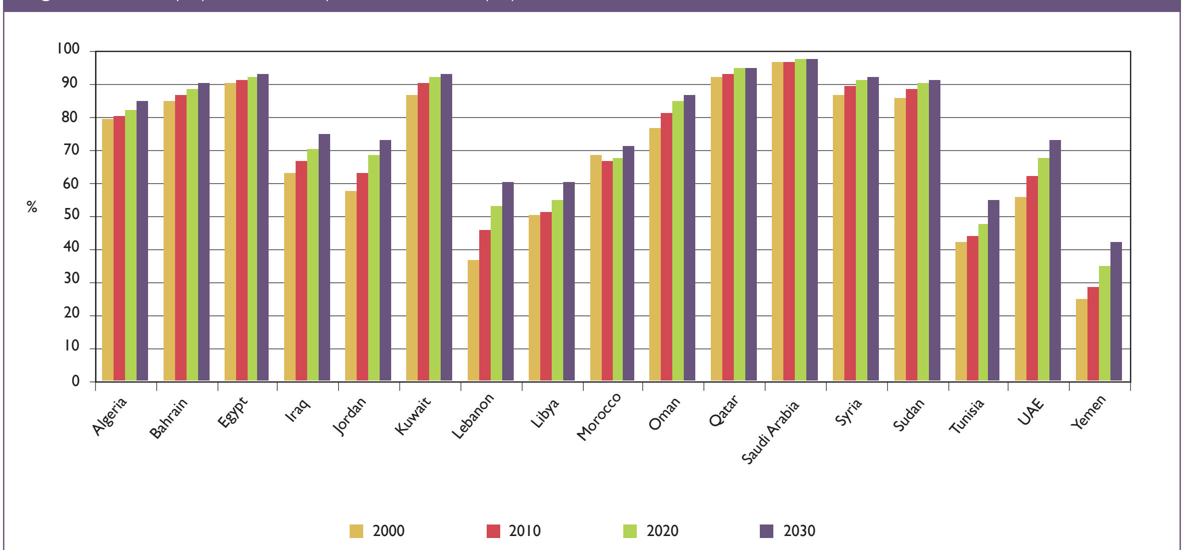
Currently, rates of net reproduction and net migration in the region are expected to remain constant or to increase. According to UN population data that has been categorized by gender and age, most of the dependent population – those who are not economically active such as the elderly and children – are supported by the labour force. This dependent population requires social services, such as education, healthcare and physical infrastructure that provide safe drinking water, solid waste management, in addition to wastewater collection and treatment. They will also need jobs, housing and other means to sustain their livelihoods (El-Kholei 2004).

Spatial distribution of population

The Arab region has encountered a great deal of urbanization throughout its long history. Old quarters of its cities are often a compact mass of residences with open courtyard houses that result in a cellular urban pattern. The old quarters usually include a permanent central market (suq), which consists of small, contiguous stalls located in numerous irregular passageways that are covered with domes or vaults. They also include public baths as well as mosques that may contain shrines, and often host a citadel. They are frequently surrounded by a large wall. Many of these cities are a blend of many cultures due in part to the trade routes responsible for their formation. Coastal cities, such as Casablanca and Eden, and inland cities, such as Cairo and Baghdad, are the outcome of complex trade networks, and served as nodes for these networks (Bonine 1983). Additionally, many Arab cities have demonstrated notable resiliency and capability for renovation over time. Morocco, Yemen and Egypt, for example, each has multiple cities that have remained well connected to the global economy, such as Casablanca, Eden and Cairo.

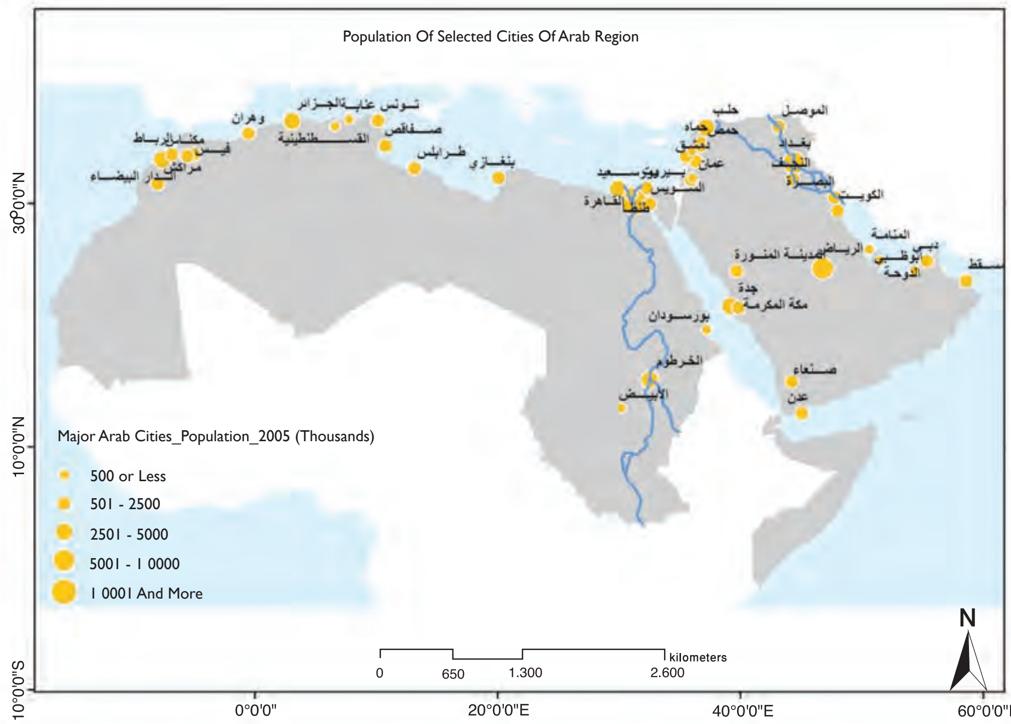
Based on estimates of the UN Population Prospects 2003, it is predicted that the region will remain highly urbanized despite the decline in growth rates among urban population (see Figure 1). Gulf States are already highly urbanized while other Arab countries, such as Egypt, will be urbanized societies by 2030. Most of the newcomers to urban areas (both, those who are born and those who migrate into them) will live in existing cities. Cairo is the largest Arab city in terms of population density as the total population of the Cairo metropolitan area reached 15 750 thousand inhabitants in 2006. The second tier of cities (with a population of 4 to 6 million inhabitants) includes Baghdad, Riyadh and

Figure 1. Urban population as a per cent of total population in some Arab countries, 2000–2030



UN 2004

Figure 2. Population of selected cities (750 thousand and more) of the Arab region 2005



CEDARE GIS Facility using data from UN Population prospects

Khartoum; followed by the third tier (less than 3 to 4 million inhabitants), which encompasses Algiers, Alexandria, Casablanca, Jeddah and Rabat. The fourth tier of cities (less than 3 million inhabitants) comprises Basra, Mosul, Amman, Kuwait City, Mecca and Medina. The final tier represents cities with a population of 1 million inhabitants or less and includes Marrakesh, Najaf and others (see Figure 2).

Currently, almost all nationally defined urban systems in the Arab world suffer from urban primacy, or an uneven distribution of the urban population among those cities that constitute the national urban system, which negatively affects the distribution of resources and investments. Many scholars have examined the reasons for urban primacy and found that the existence of primate cities reflects wide regional disparities and is not expected to change. According to scenarios for population growth and spatial distribution over the coming two decades, it is anticipated that as population grows people will reside in one or two of the existing cities rather than developing settlements in new towns and secondary provincial cities (El-Kholei 2004). Often urban primacy and regional disparities are associated with, and reflect, social and economic problems, such as unemployment, poverty, and an excessive influx of rural-urban migrants. Due in part to the large disparities in wealth and resources in many areas, marginalized sub-populations often become further removed from access to power and wealth (Abu-Lughod and Hay 1977) (see Box 1 – Figure 3).

Recent increases in oil prices and Direct Foreign Investments (DFI) are responsible for the current urban growth in many Arab countries. One characteristic of urban growth is the growing suburbanization of certain sectors of the population. For example, in Greater Cairo, a UAE real estate development company is building a 4 million square metre development, as well as a 1 million square metre landscaped park — the largest private park in Egypt. Another UAE based company is spending US$759 million to construct residential developments in and around Cairo, as well as a resort on the Northern Coast of Egypt. Between Rabat and Salé in Morocco, a third UAE real estate development company is building a network of navigable canals across this expanding area. The project will create a walking city featuring many modern amenities (Zaibet and El-Kholei 2008).

The growth rates of cities are also sensitive to economic growth and prosperity. For example, the GCC cities experienced accelerated rates of growth as a result of the boom in oil prices in the mid-1970s, and decelerated rates of population growth following the decline of oil prices in the late 1980s. Doha sustained a population growth rate of about 7 per cent per annum during the 1970s, and then witnessed a decline to 2.52 per cent per annum beginning in 1990 as foreign workers began to leave the country. Natural population growth is not solely responsible for this change as migration plays a large role in this phenomenon. Many prosperous settlements have attracted foreign labour from within and outside the Arab world.

For example, in the UAE where there has been a great deal of economic growth in recent years, there are five foreigners for every UAE citizen (El-Naggar 2005). However, there is no reliable information available on how populations have changed as a result of migration within metropolitan areas. Decline in Cairo's average urban growth is associated with the growth of neighbouring human settlements. These settlements have witnessed significant growth between 1986 and 2006, according to the Cairo census, indicating movement of rural migrants to these settlements within the metropolitan area. Thus, rather than only looking at those areas located within the proper limits of large cities, a more appropriate unit of analysis is the metropolitan area.

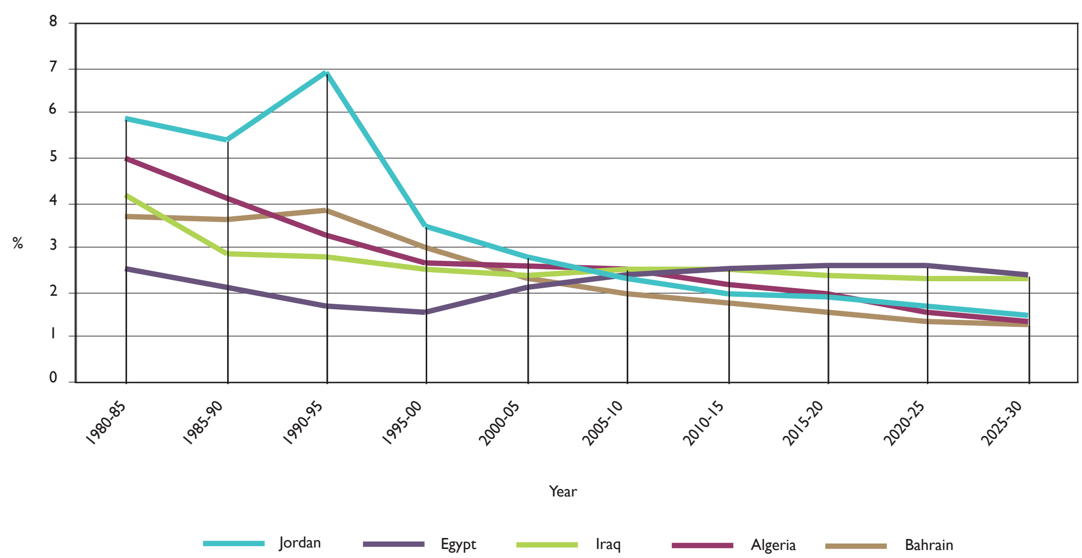
Box 1. Development of theories on urban primacy

In 1961, Berry suggested that primacy occurs in nations that recently gained their political/economic independence. In 1972, El-Shakhs found a significant relationship between city-size distribution of a nationally defined urban system and primacy, where an urban system is bound to experience primacy at the stage of economic takeoff, and the process of polarization (when urban population shifts from the primate city to other secondary cities). Reversal starts once the economy enters stage of maturity. Smith (1985) suggested that primacy associates with class relations and affiliates with dependency of the economy in the world-system.

Berry 1961, El-Shakhs 1972 and Smith 1985

By examining the average annual rate of population growth in capital cities, and selected urban agglomerations with at least 750 thousand inhabitants, there are several observations to be made. Regional conflicts and war, in addition to internal violent disputes, directly affect the development and growth of cities. For example, as a response to the Arab-Israeli wars the rate of change in the populations of Port Said, Ismailia and Suez, in Egypt, was negative during the period from 1967 to 1973. After the Israeli occupation of the Gaza strip in 1967, the urban population in that territory declined as well. Similarly, the population of Beirut declined from the mid-1970s until the early 1990s as a result of the Lebanese civil war. Khartoum also faced population decline in the early years of the 21st

Figure 3. Growth rate of urban population in some Arab countries, 1980–2030 (%)



century when an agreement was concluded to end the conflict between the Government of Sudan and the southern rebels, effectively curbing internal migration caused by armed conflict (El-Kholei 2004) (see Box 2).

Overall, a large proportion of the populations of Arab settlements are dependent populations, as indicated by their high dependency ratio. Other UN statistics show that the population momentum, or the number of years it takes for a population to double itself, is also high. These dependent groups will continue to live in major cities (capital and/or ports). This will require massive improvements in physical infrastructures and social services, as well as job opportunities in these cities. The only condition for reversing the trend of rural-urban migration is to develop provincial, secondary cities and new towns to achieve a more balanced urban system that will have a positive impact on natural resources.

Issues and Challenges

Access to Potable Water and Sanitation

Access to Potable Water

Having access to safe drinking water is important for the health and economic well-being of households and individuals. An improved water source is one that will provide safe drinking water and includes any of the following: household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater. With one of these sources nearby, individuals can spend less time fetching water and more time on other tasks.

Examples of unimproved water sources include unprotected wells and springs, unclean surface water, vendor-provided water, tanker-provided water, and bottled water. These last three examples are considered "unimproved" because they are not consistently available in sufficient quantities. Without clean water or proper sanitation, public health problems can arise such as increases in the

Box 2. Human settlement issues within the Occupied Palestinian Territories

Wars since 1948 have resulted in the migration of a great number of Palestinians, and according to UN sources the number of Palestinian refugees is estimated at 726 thousand. Now, this number has increased to reach around 4.6 million people (Mideast Web undated). In 2008, the UNRWA estimated the number of Palestinian refugees registered in camps at more than 1.3 million people (UNRWA 2009).

Following the 1993 Oslo agreement, the West Bank was divided into three territories. The first of these territories, Area A, represents 17 per cent of the West Bank land where 55 per cent of the Palestinians live under Palestinian administration and control; Area B represents 24 per cent of the West Bank land, where 41 per cent of the West Bank Palestinians live under Israeli control but Palestinian administration; Area C represents occupied territories from which Israel has not withdrawn. It represents about 59 per cent of the West Bank land, where only four per cent of the West Bank Palestinians live under both Israeli control and administration. The Israeli government built a system of bypass roads that allowed settlers to travel between Israel and the different settlements in the West Bank. These roads often encroached upon inhabited Palestinian areas and areas under cultivation, destroying many olive ranches, which are a major source of income for many Palestinians. The Israeli authorities justified the presence of some settlement units by the need to protect the West Bank groundwater layers which provide water for Israeli cities, including Tel Aviv. Furthermore, the Absentee Property Law has allowed the Israeli government to confiscate Palestinian refugee properties and villages to settle Israeli citizens in Arab communities and settlements (Isseroff 2002).

According to the Palestinian Central Bureau of Statistics, 2008 (PCBS), there were 2 350 583 Palestinians living in the West Bank (50.8 per cent males and 49.2 per cent females) in 2007 compared to 1 873 476 in 1997. Statistics also revealed that the percentage of Palestinian refugees in the West Bank in 2007 reached 28.1 per cent compared to around 26.6 per cent in 1997. This increase in number reflects increased fertility rates among refugees living in camps and declined migration rates. As for people's participation in the economic process throughout a period of ten years or more, it was revealed that the percentage of people who are economically active declined from 37.7 per cent in 1997 to 33.6 per cent in 2007, reflecting deteriorating economic conditions.

As for housing conditions, results showed an 18 per cent decrease in the number of people living in a habitable room in 2007compared to those in 1997 (Palestinian Central Bureau of Statistics 2008). Thus, the individual's share of rooms rises due to the decrease in the number of household members and the increase in the number of rooms per dwelling unit. Concerning public networks, it is noted that houses connected to the public electricity network increased from 94.1 per cent in 1997 to 98.4 per cent in 2007, with an increase in the number of houses connected to the public sanitation network from 24.4 per cent in 1997 to 35.8 per cent in 2007. Nevertheless, there hasn't been a significant change in linkage to the public water network as it only increased from 79.1 per cent in 1997 to 81.4 per cent in 2007 (Palestinian Central Bureau of Statistics 2008).

MidEast Web undated, Isseroff 2002, Palestinian Central Bureau of Statistics 2008, UNRWA 2009

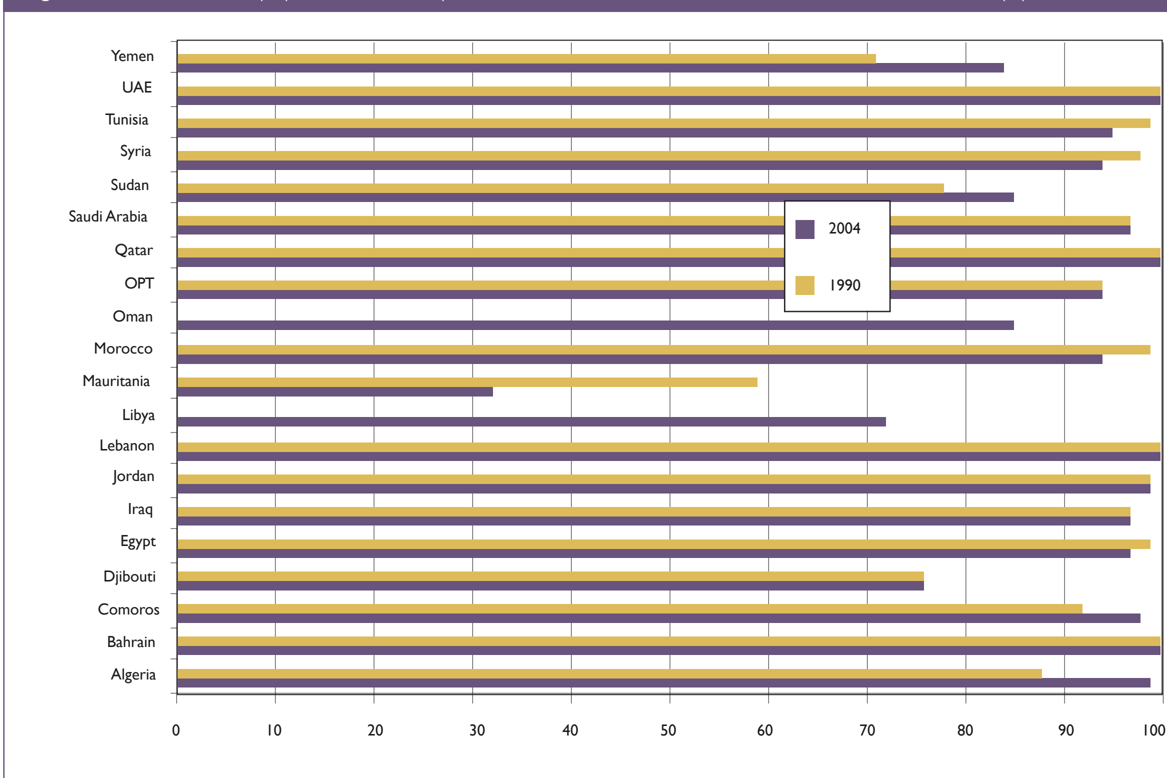
number of water-borne diseases like intestinal worms, trachoma, schistosomiasis, and cholera, which can have negative consequences on both health and economic livelihoods.

While Arab countries have been on track to meet the target of access to safe drinking water for all, stated in MDG 7, sustaining the progress needed to meet this goal will be a challenge. Across all countries, eight out of ten people now have access to improved water sources. At least 15 countries are overusing their renewable and non-renewable water resources. Eight countries confront an alarming per capita water deficit, including Bahrain, Jordan, Kuwait, Libya, Oman, Qatar, Saudi Arabia

and the United Arab Emirates. Additionally, there is a shortage of fresh water resources in many Arab countries, such as Egypt, Morocco and Tunisia (see chapter 2- water resources).

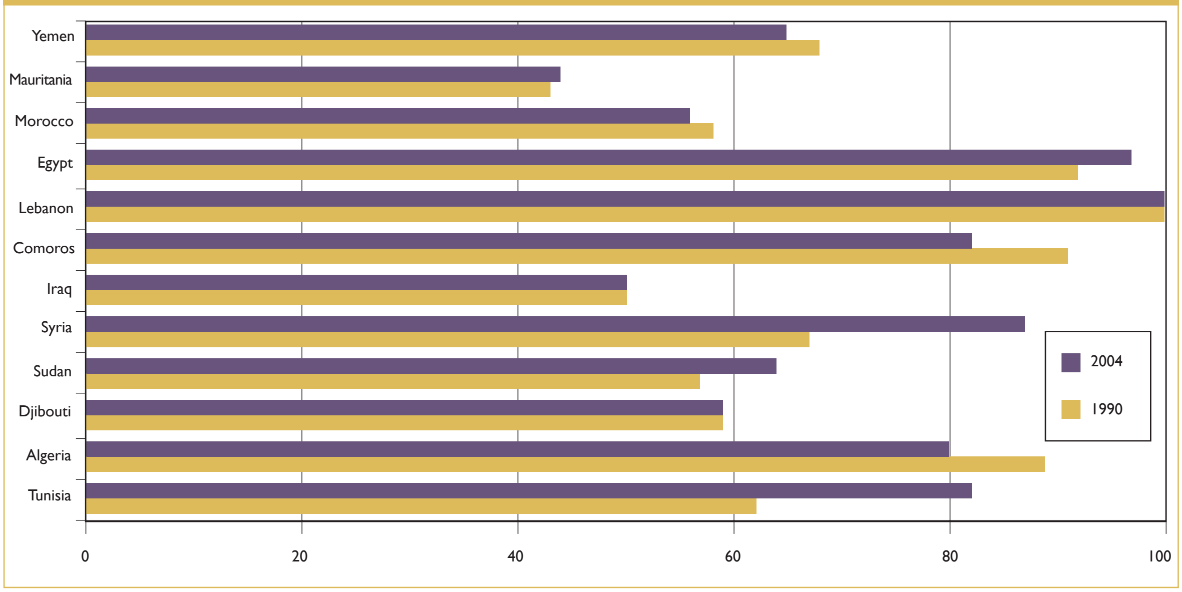
There is a gap in access to potable water between urban and rural populations. Some countries, such as Egypt and Syria have increased the percentage of rural population with access

Figure 4. Access of urban population to an improved water source in selected Arab countries 1990–2004 (%)



WRI 2007, compiled from WHO and UNICEF 2006

Figure 5. Access of rural population to an improved water source in selected Arab countries 1990–2004 (%)



WRI 2007, compiled from WHO and UNICEF 2006

to improved water sources. However, between 1994 and 2000, rural populations of other Arab countries, such as Comoros, Algeria, Yemen and the Sudan, have experienced setbacks in access to improved water source due, in part, to internal conflicts and unrest. The fact that major rivers in the region, such as the Nile, the Tigris and the Euphrates, all flow from outside the region complicates the matter (see chapter 2: water resources).

When water is scarce, although all segments of society are affected, the poor are disproportionately impacted, particularly those who live in rural areas and depend on water for agriculture. At the national level, while richer states compensate for deficits through capital-intensive solutions, such as the construction of water desalination plants, poorer countries are literally draining away their limited supplies (UNDP 2003). Moreover, population growth and increased demand for water make satisfying the needs for fresh water an even greater challenge for all Arab countries (see Figures 4, 5, 6).

Access to Sanitation

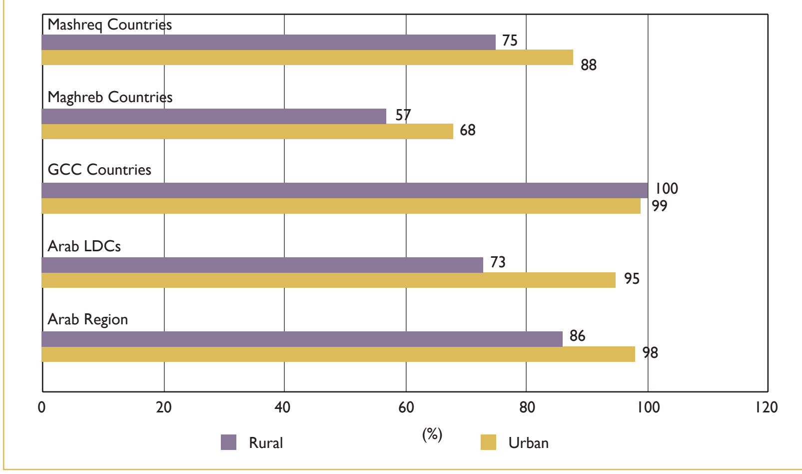
There isn't one specific definition of sanitary service. It may mean an integrated scheme for wastewater management, or just a pipe to dispose of effluents. There are two main types of sanitary service: basic and improved. Access to improved sanitation measures the total percentage of the population with access to improved sanitation facilities. Improved sanitation facilities are more likely to be sanitary than unimproved facilities. However, they are not a direct measure of 'basic' sanitation facilities, which are considered the lowest-cost options for safe, hygienic and convenient facilities that prevent the user and his or her immediate environment from coming into contact with human excreta (WRI 2007).

Clean water and adequate sanitary services both require the removal of contaminants from water sources before they are accessed by people, otherwise, serious public health consequences may arise. In the Arab region, the indiscriminate discharge of human waste into water bodies has created significant pollution problems and serious health implications. For example, some of the major contaminants affecting water quality in the region include pathogenic bacteria/parasites, heavy metals and pesticides.

In this respect, untreated drinking water can be a carrier of potentially deadly communicable diseases like typhoid, diarrhoea, dysentery, as well as some parasitic diseases like ascariasis and giardiasis. Common pathways for contamination include seepage into groundwater, the contamination of crops, and translocation of grazing animals. Many of the industrial establishments in the region do not properly treat industrial wastewater before it is released into the municipal wastewater collection networks. In Saudi Arabia, most manufacturing plants fail to properly treat wastewater, allowing industrial wastewater into city sewers without any form of pre-treatment (Al-Rahili 1997).

In ten Arab countries, over 98 per cent of urban dwellers have access to adequate sanitation. However, despite efforts to extend wastewater sanitation services in many Arab settlements, especially those in rural areas, there is a real need for improved wastewater collection and treatment schemes in at least four Arab countries. For example, over one-eighth of the urban population in Morocco and the Sudan had no access to adequate sanitation in 2000, whereas in Mauritania over one-half of the population had no access to sanitation the same year as well (UNDP 2003).

Figure 6. Proportion of Population Using Improved Drinking Water Sources 2004 (%)



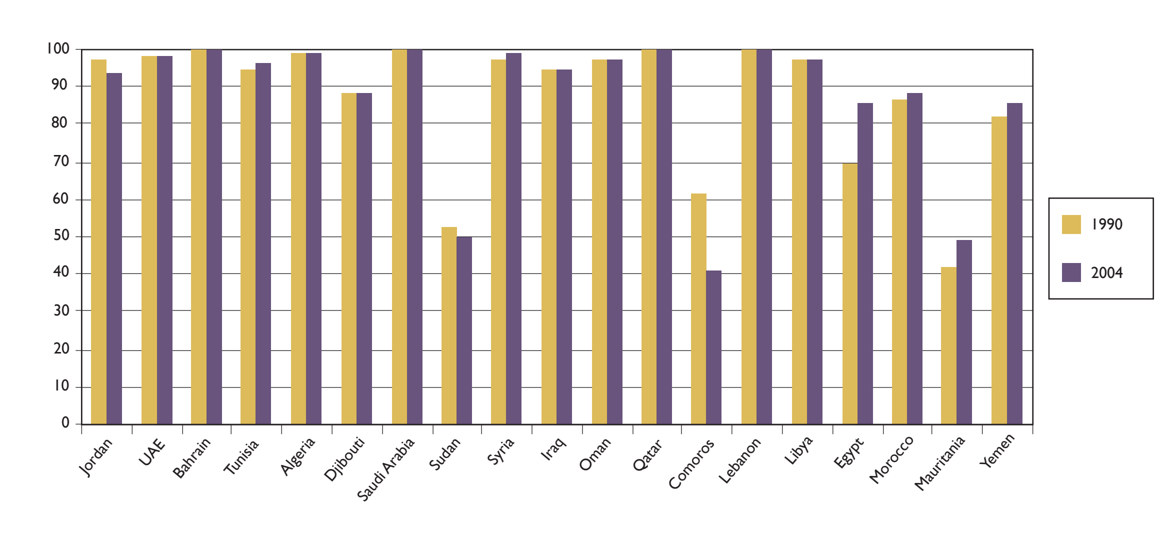
UN-ESCWA and LAS 2007

Box 3. Costs of lack of access to drinking water and sanitation

Water supply problems – substandard quality and insufficient quantities of potable water for drinking and hygiene – and inadequate sanitation facilities impose costs on society, notably in the form of waterborne illnesses and the associated mortality. Of these illnesses, the most common is diarrhoeal disease, which has the greatest impact on young children. In Morocco, for example, lack of access to water supply and sanitation is estimated to cost society 1.0 to 1.5 per cent of GDP. This estimate takes into account child mortality from diarrhoea (six thousand deaths of children under age of five each year), diarrhoeal child morbidity, and the time spent by caregivers in attending to ill children. The estimates also include loss of water storage capacity due to dam silting. The overall cost is understated because it does not include damage to fisheries, ecosystems, and biodiversity as a result of water pollution. In Lebanon, where municipal tap water is perceived to be of low quality, the population consumes about 115 litres of bottled water per capita per year. The estimated expenditure on bottled water for preventive health reasons reaches around 0.5 per cent of GDP

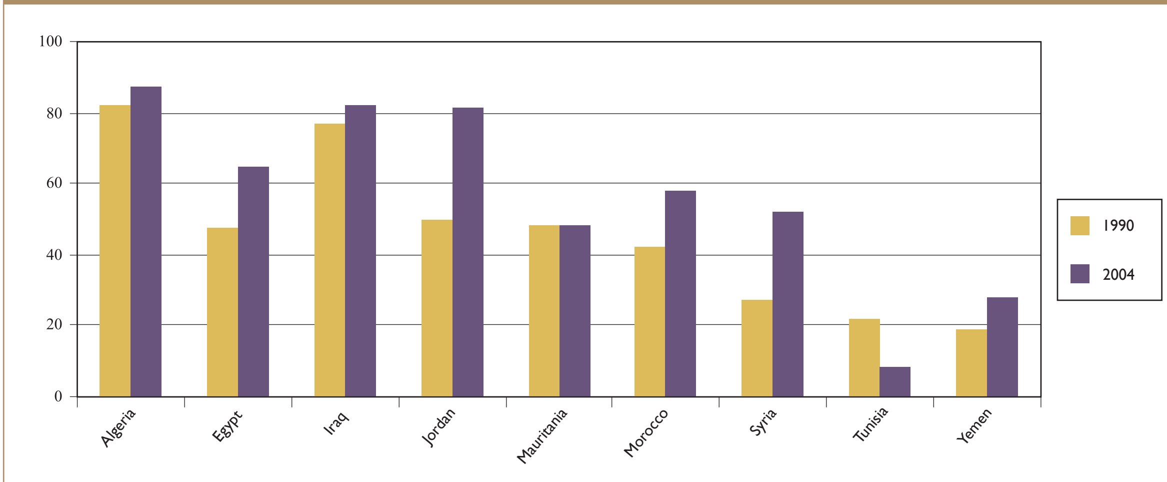
(Sarraf 2004)

Figure 7. Access of urban population of selected Arab countries to improved sanitation 1990–2004 (%)



WRI 2007, compiled from WHO and UNICEF 2006

Figure 8. Access of rural population of selected Arab countries to improved sanitation 1990–2004 (%)



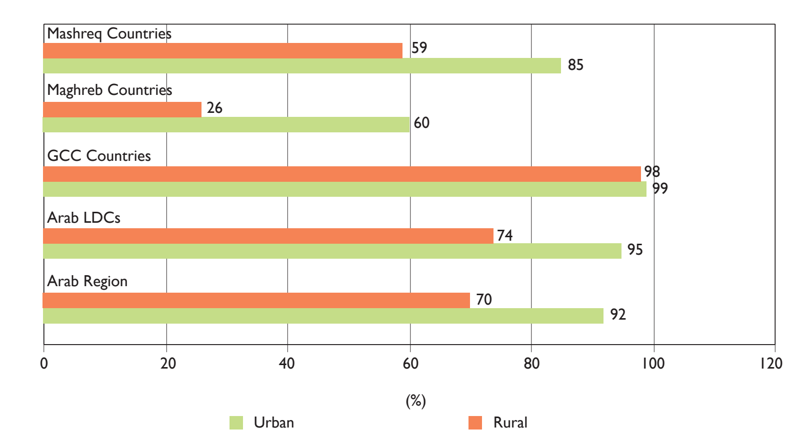
WRI 2007, compiled from WHO and UNICEF 2006

Throughout the region, access to both water and sanitation is important for the well-being of settlements. However, access varies from one country to another. Unlike many other Arab nations, the populations of certain states, such as Qatar, enjoy adequate access to both water and sanitation. The majority of the populations in countries like Lebanon, Syria, Tunisia and Egypt have decent access to sanitation. In other Arab countries, such as the Sudan and Yemen, populations have adequate access to water, but are unable to access adequate sanitary services (see Figures 7, 8, 9 and 10).

Management of Solid Wastes

Population growth and improved living standards in the region have led to increased rates of solid waste generation. Most often, this waste is referred to as municipal solid waste (MSW) and includes refuse from households, shops

Figure 9. Proportion of Population Using Improved Sanitation Facilities 2004 (%)

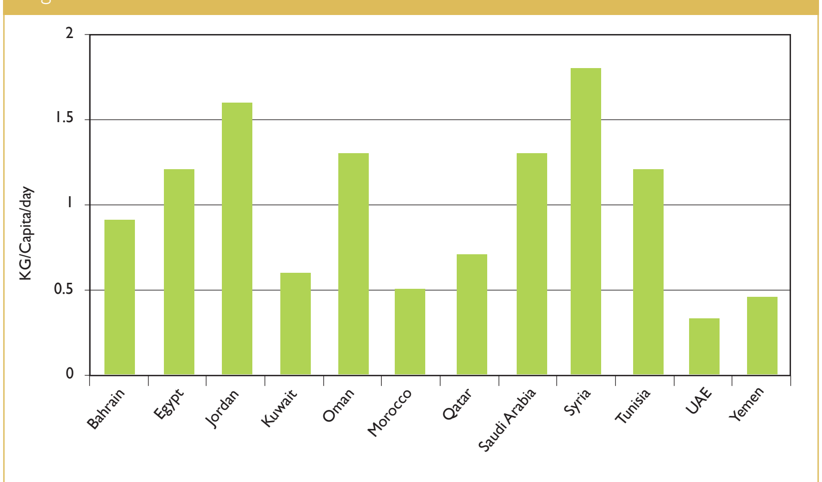


UN-ESCWA and LAS 2007

Figure 10. Annual damage costs from lack of access to water supply and sanitation

Sarraf 2004

Figure 11. Waste Generation in Some Arab Countries



Al-Yousfi and Asfari 2003

and commercial markets, service institutions such as schools, utilities, hospitals, administrative buildings, streets, gardens, markets, hotels, and recreational areas (EEAA 2005). Often, residents dump collected solid waste along the banks of drains and waterways. These practices significantly degrade water quality and aggravate health problems. Conventional waste management methods have become incapable of meeting societies' increased needs for maintaining a reasonable level of cleanliness and controlling health hazards (EEAA 2005). The lack of MSW management schemes in many Arab human settlements has further complicated the matter of solid waste collection and disposal in many countries. Currently, the efficiency of waste collection ranges from ten per cent in low-income rural areas (EPA 2005) to 90 per cent in high-income urban areas (Medina Urban Observatory 2004). In many rural areas, the organized collection of municipal waste does not exist.

Problems associated with MSW management are further complicated by changing patterns of production and consumption that lead to increased waste production. Poverty and conflict also weigh on effective MSW management. For example, in Iraq, people are using military barrels that previously contained chemicals to store their food and water. This is a serious solid waste and public health issue that could lead to grave illness. Moreover, the regional MSW rate is expected to increase in the years to come. Population increases, economic progress, expansion in urban areas, rapid industrial development, and rising standards of living have all contributed to a sharp rise in solid waste generation in the West Asia Region. It is estimated that municipal waste generation rates in West Asian Arab states have increased from 4.5 million tonnes per year in 1970 to a staggering 25 million tonnes in 1995 (Al-Yousfi and Asfari 2003). The quantity of solid wastes that the Arab region will generate by 2020 is expected to reach about 200 million tonnes per year (see Figure 11).

Living standards and wealth also contribute to the rate of municipal solid waste generation which varies from one country to another and from one city to another within the same country. On average, the daily per capita generation rate of MSW in the region is 0.5 kg at the national level. In urban areas, this rate can easily exceed 1.5 kg, whereas it drops to 0.7 kg in rural areas. For example, in Yemen, the per capita daily generation of municipal solid waste is 0.2 kg. However, within Yemen there are vast variations between urban and rural waste generation. The per capita daily generation of municipal wastes in the cities of Al-Muhra and Eden is 0.9 kg while this rate drops to around 0.2 kg in rural areas (Environmental Protection Agency 2005). In these urban and rural areas of Yemen, the collected solid waste does not exceed 50 per cent of the total generated. In Egypt, the average solid waste generation rate varies from 0.3 kg per person per day in rural areas to 1 kg per person per day in wealthy districts of large cities. As the quantity of non-organic waste has increased in wealthier districts, it has become more attractive to scavengers who recover the cost of collection by selling recyclable materials such as paper, plastic, glass, metals ...etc (EEAA 2005). In wealthier Arab countries, such as Saudi Arabia, the daily rate of MSW generation per capita is more than 2 kg (Medina Urban Observatory 2004). Hotels and tourist resorts may have waste generation rates as high as 2.5 kg per person per day, such as in Hurghada, Egypt (EEAA 2005).

When industrial and hospital wastes are left uncollected and mixed with municipal solid wastes, this impedes inventory and recycling efforts that contribute to recovering costs of MSW and, furthermore, pose potential health threats to populations (EEAA 2005). Contributing to the build-up of MSW are informal dumpsites that exist in a number of central areas including streets and vacant areas between buildings. In Egypt, total waste quantities collected never exceeded in the best scenarios 77 per cent of the wastes generated (EEAA 2005). Instead, open incineration as a means of waste disposal has become one of the main sources of air pollution in Egypt and several other Arab countries. Additionally, uncollected municipal and household waste is a perfect habitat for pests like rodents and insects that act as hosts for infectious diseases and potentially cause mortalities and economic losses when people are rendered unproductive due to illness.

Several measures have been examined to make waste collection safer and more efficient within the Arab region. In most of these countries a contingent valuation method was used to

Box 4. Morocco: Implementing an integrated and sustainable solid waste management:


Salam El Harchi

In Morocco, the management of municipal solid waste has become crucial, as it adversely affects the quality of life and the beautiful aspects of cities. It also tarnishes Morocco's image as a renowned and attractive location for tourism. Consequently, the Government has undertaken vigorous actions to reform the solid waste sector. An important National Programme on Municipal Solid Waste (NSWMP) was launched in 2007 and will be implemented over the next 15 years. It aims at enabling this sector to create the suitable measures needed for sustainable management of municipal waste. It covers all the Moroccan cities and aims to achieve the following targets:

- Ensuring 90 per cent of urban collection and cleansing (it is now 70 per cent);
- Completion of municipal waste landfills in all cities (100 per cent);
- Closing and/or rehabilitating existing landfills in all cities (100 per cent);
- Organizing and developing "separation-recycling-valorization" channels to reach 20 per cent in the re-use of generated waste, in addition to carrying out model separation operations.

This programme was based on the legislative mechanisms of decree No. 28-00 concerning management and disposal of waste. It includes a number of requirements aimed at improving solid waste management. The total cost of the programme amounts to about 37 billion dirham (around US$4.8 billion) and it will be financed through: group contributions; collection of new taxes on solid waste; the National Environment Fund; clean development mechanisms; and government support.

World Bank 2008

assess people's willingness to pay to improve waste collection and street sweeping. A 1995 survey undertaken in Rabat and Salé, Morocco, revealed an average willingness to pay US$4.7 per household per month. Adjusting this figure for inflation and aggregating it to other cities in Morocco yielded a nationwide urban figure of around US$170 million which is about 0.4 percent of Morocco's GDP (Sarraf 2004). Other surveys looked at the impact of open dump sites on natural resources and property values. According to Sarraf (2004), the closure of an open dump site in Tunis led to a rise of more than 35 per cent in real estate prices in the area. In Morocco, the cost of leakage and groundwater pollution from open dump sites reached about US$25 million per year (Sarraf 2004) (see Boxes 4 and 5).

Air Quality

Major parameters for air quality

Air-borne pollutants from vehicle emissions, electricity generation and industrial production frequently exceed levels considered safe for health. Depending on their size, particles can influence visibility as well as human respiratory functions. Particles larger than 10-micron diameter are filtered out of the air when passing through the nose (Nasralla 1999). From the nose, most of these particles reach

Box 5. Integrated Sustainable Solid Waste Management in Bahrain

Bahrain is suffering from all types of waste: municipal, industrial, agricultural and healthcare waste, due to the highly excessive disposal of waste compared to the limited geographical area, as well as the shortage of appropriate dumping sites. Thus, solid waste management has become vital for the maintenance of public health and safety. Tackling this problem in a proper environmental, social and economic way has become one of the priorities set forth by Bahrain which aims to activate the role of the Public Commission for the Protection of Marine Resources, Environment and Wildlife, through developing acceptable mechanisms and implementing comprehensive and integrated long-term solutions. For this purpose the following has been achieved:


Abdalrahem AL Arjan

Hazardous and Semi-Hazardous Industrial Waste

Hafira landfill for hazardous and semi-hazardous industrial waste was built in 2001 as one of the elements of integrated waste management, to ensure the proper disposal of industrial waste for the safety of human health and environment. The issuance of decree (No.3/2006) in respect to hazardous waste management supports the usage of waste control legal and administrative tools to prohibit the spreading of contaminants which pollute the environment and wildlife and harm public health. Waste disposal in Hafira landfill has reached approximately 70 000 m3 since its establishment in 2006.

Used oils

The issuance of decree (No. 4/2005) concerning used oil management is one of the administrative and legal tools which aims to develop the appropriate control and monitoring system to store, transport, process and dispose of used oils without diffusion of their contaminants which pollute the environment and harm the public health. Specialized companies recycle and collect used oils from their sources to utilize them in manufacturing processes, but the major part of used oils is exported for the purpose of treatment and recycling abroad. The exported quantity of oil reached 530.13 metric tonnes in 2006 while processed oil decreased from 1997 metric tonnes in 2005 to 583 metric tonnes in 2006 due to the increase of oil exports pursuant to the aforementioned decree.

Healthcare waste

Due to the availability of modern treatment facilities with environmentally sound conditions, a specialized company, adopting environmentally sound incineration techniques, is processing approximately 98 per cent of waste, pursuant to Decree (No. 1/2001) in respect to healthcare waste management. The decree aims to develop an appropriate control and monitoring system for the generation, storage, transportation, processing and disposal of waste.

The Public Commission for the Protection of Marine Resources, Environment and Wildlife, Bahrain the mouth and are swallowed. Inhaled particles of 2–10 micron diameter can impinge upon the walls of the trachea, bronchi and bronchioles. Particles of 0.1-2 microns can pass through the tissues to the alveoli (air sacs) and may be absorbed into the blood stream. These airborne pollution particles may contain several toxic and carcinogenic chemicals. Combined with other pollutants, they can cause serious lung diseases (Nasralla 1999).

Concentrations of different pollutants in the air depend on their natural and chemical characteristics and on prevalent weather conditions around pollution sources. Thus, the concentration of pollutants in the air differs from one city to another according to geographical location, size and the type of industry in and around it, traffic movement and other factors that affect the type, amount and destination of pollutants. Concentrations of pollutants inside the city also differ from one place to another. They

Box 6. Nitrogen Oxides

Nitrogen Oxides (NOx) is the generic term for a group of highly reactive acid gases, all of which contain nitrogen and oxygen in varying amounts. Nitrogen Oxides are a precursor to ground-level ozone and volatile organic compounds. NOx also contributes to acid rain and global warming and it causes a wide variety of health and environmental impacts via its various compounds and derivatives. Examples of these harmful impacts include the following:

- Ground-level Ozone (Smog) – is formed when NOx and volatile organic compounds (VOCs) react in the presence of heat and sunlight. Children, people with lung diseases such as asthma, and people who work outside buildings are susceptible to adverse effects such as damage to lung tissues and lung malfunction. Ozone can be transported by wind currents and cause health problems in areas far from its original sources. Other impacts from ozone include damaged vegetation and reduced crop yields.
- Acid Rain – NOx and sulfur dioxide react with other substances in the air to form acids which fall to Earth as rain, fog, or dry particles. Some may be carried by wind for hundreds of kilometres. Acid rain damage causes deterioration of cars, buildings and historical monuments, and can cause lakes and streams to become acidic and unsuitable for many living organisms.
- Particles – NOx reacts with moisture and other compounds to form nitric acid. Human health concerns include effects on the respiratory system, damage to lung tissues, and premature death. Small particles penetrate deeply into sensitive parts of the lungs and can cause respiratory disease such as emphysema and bronchitis, and aggravate existing heart diseases.
- Water Quality Deterioration – Increased nitrogen loading in water bodies upsets the chemical balance of nutrients used by aquatic plants and animals especially freshwater organisms. Additional nitrogen increases the productivity of algae and other micro-organisms, which leads to the depletion of dissolved oxygen in shallow waters.
- Global Warming – Nitrous oxide is a greenhouse gas. It accumulates in the atmosphere with other greenhouse gases causing a gradual rise in the Earth's temperature. This will lead to increased risks to human health, a rise in the sea level, and other adverse changes to plant and animal habitats as a result of this climatic evolution.
- Toxic Chemicals – NOx reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products, some of which may cause biological mutations.
- Visibility Impairment – Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas

WRI 2005, EPA 2008

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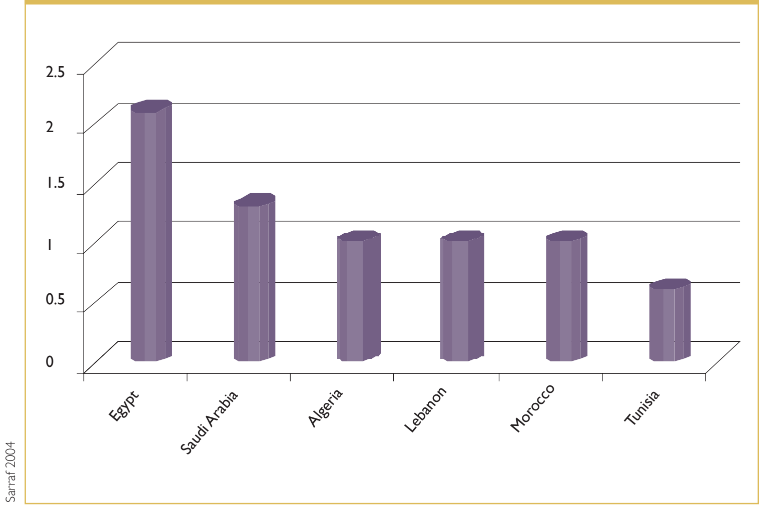
reach their maximum in industrial areas, and are less in residential areas located far from pollution sources (EEAA 2007).

The air quality in many Arab cities, particularly the major cities of Algeria, Egypt, Iraq, Kuwait and Saudi Arabia, is poor and declining compared to other parts of the region. One of the parameters of air quality is sulphur dioxide content. Sulphur dioxide is a primary contributor to acid deposition, which in large quantities is a proven detriment to the health of ecosystems and the air. Petroleum refineries, cement manufacturing, metal processing facilities, as well as locomotives, large ships, and some vehicles burn fuel with a high sulphur content, releasing SO2 into the air (WRI 2005). Monitoring results in Greater Cairo indicated that the average sulphur oxide concentrations in the air per day improved, decreasing below the defined safety limit (150 $\mu g/m^3$ to reach 49 $\mu g/m^3$ in 2007 and 39 $\mu g/m^3$ in 2008) (EEAA 2009).

The second parameter of air quality is the quantity of nitrogen oxides (NOx) present in the air. They are formed when fuel is burned at high temperatures, as in a combustion process. The primary sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels (Nasralla 1999). Currently, the NOx emissions of almost all Arab countries are increasing. Major cities in Saudi Arabia, Egypt, and Iraq are the leading producers of NOx in the region, most likely due, in part, to the oil refining and production processes. Another leading air pollutant is non-methane Volatile Organic Compounds (VOCs). These emissions are chemicals that vaporize at room temperature, like benzene, toluene, methylene chloride, and methyl chloroform.

Common sources that emit VOCs include housekeeping and maintenance products, cars, and building and furnishing materials, such as solvents, paints, and glues (WRI 2007). In sufficient quantities, VOCs can have adverse health effects on humans. Volatile Organic Compounds are also precursors to ground-level ozone, which can also cause health problems in humans (WRI 2007). Settlements in Kuwait, Saudi Arabia and the Sudan are among the highest producers of non-methane VOC emissions (see Box 6).

Figure 12. Annual damage costs from air pollution in some Arab countries



The third criterion for air quality is carbon monoxide (CO), which can trigger serious respiratory problems. Sources of CO emissions include industrial processes such as metal processing and chemical manufacturing, wood and gas stoves in addition to natural sources such as forest fires (WRI 2007). Many activities in major Arab cities, especially those with significant manufacturing sectors, are responsible for producing CO.

Industry and transportation consume a significant quantity of energy and also produce a considerable quantity of air pollution. In Tunisia, the energy generation and transport sectors are among the major contributors to air pollution, at 31 and 30 per cent of the released CO_2, respectively. Carbon dioxide emissions account for 92 per cent of the total GHG emissions in Tunisia, while methane and nitrogen oxide account for 7 and 1 per cent respectively. Emissions of CO_2 from the transport sector have increased from 3.4 million tonnes to 5.8 million tonnes between 1994 and 2002, with an annual increase rate of 9 per cent. This accounted for about 29 per cent of the total emissions generated by the energy sector in 2002, a 23 per cent increase from 1994. In Morocco, localized air pollution is the principal atmospheric problem affecting major agglomerations and industrial zones, where 56 per cent of GHG emissions originate from the energy sector, and air pollution is mainly due to automobile and industry emissions. The impact of air pollution on the economy of the country is significant. The deterioration of air quality contributes to respiratory diseases and in some cases premature death, causing a decrease in productivity estimated at 1.9 per cent of the GDP (CEDARE 2005).

Cost of Air Pollution

Air pollution has significant negative effects on public health and results in respiratory disorders such as chronic bronchitis and cancer, both of which can lead to premature death. A World Bank study in 2002 concluded that the cost of urban air pollution was almost two per cent of GDP (this cost is broken down into mortality costs—an estimated 20 thousand people die from air pollution-related causes each year—morbidity and lost revenue from potential tourism) (World Bank 2002). In rural areas, residents use biomass fuel for cooking and heating, which gives rise to indoor air pollution. This threatens the health of rural dwellers, especially women and young children who spend disproportionately more time indoors than men. The health related costs of indoor air pollution range from 0.15 to 0.45 per cent of GDP (Sarraf 2004) (see Figure 12).

Noise Pollution

Noise pollution also affects human health and welfare. Long-term exposure to disruptive

Figure 13. Nile Delta: Potential Impact of Sea-level Rise

UNEP 2002

This graph shows the Nile Delta region in 2002, the area as it would appear with a 0.5 m and 1.0 m sea-level rise.

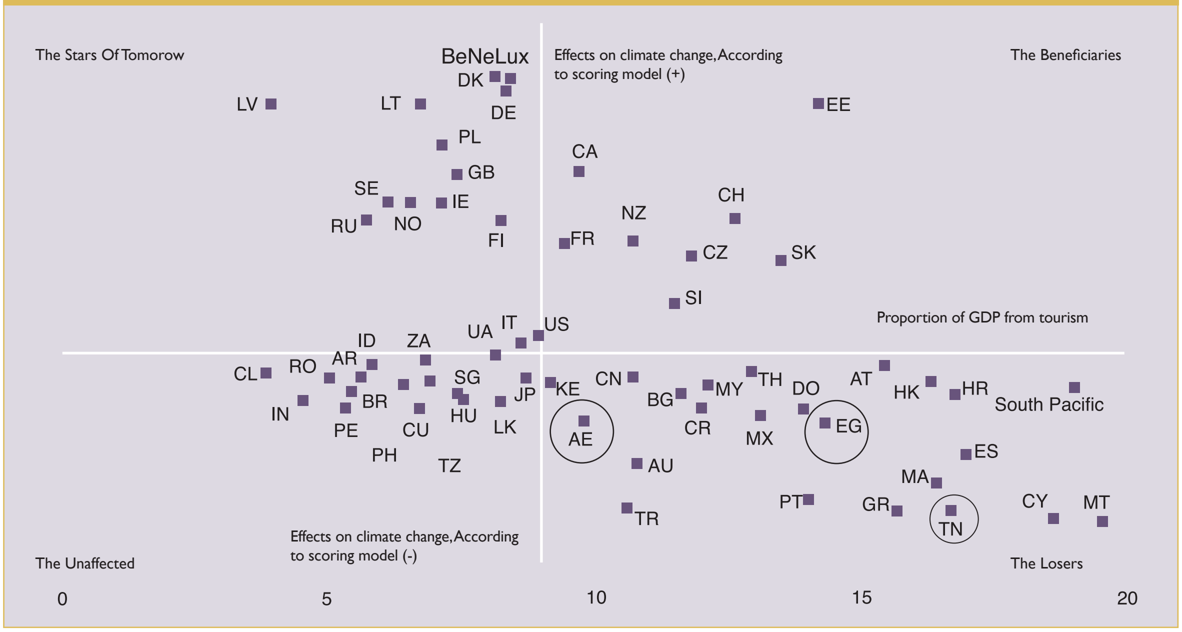
noise may result in physical or psychological damage, such as permanent hearing impairment, sleep disturbance, or excessive stress. In 2007, the Egyptian Ministry of State for Environmental Affairs established the first network for monitoring noise levels, which consists of 50 stable stations and four mobile ones. Cairo was chosen as an initial stage for monitoring environmental noise as it is the largest governorate in terms of population density and number of roads and vehicles, besides its numerous industrial and trade companies. Monitoring results revealed that noise levels in Cairo have been increasing at a disturbing rate due in part to lack of sound urban planning (EEAA 2007). These levels have reached unacceptable limits by both local and international standards. Measurements indicated that noise levels in major squares and streets reached 75–80 dB, violating permissible limits stipulated by Law 4/1994 (no more than 60 dB by day, 55 dB in the evening, and 50 dB by night).

Natural Disasters and Climate Change

Natural disasters are events associated with natural causes such as flooding, fire, earthquakes, tropical storms, or volcanic eruptions. Poverty increases people's vulnerability to natural disasters, especially for those living in run-down housing. Many poor people are forced to live in run-down housing and other dwellings unsuitable for occupation. These areas are usually disproportionately polluted and lack proper infrastructure. The poor are the most affected by natural disasters, such as flooding or landslides. Furthermore, disasters harm urban environmental systems, exacerbating catastrophic events, thus reducing resistance to disasters.

Arpingstone

Figure 14. More losers than winners from climate change



Ehmer and Heymann 2008

Note: UAE United Arab Emirates; EG Egypt; and TN Tunisia

Natural disasters occur in many Arab countries. In Algeria, for example, earthquakes hit human settlements. The earthquakes of 1980 and 2003 affected 930 317 and 210 261 Algerians, respectively (OFDA/CRED 2008). Additionally, in Egypt, the earthquakes of 1994, 1992 and 1979 affected 160 660, 92 649 and 66 000 Egyptians, respectively (OFDA/CRED 2008). Drought is another natural disaster that has influenced a great number of people throughout Arab countries. For example, drought affected 8.6, 3.45 and 8.4 million Sudanese in 1991, 1987 and 1984, respectively (OFDA/CRED 2008). In Syria, drought affected 239 thousand people in 2000 (OFDA/CRED 2008) (see chapter 3: Land resources). Flood is another major natural disaster that threatens Arab settlements. Floods affected 238 210 Yemenis in 1996 (OFDA/CRED 2008) and 13 000 Saudis in 2003 (OFDA/CRED 2008) (See chapter 9: Challenges and Opportunities).

Climate change impacts can intensify the frequency and effects of natural disasters and extreme weather events, such as heavy rainstorms, droughts, desertification and flooding. Arab settlements are particularly vulnerable to droughts and desertification, which have already brought about internal migration and conflict in the region in response to the growing scarcity of available resources, especially water. Additionally, several cities in the Arab world are within or have parts within the low elevation coastal zone that may experience sea-level rise and/or storm surges (see chapter 4: Coastal and Marine Environments). Other Arab cities are within the floodplains of major rivers, making them vulnerable to flooding. It should be emphasized that "river deltas are among the world's most valuable, heavily populated and vulnerable coastal systems" (Huq and others 2007) (see Figure 13).

In addition to severe weather events, the list of climate change related risks includes changes in rainfall patterns and distribution. This means that some Arab settlements will be drier than usual. This requires that settlement communities adapt their behaviours and practices to the available water supply, which is often already strained, and to maintain drainage systems as well. Although there are models that can predict the impacts of climate change on places and sectors, including changes in precipitation patterns, results of these models are uncertain due in part to the unpredictability of interactions between causes and effects (see chapter 2: Water resources).

Many Arab cities are vulnerable to an increasing number of heat waves caused, to some extent, by air pollution, especially in dense, large cities. This will have a negative effect on local economies as it is likely to result in a decrease in recreational tourism. In countries that rely on tourism as one of the sources of national income like Tunisia, Egypt and Morocco, the effects will be particularly severe (Eco-Plan 2008). Heat waves may discourage tourists from their regular seasonal destinations and divert them to cooler locations.

The continued bleaching of the region's coral reefs, a major tourist attraction site, is estimated to escalate with rising temperatures, leading to additional declines in tourism. Furthermore, increasing temperatures could facilitate the transfer of diseases from tropical areas into the southern areas of the Arab world that were previously inhospitable to the disease vectors, further threatening the attractiveness of many Arab countries to potential tourists (see chapter 4: coastal and marine environments).

Apart from tourism, other significant economic losses are likely to take place as a result of climate change within Arab settlements. One major fear is that there will be a loss of environmental assets and cultural landmarks. The loss of future investments in coastal zones as a result of sea-level rise is another threat to Arab nations. Job losses and increased unemployment due to climate change impacts represent another concern within the region. With these economic losses, social instability and conflict are likely to occur, which will further complicate efforts to alleviate poverty (Baby 2007) (see Figure 14).

Planning and Management of Human Settlements

Urban Planning and Informal Settlements

Informal Settlements

There are five indicators used to assess whether a settlement or dwelling is informal: durability, over-crowdedness, sufficient living area, number of informal dwellers, and access to infrastructure and social services. Durability is the first of these indicators. It assesses if the settlement was built in a non-hazardous location and has structures that are permanent and adequate enough to protect its inhabitants from the extremes of climatic conditions such as rain, heat, cold, and humidity. If the settlement is not considered to be durable, then it is informal. Over-crowdedness is another indicator of informality and is used to determine whether a household resides in a slum area.

It is assessed by the number of people living in a particular area where a habitable room is designated for more than three people. Like cities in many developing countries, Arab urban settlements face rapid expansion within the informal housing sector. Currently, Mauritania has the highest percentage of informal housing in the region, while Egypt, because of its considerable population, has the highest number of dwellers in informal settlements (see figure 15 and 16).

Figure 15. Lack of durability of housing in selected Arab countries 2001 (%)

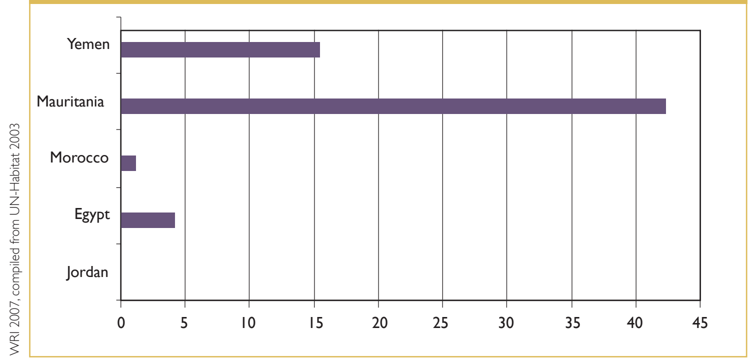


Figure 16. Lack of Sufficient Living Area in selected Arab countries 2001 (per cent)

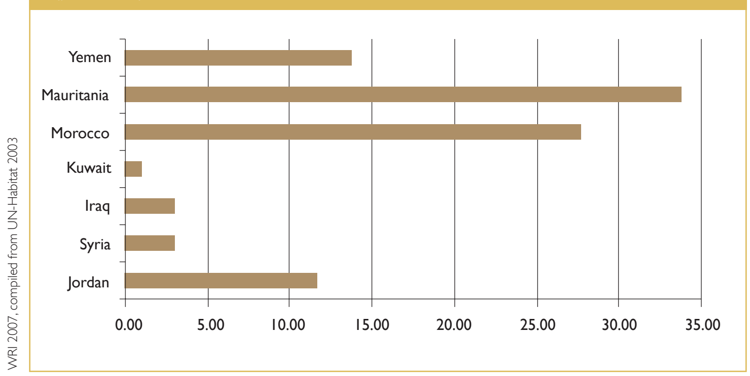
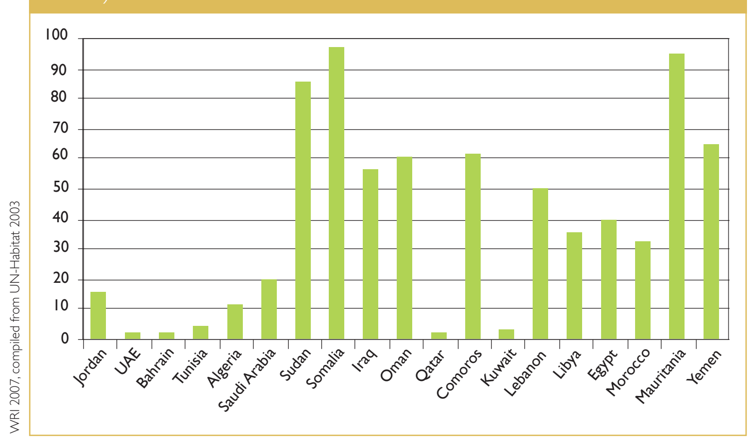


Figure 17. Urban slum dwellers in selected Arab countries 2001 (thousands)



Generally, defining a settlement as informal relies on the legal status as a frame of reference. Informality is a state of illegality that results when owners of either land or property fail to comply with requirements and regulations governing subdivisions, zoning and building. Breaching these requirements usually results in the inability of owners to legally register their land or property. The end-product of this process is dead capital (in many cases); where the property is not tradable on the market and does not officially exist. This also means that the owner cannot use the property as collateral for a loan (see Figure 17).

However, whether registered or not, dwellings are considered commodities. There are several factors governing the price/rent of a dwelling including, but not limited to: built area; quality of finishing; access to labour markets; infrastructure; social services; and environmental amenities such as gardens.

A dweller is a consumer who derives utility by residing in a dwelling. Compared to formal housing, a dwelling unit in an informal urban settlement provides its resident with less utility per unit of time. Demand for housing is a function of income, price of housing, prices of other commodities, available quantity of housing stock and available quantities of other commodities. Low income prohibits the poor from demanding a standard, formal dwelling unit. The demand for substandard housing is the outcome of strained, limited income of a household (Olsen 1969).

However, the emergence of informal settlements is not an indication of market failure as the market is not perfectly competitive. Furthermore, some government policies, such as rent control, disrupt market mechanisms, thus denying poor and middle class households access to standard housing that they can afford. The poor do not have the income or the credit to demand standard housing. Nevertheless, they can afford the supply of cheaper, substandard housing available within the informal market (see Box 7).

Box 7. Degree of Informality

There is no rigorous scientific definition of informal settlements. They are generally complex socio-spatial phenomena, characterized by: a) the de facto occupation of urban land; b) the use of self-help. The basis for self-help is often self-reliance, where people in need of housing work together to build their houses, and use mutual help in building techniques; and c) the use of unconventional building techniques, methods and materials.

Accordingly, there are three informal housing markets:

- Slum housing market: a dwelling that belongs to this category is an owned or rented unit with a legal deed. A dwelling that does not meet the minimum building requirements, zoning ordinances, and/or construction codes.

- Invasion housing market: in this case, the occupants construct dwellings that meet building requirements but on subdivisions that are illegal or violate zoning regulations. Some invasion housing markets develop on agricultural land where the Government prohibits residential development. Often invasion patterns follow the sub-division of agricultural land.

- Squatter housing market: dwellings of this market are units built below the minimum building standards on illegal subdivisions. The residents do not hold a deed to their land. These are often spontaneous developments on state-owned land with no physical infrastructure or social services.

Lim 1987

As existing formal organizations and institutions do not recognize these informal real estate holdings (de Sotto 1997), they remain dead capital. However, the legal acquisition and ownership of the parcel of land or dwelling unit can put credit and capital directly into the hands of the poor. Thus, through securing land tenure and acknowledging property rights, the poor can upgrade informal urban settlements.

The economy, society and the household will all benefit if informal dwellings are given property rights. At the city level, the legal registration of informal property means expanding the tax base, as informal or illegal dwellings are not part of the tax base. Hence, securing property rights means that more families will be required to pay taxes, which will enhance the revenues of local administrations and help to close budget deficits.

Registering these dwellings is also likely to make credit available to poor families, who will then have access to formal financial institutions, allowing them to improve their informal small enterprises, which will positively impact their incomes. At the national level, inflation rates may decrease as a result of registering more capital because the registered properties will be assets that support the value of the national currency.

Cultural Cities

Historically, many Arab cities were cradles of civilization. As a result, the region is rich in monuments and historical districts that house mosques, shrines, mausolea, and temples, representing various cultures and civilizations. Many of these cities lack the necessary infrastructure and capabilities to save these monuments from rising underground water levels, informal occupation by slum dwellers or inadequate housing. Lack of social and physical

Box 8. Rehabilitation of the Old City of Aleppo

Since the mid-1950s, the historical old city of Aleppo has been gradually falling into decay. It is a World Heritage Site, one of the world's oldest continuously inhabited cities, that was once a flourishing trade centre under Ottoman rule. After a long period of neglect, it could not cope with the constantly changing demands posed by the pressure of modernization. Half of the former population (around 200 000 people) migrated, while many of the remaining families grew even poorer, frightened to lose their homes. The greatest challenge for the inhabitants was to work to preserve the historic fabric of the city and the socio-cultural structure developed over the centuries, while at the same time creating a modern living and working world.

The living conditions and earning opportunities of the people of Aleppo are to be improved. A comprehensive rehabilitation and development plan helps to bring this about by stopping the decay of the old city and establishing a new dynamic mechanism for life in Aleppo. This is to be accomplished by pursuing an approach where Aleppo's inhabitants receive small loans and free technical consulting on housing maintenance and renovation. Rehabilitation of the water and sanitation networks will improve the supply of safe drinking water. It will also keep leaks in the water mains from softening the earth under houses and undermining their foundations. In cooperation with the relevant authorities, social infrastructure facilities will be established. Air quality will be improved as modern traffic management ensures access to all sections of the old city while organizing traffic therein. Overall, rehabilitation measures will safeguard basic elements of the local economy and secure the preservation of the old city. A strategy for sustainable tourism shall further support preserving the socio-cultural authenticity of the Old City. The municipal government has been empowered to continue the process unaided at a later stage and to place the experience gained in Aleppo at the disposal of other Syrian cities.

To adopt the approach, the city government has formed an interdisciplinary administrative team (Directorate of the Old City) which has gradually taken over the rehabilitation work that led to the renovation of 70 per cent of the water and sanitation systems of the old city; thus, securing safe drinking water and preventing structural damage caused by leaking water. The inhabitants of the old city now enthusiastically contribute their own suggestions for improvement. This resulted in the establishment of two "Health Points" where the people in the quarter receive healthcare in addition to a kindergarten. Furthermore, residents of the old city have benefited from small loans in renovating their houses. In fact, about 20 per cent of endangered buildings have been renovated by their inhabitants and this was reflected on the stability of the inhabitants whose number started to increase after a slump.

The Syrian government regards the project as a model for the preservation of historical cities and modern management of urban development. Consequently, the government has also recommended that Aleppo's rehabilitation and development concept be adopted by other Syrian cities.

GTZ undated

infrastructures and unemployment are challenges for both central and local authorities and negatively affect cultural heritage.

Several countries have successfully revived their historical cities. For example, from 1994 until 2007 in Aleppo, Syria, the Ministry of Local Administration, with the support of GTZ, formulated and implemented a comprehensive rehabilitation and development plan that stopped the decay of the old city, improving the living conditions and earning opportunities of its people (see Box 8).

Although Arab countries understand the need for stronger institutional capacity, a serious lack of capacity in some countries hampers proper environmental management. The Sudan, for example, suffers from serious institutional capacity constraints in the planning and execution of sustainable development strategies (Mohammed 2001).

In many cases, the development management of Arab cities and the functioning of local administrations are sectorial, often falling under the authority of engineers and architects, which impedes the adoption of sustainable development for human settlements. Many Arab municipalities have some autonomy, but little strategic decision making power is in their hands. Instead, the key players in development management are usually in the central government. As a result, the framework for decision making in many Arab countries is highly centralized and sector-oriented, potentially constraining local administrations.

Generally, the existing situation of development management within local administrations of many Arab cities can be summarized as under-utilization of information in decision making processes. This is due in part to traditional mechanisms of decision making and limited managerial capacities that do not generate an effective demand for information; Lack of internal institutional mechanisms for coordinated decision making, planning, policy making and development management; Lack of a stable institutional framework for partnership in decision making and implementation despite progress achieved in this field; Limited integration of the spatial dimension in decision making and planning where administration has become a mechanism for crisis management (UNDP and Government of Egypt 1996).

Resource management is one component of development management and can be improved in the region to reflect greater efficiency in the use of resources. Land is also a critical resource that should be properly invested (see chapter 3: land resources). The Arab world lacks metallic mineral resources. The deposits in Arab countries represented only about 0.37 per cent of the world total in 2005. Most of these deposits are iron, which is concentrated in Mauritania, Egypt and Algeria. Copper deposits also exist and are concentrated in Oman, Morocco and Saudi Arabia. Human capital can make up for the lack of metallic mineral deposits (El-Naggar 2005b). For example, Japan, a country whose metallic mineral deposits do not exceed 0.17 per cent of the world total, surpasses the Arab world as the second largest producer of iron and steel worldwide. The Japanese case illustrates that labour, technological and scientific advances, and transparent visionary economic management are among the critical elements in developing metallurgical industries, an important component of the urban economy. Scientific and technological advances have also paved the way for recycling minerals, and replacing copper cables with fibreglass in communication networks. Similarly, plastics and composites have replaced steel and iron in automobiles. These advances allow countries that lack mineral resources to increase their industrial outputs, which can lead to income growth and improved living standards (El-Naggar 2005b).

In contrast, mismanagement and inefficient utilization of natural resources are associated with malfunctioning markets and environmental degradation. Much of the mismanagement and inefficient utilization of natural resources, particularly land, can be traced to such malfunctioning, distorted or totally absent markets. Limited institutional capacity and absent markets for natural resources contribute to a lack of understanding about the production and distribution of public goods, such as clean air and solid waste management (see Box 9).

Many private sector companies in Arab countries do not acquire ISO 14001 certificates for environmental management, nor do they have proper schemes in place for environmental management. In addition, commitment to implement Agenda 21 does not usually exist among municipalities of Arab countries though progress has been achieved in this field. In order to encourage private sector leaders to adopt Environmental Management Systems (EMS) and use economic instruments, they must first be aware of the importance of sustainable practices (see Figures 18 and 19).

Generally, Non-Governmental Organizations (NGOs), which have been increasing in number, lead the environmental movement in the region. NGOs encourage and assist governments and private sector companies to adopt more environmentally sustainable policies and practices (see Table 1).

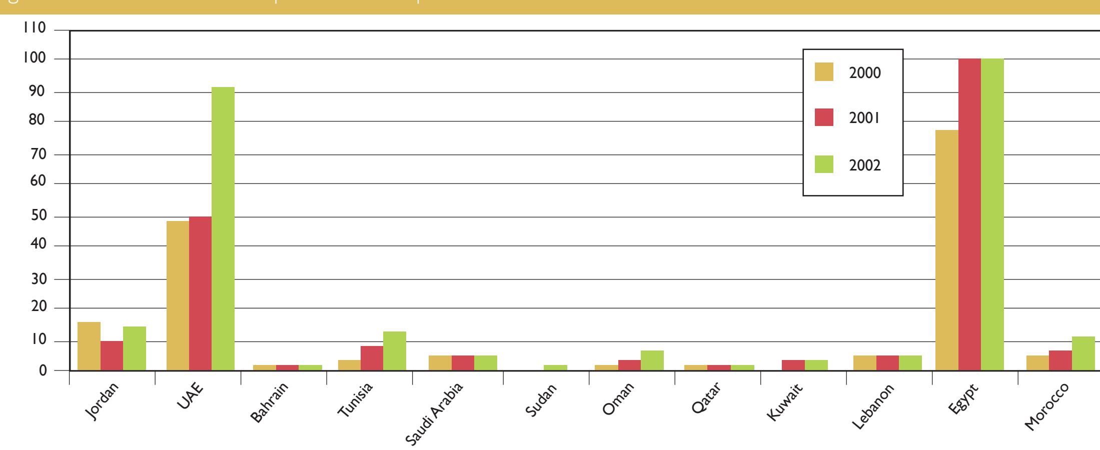
While both almsgiving (Zakaat) and dowry (Sadaqat) to aid the poor are encouraged by Islamic Shariy'aa, other forms of altruism such as philanthropy and volunteerism are lacking in the Arab region. Acts of volunteerism and philanthropy are usually manifested in the form of donations (money, property, or effort) to needy persons or groups by endowing institutions, such as schools, research institutions, universities and hospitals, or by another form of support for a socially useful purpose. However, based on the alms requested according to Islamic Shariy'aa, the amount paid by wealthy Arab oil producing countries could significantly contribute to alleviating poverty and assisting in resource management in other Arab non-oil producing countries.

Box 9. Definition of the Public Good

The public good should have two conditions: initially, it should not be restricted to a specific class and secondly, the consumption of a good by an individual should not prevent its consumption by another. Refuse collection, clean air, defence, protection, safety and security are all public services and goods. There are also other public goods that could be provided by the private sector such as coded television broadcast. With the provision of public goods emerges the issue of individuals who are uncommitted to pay their membership fees. Accordingly, a number of legal measures are undertaken to ensure punishment of those individuals. Often the market fails to provide the public good, even in the presence of competition, and this case is called "market failure."

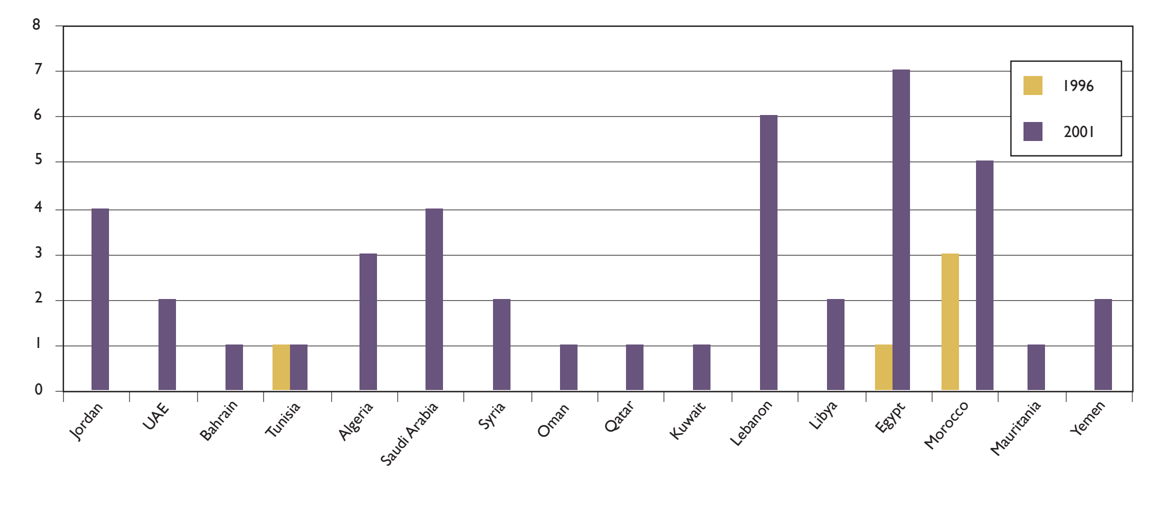
Lim 1988

Figure 18. the number of companies who acquired the ISO 14001 Certificate in selected Arab countries



WRI 2007 Compiled from ISO 2001 & ICLEI 2001

Figure 19. Agenda 21: Number of formally committed municipalities in selected Arab countries



WRI 2007, compiled from ISO 2001 and ICLEI 2001

Conflict

The two major factors contributing to urban growth in both demographic and spatial dimensions are: 1) natural population growth and 2) migration. The second factor manifests itself in the form of rural-urban migration, or migration to another country in search of work, which is very common in terms of emigration to the Gulf States and in the case of internally displaced persons (IDPs). Most of the future population growth in Arab countries will be in existing major urban settlements and their outlying areas. In 2008 the Sudan had the highest number of IDPs among Arab countries; Iraq and Algeria came in second and third positions respectively. IDPs require jobs in their new settings and, thus, strain urban services and infrastructures that are not ready to handle them (see Figure 20).

Quality of Life

The scores of Arab countries on the Human Development Index (HDI) have improved during the period from 1975 to 2007. The average score of Arab countries is around 0.5, or higher. Oil producing countries with small populations, such as the UAE and Qatar received scores placing them in the upper-middle of countries worldwide. Other middle-income Arab countries, such as Egypt and Tunisia have also improved while low-income countries, such as Yemen, Mauritania and Djibouti are still struggling to improve their scores. Regardless of income levels the gender gap is still significant in several Arab countries. Women represent almost 50 per cent of the population in the region and thus are very important for economic growth. They also play an important role in managing natural resources at the local level. However, many women in the region remain illiterate, unqualified for formal employment and lack equitable access to property and rights within Arab human settlements. Moreover, tribal traditions often remain a barrier to the implementation of legal and Islamic inheritance laws for women (see Figure 21).

Poor economic performance in the Arab region is associated with low savings and investment rates, which are mechanisms for alleviating poverty. Only oil producing Arab countries are capable of maintaining high rates of savings, which currently

Table 1. Density and membership of international NGOs in Arab countries

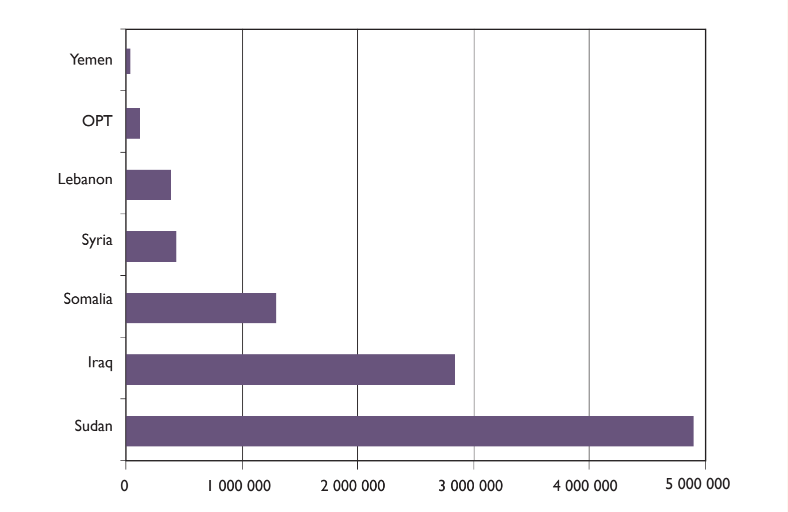
Country	Density of international non-governmental organizations with membership		International non-governmental organizations with membership	
	2000	2003	2002	2003
Algeria	33	33.1	1 062	1 069
Bahrain	734	748.0	484	491
Comoros	246	271.8	166	167
Djibouti	364	505.1	218	226
Egypt	28	27.3	1 963	2 005
Iraq	22	22.0	518	527
Jordan	133	185.2	941	983
Kuwait	369	367.0	767	775
Lebanon	291	294.5	1 030	1 083
Libya	78	87.7	452	471
Mauritania	155	149.2	419	422
Morocco	47	44.0	1 358	1 382
Oman	148	145.2	394	394
Qatar	553	467.6	350	371
Saudi Arabia	48	47.0	1 082	1 105
Syria	25	20.0	739	743
Sudan	36	36.1	592	620
Tunisia	125	127.9	1 228	1 255
UAE	295	323.0	750	790
Yemen	18	18.8	335	352

WRI 2007, compiled from Anheier and others 2004

exceed international levels. In 2002, according to World Bank data, Algeria, Saudi Arabia, Oman and Libya had saving rates of 40, 37, 34, and 26 per cent, respectively, compared to the international savings rate of 20 per cent for that year. Generally, poverty seems to be declining in some Arab countries, while in others, it is on the rise. Yemen, Mauritania, Comoros and Djibouti have the highest rates of human poverty in the region (see Figure 22).

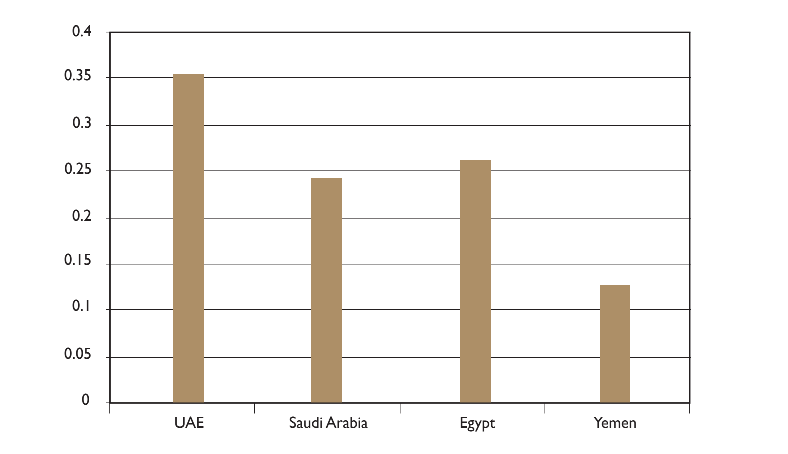
Poverty is closely associated with reduced levels of education and inadequate healthcare. The data suggests that adult and youth illiteracy, particularly among women and girls, prevails within poor Arab countries, such as Djibouti, Mauritania and Morocco. Without basic education, women cannot be fully active in the development of their communities or fully contribute to the labour market. Widespread

Figure 20. Internally displaced persons, total number 2008



WRI 2007, compiled from Norwegian Refugee Council 2006

Figure 21. Gender empowerment measure for selected Arab countries 2004



WRI 2007, compiled from UNDP 2006

Note: Units: Index: 0-1, higher number indicates greater gender equality

illiteracy also hinders possibilities for raising awareness among population. This is especially relevant where only conventional methods of public awareness raising, such as billboards and other written materials, are used.

Selected health indicators for Arab countries show some improvements. For example, with the exception of Iraq, the region has shown an average annual reduction in under-5 mortality rates (U5MR) measured from 1990 to 2005. Some countries, such as Egypt, Syria and Tunisia, have significantly reduced under-5 mortality rates. Another indicator of improved health conditions is the decline in the region's infant mortality rate (WRI 2007, UNICEF 2006, UNAIDS 2006, WHO 2006a and 2006b).

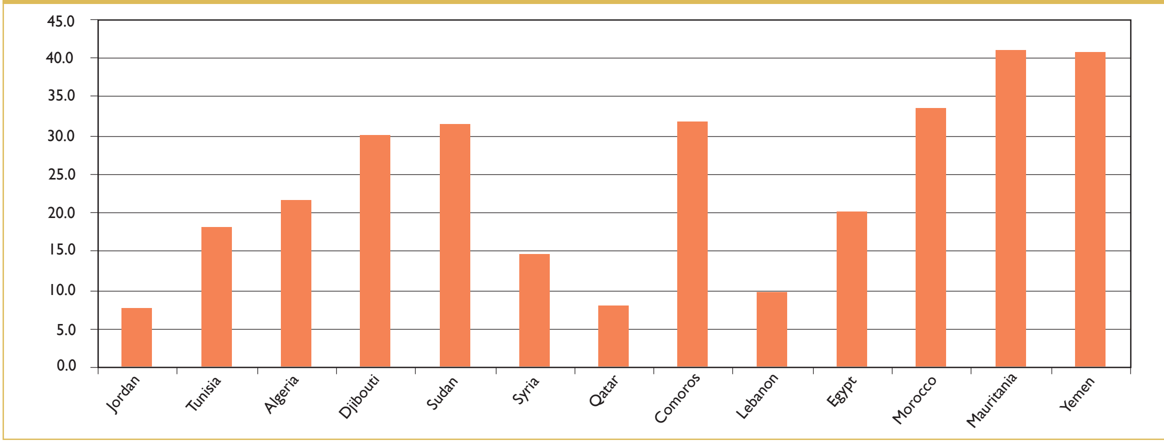
However, viral infections in the Arab world require more attention. The estimated percentage of adults aged 15 to 49 living with HIV/AIDS is increasing. Both Djibouti and the Sudan have the highest rates of HIV/AIDS and Hepatitis C (see Box 10).

Conclusion

There is a need for local information generation and dissemination with regard to the region's human settlements. Most of the available information on human settlements in the Arab region is coming from international sources. This information would be enhanced if it was generated locally and nationally. In order to do this, many Arab states need to develop their national and local urban observatories to monitor the inter-linkages between rural and urban areas, and the interactions between the development and the environmental sectors, in order to embark on formulating improved urban management schemes.

It is of the utmost importance to consider population dynamics when examining human settlements. In the case of Arab countries,

Figure 22. Human Poverty Index for selected Arab countries 2006 (%)



WRI 2007, compiled from UNDP 2006

Note: Units: Percent (%): higher number indicates greater incidence of poverty

Box 10. Viral Infection

In 2005, the World Health Organization estimated that there were at least 21.3 million hepatitis C virus (HCV) carriers in the Eastern Mediterranean countries, which is nearly equal to the number of carriers estimated in the Americas and Europe combined. In the review on the epidemiology and distribution of HCV genotypes in the Eastern Mediterranean countries, it was found that genotype 4 is prevalent in most of the Arab countries. It was concluded, based on the limited number of clinical trials on the treatment of chronic HCV genotype 4, that using peginterferon alfa-2b in combination with ribavirin has encouraging potential. However, efforts to develop more effective antiviral therapies in addition to the establishment of an effective HCV vaccine remain the most significant challenges in the near future.

Ramia and Eid-Fares 2006

many populations are young and demand social services, such as education, healthcare, and physical infrastructure, such as water and wastewater treatment. Employment is another crucial issue that requires large investments in both human resources and the environment.

Many Arab cities also require proper urban planning and management. Several cities are experiencing suburbanization and the expansion of pockets of poverty. One method of reversing the trend of rural-urban migration is to develop provincial, secondary cities and villages to achieve a more balanced urban system that will have a positive impact on natural resource use.

New western style housing developments, which feature single family residences, and even golf courses, take up large areas and often have serious environmental impacts. When planning these new developments, measures should be undertaken to ensure that they are in harmony with the environment, and contribute to economic growth and social equity.

Existing areas should not be overlooked in this process, especially informal areas that require significant upgrading. These settlements should be viewed as an opportunity for progress and capital formation and not as a problem. Also, there is a need to preserve and improve old historical quarters in many Arab cities. The management of human settlements would not be complete without channels for providing public goods, such as clean air for citizens. However, mechanisms must be installed to protect against free-riding and to promote the equitable use of resources.

There is a need for institutional transformation, which is necessary to ensure the sustainability of human settlement development. This can be achieved through: capacity building, awareness campaigns, strengthening the role of media, using the power of community and religious leaders to convey messages and build support, and empowering poor and marginalized populations. Special attention should also be given to closing the gender gap by involving women in the process of institutional and community level transformation as well as providing them with greater access to goods and services. For proper institutional transformations to take place, the administration of human settlements has to be based on principles of good governance. These principles include: promoting public participation, building partnerships among stakeholders, enforcing the rule of law, building consensus regarding issues and solutions, ensuring transparency and accountability, providing efficient and effective services, and supporting inclusiveness.

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Chapter 6

BIODIVERSITY

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Main messages

Biodiversity contributes to improving human livelihoods and welfare. Human cultures are inextricably linked to the services and products of biodiversity which is the genetic warehouse for speciation and development of new species and products. Biodiversity is also a source of food and medicine and the basis for the sustainability of ecosystems. The following are the main messages of this chapter:

- The Arab region features a wealth of biodiversity resources including terrestrial and aquatic ecosystems, various habitats and several endemic species of global significance. People rely on ecosystems for goods and services and use their products for agricultural, medicinal, and industrial purposes without recognizing their real value.

- Biodiversity has declined in the Arab region as a result of severe pressures exerted by the development process. Over the last thirty years, overexploitation of the region's ecosystems has led to habitat loss, reduction of species abundance and the shrinkage of their natural range of distribution. Habitat degradation has been rapidly accelerating due to the unprecedented and exceptionally high rates of economic development activities which have rarely taken biodiversity into consideration. Coastal and marine biodiversity are showing signs of stress, particularly in the most developed areas along the coasts of the Arab region which are associated with dredging and infilling operations.

- Biodiversity is the basis of life on Earth and one of the pillars of sustainable development. It guarantees the sustainability of ecosystems as well as plant and animal agricultural production and its decline weakens a major component of Arab development. Biodiversity loss may eventually jeopardize food security as important genetic resources are being simplified, eroded and/or depleted. Serious measures and responsible policies should therefore be put into effect regarding biodiversity issues such as habitat degradation and species loss particularly those used in food and agriculture.

- Species conservation and breeding programmes and protectorates have contributed to reducing the threats facing ecosystems. Nevertheless, there is still a need for further conservation programmes in addition to the establishment of various protected areas in accordance with scientific standards. Achieving a significant reduction of the current rate of biodiversity loss requires accelerating efforts and providing an enabling environment to meet Millennium Development Goal (MDG) 7 as well as CBD 2010 objectives. This requires the scaling up of biodiversity conservation measures from the local to the decision making level as well as integrating strategies into national planning.

- Invasive alien species (IAS) are a major threat to local biodiversity, causing environmental and economic damages. This is one of the emerging issues that should be seriously considered as their numbers are increasing in Arab countries. The problem of both alien and native invasive species should be given special attention as several different species have currently become problematic in particular parts of the Arab region, threatening biodiversity in the whole region. Invasive species have now reached 551 in Arab countries and are a major threat to native fauna and flora as well as to natural ecosystems and their products, causing serious damages. Examples of these are: the Palm Weevil, the Water Hyacinth (Eichhornia Crassipes) and the Corvus Splendens found in abundance in GCC countries, as well as in Yemen, Djibouti, Egypt, and Morocco.

- Biosafety in the Arab region has become a critical issue, due to increased world trade of genetically modified organisms (GMOs) and their products. Arab countries need to prepare for this era by enacting bio-safety measures regarding GMO products. These measures should include: building institutional capacities, developing laws and national criteria, reviewing and enforcing legislation, scaling up technical processes for management and assessment of the risks associated with circulation and transfer of GMOs as a result of the global expansion in this domain. Measures also comprise involvement in international regulations pertaining to bio-safety and their application at the national level. In this context, Arab countries can benefit from each other's experience regarding enforcing biosafety legislation, regulating access to biological resources, implementing laws and issuing guiding lists to assess their ecological effect.

- There is insufficient information on the status and trends of biodiversity, particularly in relation to threatened species and the impact of development on biodiversity in several Arab states. This information and relevant scientific assessments provide the basis for responses to all problems related to biodiversity. Moreover, knowledge sharing and information exchange among Arab countries, which significantly aided in biodiversity conservation, progressed tremendously during the last five years due to the Clearing House Mechanism Programme adopted by several Arab countries.

- Formulation of a common Arab strategy for biodiversity conservation, the sustainable use of its resources, and the development of its genetic organisms are a priority and an opportunity that should not be ignored. A regional policy framework should be adopted with a broad vision that reflects concerns about biodiversity loss and contributes to the conservation and assessment of its status, and the sustainable use of its components. Additionally, mainstreaming biodiversity into the national planning process is of prime importance to achieving sustainable development in biodiversity and its related cross-cutting issues. Furthermore, people and national institutions should be empowered to better manage biodiversity and ecosystem services in order to effectively conserve resources.

The dragon blood tree, also known as the two brothers- blood tree in Socotra Island in Yemen

Introduction

Biodiversity is defined as "the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (UN 1992). Significance of biodiversity comes from its important scientific, educational, cultural, social, economic, recreational, aesthetic, and historic values.

Biodiversity offers great potential for improvements in human well-being as it is a genetic warehouse for speciation and the development of new species and products. Human cultures have developed within the structure of the environment around them and played a central role in promoting traditional knowledge in various parts of the world. Throughout history, humans have derived food, medicine and a great number of manufactured products from various biodiversity resources. Ecosystem services, like regulating water flow, supporting food production, breaking down wastes, and stabilizing climate, are another component of biodiversity that supports human welfare. Furthermore, biodiversity creates suitable habitats for humans to live in and forms unique seascapes and landscapes for recreation.

Biodiversity is usually divided into three levels: genetic diversity, species diversity and ecosystem diversity. Genetic diversity refers to the variation of genes and the frequency of their occurrence within and between populations of the same species.

Genetic variation is partially attributed to the behaviour of different organisms and the variety and complexity of their habitats. For example, a larger population of a particular species will have more genetic variation than a smaller population of that same species. The more the genetic variation is present in a particular population, the more adaptable that species will be to environmental change. Genetic variations within species are of prime importance to agriculture and food security since they form the raw material for breeding new and higher yielding agricultural crops.

Species diversity is the basic unit of biological diversity and its proper measure, and refers to the quantity of species within a certain area. It is also known as species abundance, species richness or taxon diversity. Species diversity is extremely important to human consumption as humans rely on a wide range of plant and animal products for their health and well-being. For example, nearly 25 per cent of all commercial medical drugs in developed countries are made of plants and plant derivatives (Principe 1991). Dependency on plant products for medicinal use may reach as much as 75 per cent in developing countries (Principe 1991).

In the Mediterranean region, it is estimated that between 200–250 herbal species used to treat human illnesses are traded (Lev and Amar 2002, Said and others 2002). In the coastal region of the Mediterranean, nearly 230 species of herbs were documented in Egypt alone as having potential medicinal value (Heneidy and Bidak 2004).

Ecosystem diversity describes the various characteristics that make up a particular ecological system. In any given area, complex relationships between living organisms and non-living entities, such as energy and nutrients, create and maintain the balance of ecosystems. Different ecosystems can have extremely different characteristics, governed principally by rainfall and temperature. Great variation can also occur within the same ecosystem, which is also impacted by climatic conditions. This variation is the main cause of diversity in ecological processes, habitats and communities and drives ecosystem diversity.

The richness of resources allows healthy ecosystems to provide goods and services that sustain human needs. Some of the products and services of ecosystems include food, water, timber, and fibre. The characteristics that regulate ecosystem services include climate, floods, diseases, wastes, and water quality. Simultaneously, services like recreation, aesthetic enjoyment, and spiritual fulfilment are examples of ecosystem services that coincide with human values. In addition, supporting services such as soil formation, photosynthesis and nutrient cycling are of great importance and result in the proper functioning of the ecosystem (MA 2005).

However, many biodiversity products and services are neither widely recognized nor economically valued, which means that many are not properly managed. As a result, about 60 per cent of ecosystem services that are linked directly to human well-being are in a global state of decline (SCBD 2006). For example, the direct services provided by the ecosystems to coral reefs and mangrove trees in the field of tourism and indirect services, such as the protection of the Red Sea shores in Egypt, are estimated at nearly US$14.3 million/km (EEAA 2007).

Although there is a lack of accurate data on the status of many aspects of biodiversity across Arab countries, it is clear that biodiversity loss is present and that it generally takes one of three forms: habitat degradation and loss, species decline, or habitat disturbance associated with the introduction of IAS. This chapter will address these three issues while focusing on biodiversity resources in the region, driving forces and pressures that threaten biodiversity, and the challenges and opportunities for biodiversity conservation and investment.

Status of biodiversity: An overview

The Arab region features a great variety of biodiversity resources, including terrestrial and aquatic ecosystems with various plant and animal species. These ecosystems provide services and habitats for native wildlife and form transit stations for migratory species. The relative richness of these biotopes is supported by diverse habitats such as deserts, steppes, savannahs, oases, rivers, lakes, salt marshes, mountains and regional seas. Several species, especially those used in food and traditional medicine, provide an abundant stock of biological resources that are well adapted to the arid climate prevalent in much of the region and can be utilized to serve agricultural, medicinal and industrial purposes. Additionally, aquatic species, particularly marine species, are a major source of inexpensive protein.

The spectacular terrains prevalent in the Arab region, as well as the diverse bio-geographic origin of its species, contribute to the species diversity of fauna and flora, and particularly to the endemism of these species. For example, the three phytogeographical regions (Mediterranean, Irano-Turanian and Saharo-Arabian) contain a diverse collection of woody and various herbaceous plants, especially annuals and geophytes (Zohary 1973).

The recorded number of species in the Arab region varies among countries depending on their geographic location. The number of higher plant species ranges from nearly 220 in Qatar to more than 3600 in Lebanon, Morocco, Syria and Yemen. Nearly 70 per cent of these wild plants are known to be of potential economic value; at least 35 per cent of which are known to have multiple uses (Batanouny 1981, UNEP, Boulos and others 1994, WCMC 1992). The number of mammals ranges from 21 species in Kuwait to around 267 species in Sudan, bird species range from 22 species in the Comoros islands to 938 species in Sudan, and reptiles may reach numbers of up to 193 species in Somalia alone (Ash and Miskell 1998). Furthermore, the number of known amphibian species ranges from 2 species in Kuwait to 27 in Somalia (UNEP-WCMC 1992).

The Arab region is characterized by the presence of large numbers of endemic taxa as well. The total number of known endemic flora in the region is about 3 397 species and the total number of endemic species of mammals is 39 (Ghabbour 1997, Zohary 1986). Thirty species of birds, 132 of reptiles and 8 of amphibians are also considered endemic. At the country level, high numbers of endemic biota are found in Morocco, Somalia and Yemen including the Socotra Archipelago, where more than 30 per cent of its biota is endemic (Thulin 1995, Fennane 1997, and UNESCO MAB 2004). Large numbers of these species are of national, regional and global significance. Egypt, for example, is home to 143 species of global importance (EEAA 2008).

Moreover, of the 34 internationally recognized hotspots in the world, five are located within the political boundaries of Arab countries (see Box 1). By definition, these hotspots contain at least 1 500 species of endemic vascular plants which have already lost at least 70 per cent of their original natural vegetation cover. Furthermore, the Arab region houses 1 of 11 marine biodiversity hotspots worldwide. As a result of significant environmental and ecosystem degradation, these hotspots require immediate conservation efforts to rehabilitate and sustain their ecosystems.

Major terrestrial ecosystems found in the Arab Region are part of these hotspots. Within the land area of the Arab region's ecosystems, steppe and desert rangelands constitute more than 75 per cent. These lands encompass a wide diversity of plants and animals adapted to arid and semi-arid conditions. They are a primary source of animal protein and provide precious environmental services like regulating water flow and curbing soil erosion. With forage productivity varying between 50 kg/ha in desert rangelands to 1 600 kg/ha in savannah rangelands, they contain many plant species adapted to the harsh environment and are of potential nutritive value (AOAD 2005). Large numbers of these species, such as Periploca angustifolia, Dactylis glomerata, Oryzopsis miliacea, Hyparrhenia hirta, Pennisetum divisum, Panicum turgidum, Cenchrus ciliaris, Dipterygium glaucum, Coelachyrum piercei, Stipagrostis plumose, Artemisia herba-alba and Schismus barbatus, are known either for their good forage quality or their use in traditional medicine (ICARDA 1997).

Box 1. Biodiversity hot spots in the Arab region

- The Irano-Anatolian Hotspot: It includes, in part, the mountains of northern Iraq, south eastern Turkey and north western Iran. Iraq and Syria are on the peripheries of this phytogeographical zone. Its vegetation cover consists of 2 500 endemic species. The principal habitat is mountainous forest steppe where Quercus spp. and Juniperus spp. are dominant species.
- The Mediterranean Basin Forests: Significant quantity of vegetation that exists in the Mashriq and the Maghreb countries lies within this region. The area comprises the highlands of Lebanon, north western Syria, Algeria and the High Atlas Mountains of Morocco, where coniferous and deciduous species prevail. It includes 22–500 endemic vascular plant species. Sclerophyllus shrub land species like Myrtus communis, Olea sp., Phillyrea spp., Pistacia spp., and Quercus spp. dominate this area.
- Coastal Forests of Eastern Africa: These are fragmented forests in south eastern Somalia. This hotspot is home to a variety of primate species commonly related to the lemurs, monkeys, and apes (Conservation International 2007).
- The Horn of Africa: This area includes the southern coastal parts of the Arabian Peninsula, most of Somalia, Djibouti, Yemen (including Socotra Archipelago), Oman and a limited part of eastern Sudan as well as the tiny islands of the Red Sea. The area contains 2 750 endemic plant species and is known as the most degraded hotspot in the world. Acacia and Prosopis spp species exist in this region.
- Madagascar and the Indian Ocean Islands: This area encompasses a number of islands including the Comoros. Biodiversity in this region is very rich with high levels of genus- and family-level endemism as well as a number of endemic and internationally threatened marine species like the coelacanth, humpback whale, dugong and sea turtles.

Conservation International 2007

Mangrove Stands along the Red Sea Coast (Al Leith, Jeddah, Saudi Arabia)

Forests constitute 6.3 per cent of the Arab region's total area, which is far less than the world's total forested area of 30.3 per cent (AOAD 2004). Nearly 83 per cent of forest ecosystems are found in Northern Africa, Sudan and Somalia while less than 17 per cent are found in the Arab countries of West Asia. Forest ecosystems are quite diverse and home to many species. The closed Mediterranean forests of Abies sp., Pinus spp., and Cedrus spp. are found in the mountains of Mashriq countries and the Atlas Mountains of Maghreb countries, whereas subtropical associations, mainly Acacia spp., are found in southern Sudan. Scattered stands of drought-adapted woody vegetation like Juniperus spp., Acacia spp., Prosopis sp., Tamarix spp. and Salvadora sp. are found in the mountains, floodplains and valleys of the Arabian Peninsula. Also, patchy tracts of Mangroves grow along the coasts of the Gulf States and the Red Sea (FAO 2007).

Major rivers, lakes, springs, marshlands, sabkhas and man-made water impoundments are the main sources of wetland biodiversity. These wetlands support breeding several populations of rare, globally endangered bird species. Furthermore, they are transit stations for major flyways. The Nile, Euphrates, Tigris and Jordan rivers and their natural and artificial water impoundments – which contain water lilies, reeds, and cattail in addition to other submerged and emergent species – hold a wealth of species that are of great importance to maintaining biological diversity (see Box 2).

Wetlands also play a vital role in conserving water and preventing erosion and flooding, thus providing critical economic services. Moreover, numerous inland oases and coastal sabkhas exist in the region and a large number of them are considered important bird habitats (UNEP 2001). In addition, the largest marshlands in West Asia are found in southern Iraq and feature unique human settlements, diverse habitats and species (Iraqi Ministry of Environment 2004).

Human interaction with natural environments in the Arab region has yielded a unique type of biodiversity called agrobiodiversity, where various combinations of crops, forest trees and animals are raised together in spatial and temporal settings. Most temperate-zone agricultural crops originated in the Fertile Crescent, where the domestication of many wild plant species took place thousands of years ago. Today, the Arab region is one of the world's main contributors to agrobiodiversity (Davis and others 1994). Approximately 83 species of the world's cultivated crops originate from the eastern side of the Mediterranean basin. Many wild relatives of these crops, landraces and primitive cultivars are still found in the region (Zohary 1986, Davis and others 1994).

Box 2. Biodiversity in water and wetlands (the Nile River)

The Nile Valley and the wetlands are among the most diversified and productive ecological systems in Egypt as they house 87 species of seagrass beds, 80 plant species, 100 animal species, 82 fish species, 31 species of reptiles and amphibians, 144 bird species and 37 mammal species. There are indications that the Nile fish species have been declining especially after the construction of the High Dam. Lake Nasser now contains only 58 fish species and some other species that are threatened with extinction like the turtle, the crocodile and the lizard. The rhinoceros existed in the Nile Valley till 1800. The number of Egyptian geese has increased in lake Nasser as well as migratory birds whose number exceeded 200 000. Furthermore, there are some invasive species in the Nile River like Eichornia Crassipes, Procambarus Clarkii, some fish and shellfish species, in addition to one species of reptile and three of birds.

EEAA 2007

The Arab region is bordered by major marine bodies, some of which are totally enclosed like the Dead Sea. These water bodies include the Indian and Atlantic Oceans, the Red sea and the Gulf of Aden, the Dead Sea, the Arabian Sea, the ROPME Sea Area as well as the Mediterranean Sea (see Chapter 4). With the exception of the Dead Sea, these water bodies are rich in biodiversity and are vital for sustaining human life. They also support the artesian, semi-industrial and industrial fishery fleets of bordering countries.

The Red Sea and the Gulf of Aden feature particularly rich biodiversity resources and host high numbers of endemic species. Several distinctive marine habitats, including sea grass beds, saltpans, mangroves, coral reefs and salt marshes occur within and along these marine boundaries. The number of coral reef species in the Red sea is estimated at 300 in addition to 1 300 fish species, while that in the southern Red Sea and the Gulf of Aden is estimated to be 130 (Sheppard and others 1992). The most extensive areas of coral reefs are found along the Saudi Arabian coastline, with over 194 recorded coral species (UNEP 1997, PERSGA 2002). The Red Sea is considered a regional centre of endemic fish and invertebrates. It also hosts a unique plethora of flora and fauna such as turtles, and several endemic birds.

The Arabian Sea is home to highly productive habitats that reflect biophysical systems and endemism. Several endemic species of marine fauna, including a wide variety of invertebrates and algae as well as distinctive fish species live in this sea. The Arabian Sea also hosts coral reefs with over 57 per cent cover in selected areas and sea grass beds that provide important breeding and nursery habitats for a number of mollusc species (WWF 2006). In the ROPME Gulf Sea Area, there are numerous coral species, 31 of which are found in the marine area of Bahrain alone. These species thrive, along with some 55 coral reef fish species, in harsh environmental conditions that feature high temperatures and extreme salinity (Vousden 1985). Socotra Archipelago is called the "Galápagos of the Indian Ocean" due to its richness in species; particularly endemic ones (see Box 3).

Similarly, the Mediterranean Sea, with its small surface area (2.5 million km2) compared to world oceans, contains 8 to 9 per cent of the world's marine species. Nearly 622 species of

The Nile River as it runs through central Cairo

A promenade by boat across the Nile River as it runs through central Cairo

sponges, more than 600 fish species, 3 turtle species, 9 bird species and 12 whale species have been recorded there.

Of these Mediterranean species, about 28 per cent of the 10 000 species of recorded marine biota are endemic (Bianchi and others 1995). As for the Tunisian marine bodies, they contain 2 135 species, 69.6 per cent of which are animal species (Ministry of Environment and Sustainable Development 2007).

Driving forces and pressures

Globally, biodiversity is declining at a faster rate now than at any other time in the past (MA 2005). Biodiversity in the Arab region is no exception, and the current trend is expected to continue unless strict and concrete measures are taken to reduce biodiversity loss and protect species and their habitats from destruction (MA 2005). The current threats to biodiversity are exacerbated by the fact that they are constantly changing and that they vary from one place to another and from one country to another. However, some threats are constant. For example, the degradation resulting from urban, agricultural and industrial development is a major cause of biodiversity decline in all countries across the region. Specifically, overgrazing, overutilization of land and water resources, commercial exploitation of biodiversity resources and over-population are common sources of biodiversity loss throughout all of the Arab countries. Pollution, domestic sewage, industrial waste, pesticides and fertilizers particularly in Algeria, Egypt and Tunisia, also exert additional pressures on biodiversity (UNEP-MAP 2002). Furthermore, the diversion of water supplies for economic development has become an important driver of biodiversity loss in a number of countries like Egypt, Jordan, Lebanon, Somalia, Sudan and Syria.

Box 3. Socotra Archipelago the "Galápagos of the Indian Ocean"

The Socotra Archipelago is located in the north-western Indian Ocean, 450 km south of the southern coast of Yemen. It is made up of four islands, three small ones as well as the main island Socotra (3 625 km2). The topography of Socotra is diverse, ranging from coastal plains to high mountains (1 525 m) while the climate is tropical with seasonal Monsoon rains and winds.

The Shag in Socotra Island : one of the birds threatened with extinction

With nearly 34.3 per cent of its species being endemic, the Socotra Archipelago is considered a unique ecosystem off the shore of Yemen. It is an ecosystem with great global ecological value for biodiversity conservation. Nearly 37 per cent of its plant species are endemic as well as 90 per cent of its reptiles. The island is home to a number of endemic bird species (7) and sub-species (12) which represent 3.2 per cent of the total number of birds on the island. Furthermore, with over 22 Important Bird Areas (IBAs), the island is also a breeding site for many other migrating species. Although the Archipelago is less famous for its marine biodiversity, preliminary studies indicate the presence of 253 coral species, 730 coastal fish species and 300 benthic species like crab, lobster and shrimp.

The isolation of Socotra Archipelago and the customs and traditions of its inhabitants played a major role in biodiversity conservation and finding a balance between nature and human beings. However, biodiversity is currently threatened by pressures like road building and overgrazing of some species. Increased demand for timber and non-wooden products led to the threatening of some important species such as Maerua angolensis, Metaporana obtusa, and Cephalocroton socotranus. Some fish species are also endangered as a result of traditional and commercial overfishing. Oil mining activities in the neighbouring coastal areas, development projects, inland transportation in Yemen, tourism, in addition to IASs are among the potential future threats to Biodiversity in the islands unless severe measures are undertaken in monitoring and rehabilitation.

In 2008, UNESCO declared the island a global traditional site. The Yemeni government, in cooperation with international organizations, set up a number of projects aimed at conserving biodiversity and improving the livelihoods of Socotra Archipelago's dwellers (44 000).

SCDP undated, UNESCO 2008

Food security is another major issue related to biodiversity loss. The attrition of genetic resources of native species, such as local wheat varieties in Syria and Jordan, jeopardizes food security and reduces the opportunity to benefit from these resources (Charkasi 2000). For the purpose of improving food security, genetically modified organisms (GMOs) have been exposed to experiments in some Arab countries and may be introduced into certain commercial markets in the near future. However, GMOs and their products may be of concern to biodiversity and human health as the list of transgenic crops and their associated products continues to grow despite a lack of understanding of their consequences.

Although the quantitative record of biodiversity decline is lacking in many respects, the underlying causes – population increase, socio-economic, scientific and technological developments – are obvious. At the policy level, the following list illustrates the major direct and indirect causes of biodiversity decline in the Arab region:

- High population growth rates and the resulting imbalance between production and consumption. Production and consumption have direct and indirect effects on the reduction of biodiversity through the over-harvesting of animal and plant crops, unsustainable mining of natural resources, oil extraction, bio-fuel farming, and land clearance. As a result of this imbalance, the carrying capacity of ecosystems will exceed, thus creating an ecological deficit.
- The increasingly narrow spectrum of traded products in the agriculture, forestry and fishery sectors. This results in favouring only certain crop-raising techniques and only particular resource uses for soil, water and crops; thus encouraging monoculture while neglecting other non-favoured species.
- Failure to account for the economic value of environmental and natural resource services within economic systems, leading to insufficient protective and regulative policies.
- Inequity in the ownership, management and flow of benefits derived from both the use and conservation of biological resources.
- Lack of knowledge about the nature and functions of ecosystems and, consequently, the failure to recognize the tipping points of the ecosystems and the interconnections between their components.
- Inadequate legal and institutional systems, leading to unsustainable exploitation of biodiversity resources.

Moreover, the mismanagement of natural resources, rural poverty and disputes over resources, have generated additional pressures on biodiversity resources. The growing influence of the sportive safari, combined with expanding tourism facilities opening in pristine and remote areas, and the unprecedented infrastructure development in these areas contributed to the erosion of traditional norms and values. This has led to the destruction of much of the biodiversity heritage of Arab countries, including the various uses of medicinal plants, trees and shrubs, in addition to hunting techniques.

Habitat degradation and loss

Habitat degradation is usually caused by a variety of factors, including natural and human-induced causes. In Arab countries, changes in land-use and the physical modification of habitats are the main causes of habitat degradation and loss. The destruction of wetlands, forest areas, and rangelands is impacting terrestrial habitats across the region. Although habitat degradation has been taking place for thousands of years, the process has been accelerating rapidly during the past thirty years due to the unprecedented and exceptionally high rates of economic and industrial development activities along with population expansion in most countries in the region. Frequent extreme weather events such as persistent droughts or floods can also significantly alter habitat structure, consequently modifying biota relationship and disrupting ecosystem functioning.

Food self-sufficiency policies, coupled with the mismanagement of natural resources, have resulted in the conversion of marginal, often

The impacts of groundwater depletion and overgrazing on the local ecological system of Prosopis cineraria in the eastern desert of north Oman.

arid lands into irrigated intensive agricultural lands. Moreover, the ploughing of rangelands and the reclamation of deserts contributed to the destruction of flora and fauna in these areas. These practices, along with improper management of reclaimed arid soils, have strained water resources and caused land salinity, negatively affecting terrestrial and fresh water biodiversity.

Wetlands in many Arab countries are under severe man-induced pressure due to their significance to local populations as well as easy accessibility. The depletion of groundwater supplies in many countries has led to the deterioration and loss of water springs and wetlands, as well as their associated biota. In Jordan, for instance, groundwater extraction for urban needs has led to the deterioration and drying up of the Azraq wetlands (Fariz and Hatough-Bouran 1998). As a consequence, tourism in Azraq has declined.

Oases agricultural systems have also been degraded in eastern Saudi Arabia, Bahrain and several parts of Arab countries. Many of the date palm oases and natural freshwater springs have been lost in the past three decades due to over-pumping, diverting water for urban use and the transformation of these ecosystems for other purposes (see Chapter 2) (Bundy and others 1989). Similar situations exist in other wetlands, like marshlands in Iraq, where for example, land reclamations and drainage projects have caused a loss of 90 per cent of the once 20 000 km2 marshlands; thus, negatively affecting fauna and flora and the living conditions of local people (UNEP 2001). Irrigation projects and other ventures aimed at extending water outside its natural trajectory contribute to habitat degradation and decline of species. An illustration of this is the Jordanian experience in the1960s following the establishment of the Qatari -Israeli water

Palestinian researcher Omar Attoum while conducting an experiment for the conservation of wild turtles threatened with extinction in Al Zaraneek Protected Area, Egypt

carrier which restricted the flow of Lake Tiberias water in the Jordan River, adversely affecting its ecosystem.

Forest ecosystems are being degraded and decreasing in size due to the clearing of land for agriculture, village expansion and wild fires (FAO 2005). This decline, along with the mismanagement of remaining forest resources, has contributed to the additional degradation of forests, leading to habitat destruction and jeopardizing species survival. For example, the loss of Algerian forests in the last ten years has nearly tripled, from 8 000 to 25 000 ha per annum, due to fires which potentially threaten 1 300 plant species (SCBD undated). Similar situations took place in the Mashriq, where major forest fires claimed thousands of hectares of forests in Lebanon and Syria over the last four years, further threatening existing flora and fauna (AFP 2004).

In North African countries and Sudan, where the largest forest areas exist, forest coverage declined annually by 0.69 per cent between the years 2000–2005, compared to the average global decline of 0.18 per cent (FAO 2007). At the country level, the picture is varied. However, forests within the Mashriq and the Arabian Peninsula countries reflected a mixture of increases and decreases in area due to some reforestation and the updating of forest inventories (FAO 2007).

Climate change, which is manifested in heat waves, frequent droughts and temporal shifts in precipitation patterns and quantities, is blamed for the die-back and decline of juniper forests in the Arabian Peninsula, especially at lower altitudes (Gardner and Fisher 1996). Similarly, juniper forests in Jebel-Al-Akhdar in Libya are showing signs of stress. The decline of these forests threatens the survival of coexisting species as changes in microclimate take place (Zaied 2005).

The overall situation of rangelands does not differ much from that of forests. Rangelands have been subjected to heavy use and a change in species composition. In Saudi Arabia, rangeland deterioration – due to land conversion, overgrazing, off-road vehicle driving and fuelwood collection – has led to a decline in productivity and a gradual decrease in perennial species (Mirreh 2005, Al-Rowaily 1999). In Oman, large areas of rangelands have been turned to agricultural and housing developments since 1970, reducing the native tree cover and rangeland species (Directorate-General of Natural Reserves 1997). Similarly, within the Maghreb countries, rangelands have decreased by 10 per cent in Morocco and Tunisia and by 14 per cent in Algeria between 1970 and 1990 (Abdelguerfi and Laouar 2000). The environmental consequences of rangeland degradation far exceed the loss in meat production generally associated with rangelands, since they also generate negative externalities such as the loss of wild fauna and flora and hamper rangeland ecosystem capacity to provide goods and services (Dutilly-Diane 2006) (see Chapter 3).

Coastal and marine biodiversity are also showing signs of stress, particularly in the most developed areas along the coasts of the Arab region. Coastal developments, which are associated with dredging and infilling operations, represent one of the greatest threats to coastal biodiversity. This is evident in the Regional Organization for the Protection of the Marine Environment (ROPME) Sea Area, as more than 40 per cent of the ROPME countries' coastlines have been developed in the last twenty years (Price and Robinson 1993). The trend is ongoing and intensifying as new areas are made available for planning and many resorts and residential towns are being developed along the coast, putting more pressure on natural habitats, fisheries and water resources. For instance, the coastal zone in Bahrain has increased by around 40 km2 in less than 20 years (ROPME 2004). In Saudi Arabia, about 40 per cent of its eastern coastline was reclaimed and almost 50 per cent of its mangroves were lost (Sheppard and Others 1992). In a similar way, the coastal development of artificial islands on the coast of Dubai (UAE) will increase Dubai's shoreline by 120 km. This trend is affecting pristine areas and disturbing valuable habitats. Coastal development operations are also present along the Red Sea in the form of dredging and land filling operations associated with urban expansion, industrial development and tourism. This applies to Egypt, Jordan, Saudi Arabia, Sudan and Yemen (UNEP/PERSGA 1997, Shaalan 2005, Medio and others 1997).

Coastal and marine pollution is the second major cause of the physical alteration of habitats in the GCC countries where a great deal of oil exploration, transport and the establishment of mega projects take place. Each of these activities contributes significantly to the direct and indirect discharge of pollutants into coastal and marine environments. In the Mediterranean Sea, major sources of industrial pollution come from European coastlines. The major sources of pollution from Arab countries along the eastern and southern coasts of the sea are oil tankers, organic loads, oil and gas spills, and heavy metal contamination resulting from the discharge of domestic and industrial pollutants into the sea (Danovaro 2003).

Urban wastewater is another major pollutant and is discharged into the sea from major cities in many countries including Lebanon and Syria (UNEP-MAP 2003a, UNEP-MAP 2003b, MoE and UNEP-MAP 2005, EEA and UNEP-MAP 2006). This wastewater disturbs and degrades coastal and marine habitats. As a result, and in combination with other supporting factors, a number of marine species, like the Mediterranean Monk Seal, as well as other biota of the sea like red coral, sea turtles and some sea birds, are endangered. Cases of fish, tortoises, whales, and dolphin deaths due to pollution have been reported in marine areas in most Arab countries.

Overexploitation of fish stocks is of concern to national authorities as well. For example, overfishing by using dynamite, toxics and

The Wild Cow Protected Area, chosen by UNESCO in 1994 as one of the global natural heritage sites, Sultanate of Oman

electric shocks is one of the causes of habitat degradation and biodiversity decline in marine or fresh water environments in several countries, such as the Comoros Islands (UNEP 1999). Furthermore, in the Mediterranean, nearly 1.5 million tonnes of fish are caught each year. Many species, such as tuna and swordfish are overexploited. In addition, destructive, unsustainable, and often illegal fishing has depleted some fish stocks in the Red Sea. For example, the catch of lobsters and strombidae is declining and the cuttlefish stocks in major fishing grounds have completely collapsed (PERSGA 2002).

Climate change is believed to be a major emerging issue affecting marine biodiversity, especially among coral reefs. Coral bleaching and coral erosion may increase due to rising seawater temperature, which in turn may affect coral fish stocks. Increases in water temperature have already caused up to 100 per cent of coral bleaching in some locations (Al-Qaseer and Uwate 2000). It was reported that reefs off of Bahrain's marine area have recently experienced major coral bleaching on two occasions (Pilcher and others 2000). These changes threaten both biodiversity and the livelihoods of fishermen. The potential effects of sea-level rise, another impact of climate change, on corals have not yet been regionally assessed and it is quite difficult to quantify in the long-term.

Species decline and loss

Populations of certain species, especially large mammals, have declined in the last 100 years in the Arab region as a result of habitat degradation and overhunting. For example, both the Asian Lion (Panthera Leo persicus) and the Ostrich (Struthio camelus syriacus) became extinct in the wild due to overhunting. Furthermore, after becoming extinct in the western desert in Egypt, the Cheetah disappeared from north eastern

NASA

The National Park in Sidi Al Towi, Tunisia; established in 1993 to combat desertification. It contains a plethora of fauna and flora adapted to arid areas

Africa at an early period in time. In Somalia, the Beisa Oryx and Gerenuk have become locally extinct (IUCN 2000). Currently, pressure on particular species is still mounting, thereby endangering their survival. The total number of known animal species in Arab countries is 13 164, five per cent of which are threatened with extinction (World Bank 2007). The number of bird and reptile species threatened with extinction doubled between 2002 and 2006, and the number of threatened fish species increased by 14 times (World Bank 2007). In Yemen, for instance, of the 250 endemic species of plants found in the Socotra islands, 34 per cent are considered near extinction (Ministry of Water and Environment – Environment Protection Agency 2005). Meanwhile, in Oman, according to available information, there are 136 threatened plant species in addition to 46 per cent of the endemic species in the south (Ministry of Environment and Climatic Affairs 2001). In Jordan, Pterocles alchata, Fulica atra, Ammoperdix heyi, Chlamydotis undulata, Falco peregrinus, Gyps fulvus, Francolinus francolinus, Alectoris chukar, Burhinus oedicnemus and Anas platyrhynchos are rare bird species threatened with extinction (Ministry of Environment, Jordan 2008). Similar cases exist in the Maghreb countries, where the Rhim (Gazella leptoceros) and the Cuvier's Gazelle (Gazella cuvieri) are considered endangered throughout their natural range in Algeria, Morocco and Tunisia (IUCN 2007).

Presently, some species are confined to a small section of their original range while others are restricted to isolated areas. For instance, although wild goats (Capra ibex) and gazelles (Gazella gazella, G. dorcas and G. subgutturosa) are still present in the Mashriq countries, they have been quite restricted in range and reduced in numbers in the wildlife. The leopard, formerly widespread in the Mashriq, persists now in a few isolated and protected areas in the mountains of the Arabian Peninsula (Cat Specialist Group 2002, Judas and others 2006). Other species, like the Arabian Oryx (Oryx leucoryx), were locally extinct although they have been successfully reintroduced in a number of Arab countries by using captive stock. Similarly, birds like the Houbara bustards (Chlamydotis undulata) now spend their winters in Saudi Arabia in fewer numbers.

Wild species of medicinal and herbal plants are also becoming either rare or endangered due to the ongoing destruction of their natural habitat, overharvesting, unfavourable climatic conditions and land-use changes (Azaizeh and others 2006). For instance, wild saffron plants (Crocus hermoneus and Origanum syriacum) are confined to a small area of their natural range in Jordan, while vascular plants like Daucus jordanicus and Capparis decidua are becoming either rare or endangered (Al-Eisawi 1998, GCPE 1998). Similarly, 900 plant species were in existence in the Jebal El-Arab Mountain of southern Syria in 1953. However, inventory missions carried out between 1996 and 2000 found only 512 of these species in the area. This represents a loss of over 50 per cent of these plant species over the last fifty years. This loss is attributed to growing urbanization, the clearing of vegetation cover, overgrazing, agriculture, and mismanagement of plant resources (El-Beltagy 2003).

In Libya, out of 1 776 known plants, there are 50 species that are rare or threatened with extinction (The General Environment Authority 2008). In Morocco, some forage species like Phalaris aquatica are experiencing genetic erosion, or the reduction of certain traits leading to the genetic simplification of a species (Tazi and others 1999). As for the Mashriq, valuable rangeland species of the

Breeding the Capra ibex under captivity in preparation for introducing it in Abu Hadma Protected Area, Tunisia.

Syrian steppe such as Dactylis glomerata, Oryzopsis spp., Hordeum bulbosum, Aristida spp. and Stipa barbata, have been replaced throughout their natural range by less palatable plants of very low forage value (Sankary 1993, Diaz 1980). It is presumed that if this trend continues, a significant number of species will disappear within the next decade, particularly in arid areas, where almost one-third of native plants in the Arab region are found.

Marine species are experiencing a similar loss due to habitat alteration, degradation and destruction. The percentage of coral reefs at risk in the Arab region varies from 32 per cent in Sudan to 100 per cent in Djibouti (Reef Base 2007). In the ROPME Sea Area, about 20 000 km2 of coral reefs, making up 7.9 per cent of the world's total area of corals, have been exposed to bleaching from increases in seawater temperature. Moreover, mortality reached 90 per cent in some species (ROPME 2004, Sheppard 2003). The bleaching of coral reefs has also been reported in Egypt in 2007 (EEAA 2007).

The decline in the number of Paeonea muscula in Al Arz (Cedar) and Al Shouh Protected Areas, Syria

In the Arab region, the number of threatened species has reached 1 084. Fish are the most affected, making up 24 per cent thereof, followed by birds at 22 per cent, and mammals at 20 per cent. (IUCN/WCPA 2008) (see Figure 1).

Invasive Alien Species

Invasive alien species (IAS) are non-native organisms that cause, or have the potential to cause, harm to the environment, economy, or human health (IUCN/SSC/ISSG 2008). Invasive alien species are further defined as species, sub-species, or lower taxon occurring outside of their natural range that might survive and subsequently reproduce (IUCN/SSC/ISSG 2000). Generally speaking, IASs are usually introduced to new environments as a result of trade associated with globalization. A native species may be classified as invasive once it becomes out of control, or in other words, when it escapes from its natural habitat or range and becomes widespread. Now, around 100 species belonging to different taxa are classified as the worst species ever.

The problem of invasive species is growing in a number of Arab countries and may be one of the emerging issues threatening biodiversity in the region. A total of 551 invasive species have been reported in Arab countries (IUCN/SSC/ISSG 2008). Thirty-five per cent of these species are classified as alien whereas nearly 51 per cent are native, while the bio-status of a total of 75 species is yet to be identified (IUCN/SSC/ISSG 2000) (see Figure 2).

The data released by the UN Food and Agricultural Organization (FAO) on the integrity of forests and alien species in the Near East referred to the existence of several invasive species (FAO 2009a). For example, in Morocco, Leucaena leucocephala, Phoenix canariensis and Prosopis sp. are considered invasive. The same applies to Populus Alba in Tunisia and Ziziphus Mauritiana in Syria. Officials in the field of water environment in Egypt regard Procambarus clarkii as one of the most invasive widespread species in the Egyptian water environment that has significant adverse economic and environmental impacts (EEAA 2007).

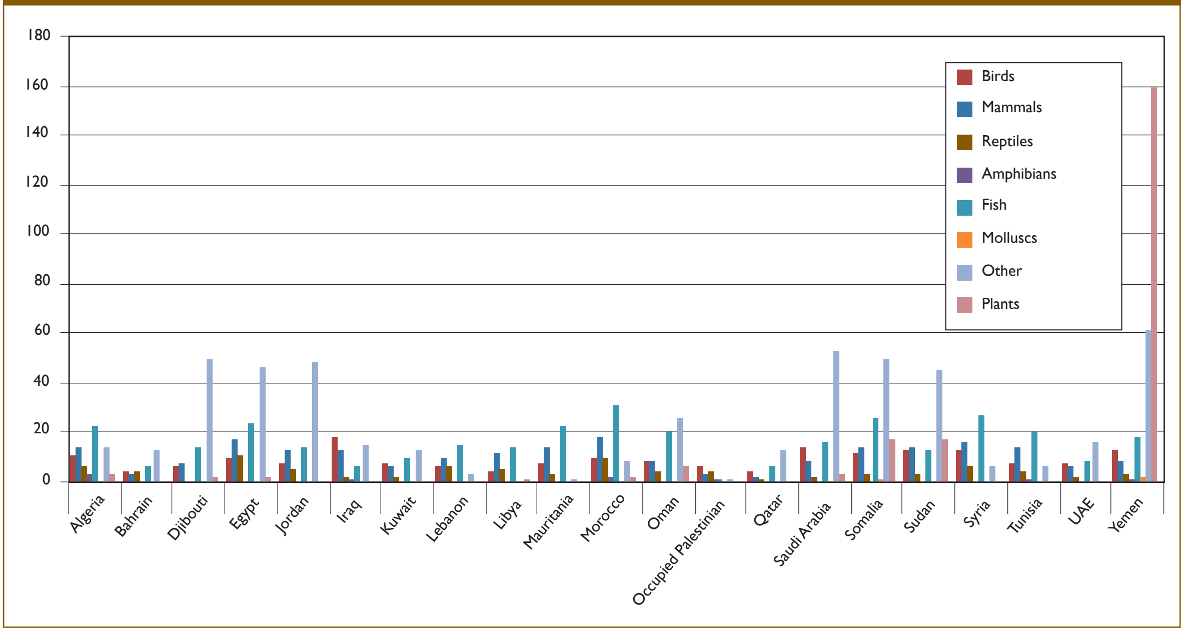
Invasive alien species are a major threat to native fauna and flora as well as natural ecosystems and their products, causing serious damage to several areas such as palm weevils (Rhynchphorus ferrugineus). Moreover, estimations indicate that the total area infected by the Water Hyacinth (Eichhornia Crassipes) in Egypt amounted to 487 km2 covering most of irrigation and drainage canals in various governorates in addition to nearly 151 km2 covering lakes. This has adverse effects as it causes severe problems to various species in water surfaces. The Water Hyacinth (Eichhornia Crassipes) results in water losses estimated at approximately 3 500 million cubic metres/annum through transpiration. This quantity is sufficient for the irrigation of around 432 km2 annually (EEAA 2007). Another example, Prosopis juliflora, which is in abundance in the United Arab Emirates, results in a significant decline in the biodiversity of the plant communities it invades, as the density of its accompanying herbaceous species decreases by around 50 per cent (El Keblawy and Al Rawai 2007).

The invasive alien species database includes a number of species found on a wide-scale in Arab countries such as the Corvus splendens which is found in abundance in all the GCCs, and other countries like Yemen, Djibouti, Egypt and Morocco. Moreover, the weed species of Solanum elaeagnifolium Cav. # SOE is now recognized as an invasive alien plant species in the agricultural fields of Algeria, Egypt, Morocco, Syria, and Tunisia (Mekki 2005, Al Mouemar 2005). Additionally, some species of Prosopis juliflora invaded GCC countries, Iraq, Egypt, Libya, Tunisia, Sudan, and Mauritania. Various reports indicate that 170 alien species have been recorded in the Egyptian environment.

Marine invasive alien species, carried into the Arabian Gulf in the ballast water of large cargo ships, are of concern to authorities in the region as they may have a significant impact on biodiversity in the ROPME Sea Area (ROPME 1999). In Mashriq countries, about 400 taxa of phytoplankton have been recorded both in and offshore of Lebanese seawaters since 1970. About 10 per cent of these species are considered to be invasive or lessepsian migrants (Lakkis 2003). Of the 296 alien species along the Mediterranean coast till Gaza, 96 per cent have been introduced into the Sea from the Suez Canal (Galil 2007). A report on the state of the environment in Egypt for 2007 indicated that 110 invasive species have been recorded in various Egyptian environments (EEAA 2008).

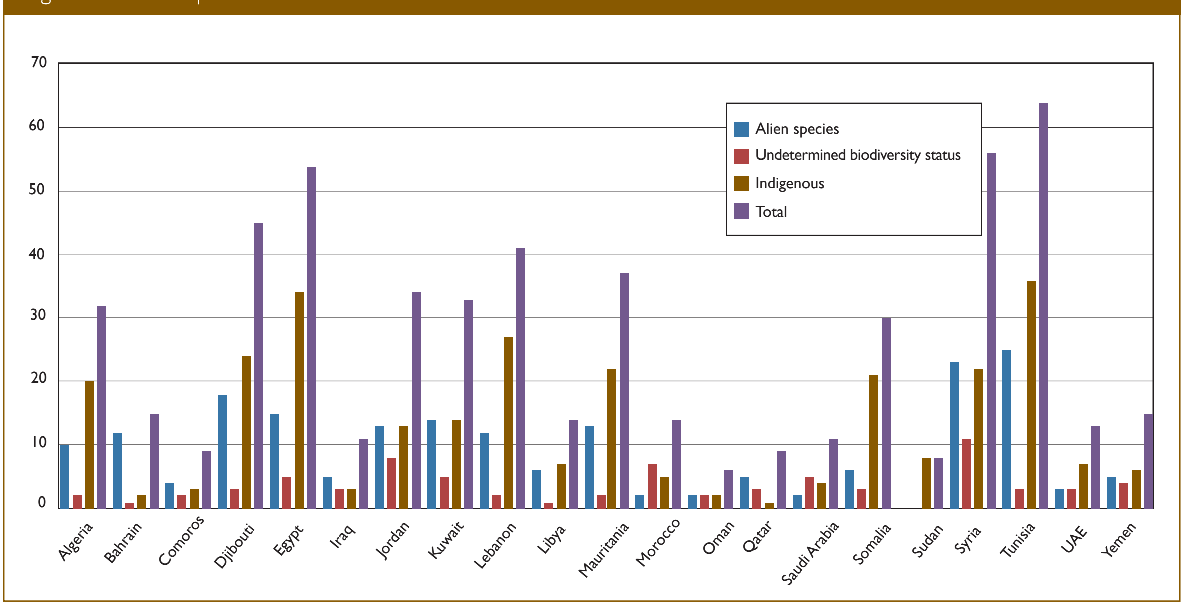
With few exceptions, the issue of IAS hardly ever gets the attention of national authorities or policy-makers in Arab countries, mainly because of the ambiguity of the problem, the inadequate scientific knowledge related to it, uncertainty of its impacts, in addition to the shortage of financial and technological capabilities. Accordingly, it is still mainly confined to the scientific community and narrow government circles. Nevertheless, IAS are among the most important considerations for biodiversity conservation as they may be responsible for the decline in naturally occurring species and may also harm ecosystems and

Figure 1. The number of threatened species in some Arab countries



IUCN/WCPA 2008

Figure 2. Invasive species in Arab countries



IUCN/SSC/ISSG 2000

human health. Major international initiatives are underway to highlight this issue and to carry out scientific assessments that help create better technical measures and policies to manage the problem. This is accomplished through international programmes including the CBD Invasive Alien Species Programme.

Biodiversity conservation efforts

Concern for biodiversity conservation has been deeply rooted in the Arab region and within Arab cultures from their earliest history onwards. This is witnessed by the Hema system of rangelands, strictly applied in various parts of Arab countries before the emergence of Islam

Biodiversity conservation: nature for the sake of human beings

and until the second half of the 20th century. The Ghuta orchards of Damascus, which existed during the Omayyad period; the forest reserve protected within Medieval Egypt; and the oases of Morocco and Andalusia, are additional examples of traditional biodiversity conservation in the region.

However, the breakdown of traditional systems of resource management has had a major impact on biodiversity. For example, the traditional Hema system, which facilitated the sustainable use of rangelands and other natural resources by setting aside large reserves during times of stress, was abandoned in the 1960s in both the Arabian Peninsula and Mashriq countries (Abu-Zinada and Child 1991, Daraz 1985). As a result, while 3 000 Hema reserves existed in Saudi Arabia in 1969, only 71 were in existence under various degrees of protection in 1984 and only 9 were on the 1997 List of Protected Areas (IUCN/WCPA 2008) (see Chapter 3).

The political will for biodiversity conservation exists today in Arab countries. Several examples demonstrate this will throughout the region. Protected areas have been created in Arab countries like Algeria, Morocco, Sudan and Tunisia in the 1920s. Programmes for the captive breeding of threatened species have operated since the 1980s, with re-introduction programmes for the Arabian Oryx, Houbara bustard and some gazelle species in Jordan, Oman, Saudi Arabia and Syria (Massolo and others 2008). Most countries of the region have become parties to the Convention on Biological Diversity (CBD), Cartagena Bio-safety Protocol, and other related conventions such as the International Treaty on Plant Genetic Resources for Food and Agriculture, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Migratory Species (CMS) and the RAMSAR Convention on Wetlands (see Table 1), in addition to several other regional conventions.

There are ongoing schemes to establish protected areas all over the region. Many of these schemes have already proven successful as the countries of the region currently have over 150 protected terrestrial areas and 24 biosphere reserves, according to the Classification of the World Nature Conservation Federation. These reserves exist in 11 Arab countries and cover a total area of 12 733 710 ha, of which Tassili N'Ajjer in Algeria takes up 65.54 per cent of the total area of biosphere reserves in the Arab region (UNESCO-MAP 1987). There are also

Table 1. Arab countries parties to CBD, Cartagena Bio-safety Protocol, International Treaty on Plant Genetic Resources, CITES, CMS and Ramsar conventions

Country/Convention	CBD	Cartagena biosafety protocol	International treaty on Plant Genetic Resources	CITES	CMS	Ramsar
Jordan	X	X	X	X	X	X
UAE	X	-	X	X	-	X
Bahrain	X	-	-	-	-	X
Tunisia	X	X	X	X	X	X
Algeria	X	X	X	X	X	X
Djibouti	X	X	X	X	X	X
Saudi Arabia	X	X	X	X	X	-
Sudan	X	X	X	X	-	X
Syria	X	X	X	X	X	X
Somalia	-	-	-	X	X	-
Iraq	X	-	-	-	-	X
Oman	X	X	X	X	-	-
Qatar	X	X	X	X	-	-
Comoros Island	X	X	-	X	-	X
Kuwait	X	-	X	X	-	-
Lebanon	X	-	X	-	-	X
Libya	X	X	X	X	X	X
Egypt	X	X	X	X	X	X
Morocco	X	-	X	X	X	X
Mauritania	X	X	X	X	X	X
Yemen	X	X	X	X	X	X

SCBD 2009, CITES Secretariat 2009, CMS 2009 and Ramsar Convention Secretariat 2009, FAO 2009b

Several Arab states are implementing projects to conserve medicinal plants

113 protected wetland areas in the region, 42 of which lie in Algeria, and are of international importance in addition to 24 in Morocco, 3 in the Comoros Islands, and one in each of the United Arab Emirates, Jordan, Djibouti, Iraq, Syria and Yemen (Ramsar Convention Secretariat 2009). Moreover, the number of Tunisian protected areas recorded in RAMSAR's list reached 20 (Ministry of Environment and Sustainable Development 2007). Furthermore, there have been increases in the total number of international marine and terrestrial protected sites in West Asian Arab countries, from 120 in 1970 to 231 in 2007, creating a total of 87 863 902 ha of protected areas. The total number of protected sites also increased in North African countries, from 54 in 1970 to 130 in 2007, totalling 53 154 609 ha (UNEP 2007).

At the country level, Saudi Arabia announced the presence of 16 protectorates with a total area of 71 782 km2and in Egypt, the protected sites reached 27, representing 15 per cent of the total area of the country (NCWCD 2008, EEAA 2008). Furthermore, Algeria has declared 24 per cent of its total land area as protected, whereas the total protected land area barely exceeds 6 per cent in Jordan, Oman and Sudan. Certain Arab countries comprise other forms of protected sites, which fall under the category of nationally-declared protected areas or ecosystems. However, in the Arab region as a whole, less than 5 per cent of the total land area has been officially protected, which is below the world standard of 10 per cent (UNEP 2008). Nevertheless, some countries intend to increase their protected areas to more than 15 per cent within the next decade. In this respect, the role of the protected areas in protecting the unique ecosystems should be consolidated, in addition to enacting its guiding mission in managing ecological systems. This is accomplished through achieving administrative and financial sustainability of these units.

Among the most significant achievements regarding biodiversity conservation is the restoration of the Mesopotamian Marshlands of Iraq after being almost dried off (despite the shortage of water in the area as a result of the scarcity of the river water that feeds it), the preservation of local wheat varieties in Jordan and Syria, and the expansion of protected areas (Charkasi 2000, ICARDA 2002, 2004, UNEP 2003, Iraqi Ministry of Environment 2004). Furthermore, the creation of large water impoundments in Iraq, Jordan and Syria have provided new habitat opportunities for resident and migrating species, especially avian, off-setting the negative impacts of natural wetland destruction.

Arab countries are aiming to meet Millennium Development Goal (MDG) 7 to ensure environmental sustainability and most of them

Box 4. Protected area status and trends reporting: Morocco

Morocco contains 39 defined ecosystems, many of which fall under the 92 per cent of

Morocco's total land area that is classified as 'dry lands'. Morocco also comprises 40 000 km2 of protected areas, representing approximately 9 per cent of its total area. A 1996 National Study on Protected Areas identified 160 sites of biological and ecological interest in addition to 10 national parks that represent all of the Moroccan ecosystems. Furthermore, in 2004, a national workshop on Important Plant Areas (IPAs) identified 57 IPAs, and included recommendations for their protection. The workshop also reported an increase in protected areas from 14 450 km2 in 1990 to 47 950 km2 in 2004.

Morocco's Clearing House Mechanism, a web-based database for exchanging information on biological diversity, centralizes reports and data from 10 national agencies and ministries, national research institutes and two NGOs. It provides information on the status and trends of Morocco's biodiversity including ecosystems, flora and fauna, endemic and threatened species, genetic diversity as well as agro-biodiversity. The Clearing House also makes available a list of categorized protected areas as well as the hosted endemic and threatened species and the threats facing them.

SCBD undated b

have already prepared road maps to this effect (UN undated). In addition to the national strategies previously formulated for conservation of biodiversity as well as the related enforced legislation and regulations, achieving a significant reduction in biodiversity loss is inevitable. It necessitates accelerating efforts and paving the way for achieving environmental objectives, which require the scaling up of biodiversity measures from the local to the national level as well as integrating biodiversity into national planning.

Raghadan Park in Al Baha, Saudi Arabia

Conservation programmes need to be adapted to specifically tackle GMOs, species and ecosystem diversity. Both in-situ (protection of species and their genetic resources within ecosystems) and ex-situ (protection of species and their genetic resources outside their natural range of distribution) conservation should be utilized in conservation programmes.

Information exchange among Arab countries will significantly aid in biodiversity conservation. This exchange of information has progressed significantly during the last five years due to the Clearing House Mechanism Programme adopted by the CBD conference of parties. A significant number of the CBD Clearing House Mechanisms (CHMs) are in operation, providing various sources of information about the status and trends of biodiversity and the general policies and programmes carried out in each country relevant to conservation and sustainable use. Currently, CHMs exist in Egypt, Lebanon, Morocco, and Saudi Arabia in addition to other programmes that facilitate exchange of information (see Box 4).

Challenges and opportunities

The lack of peace and security in many parts of the Arab region is considered a major constraint to biodiversity conservation. This is due in part

The Yemeni Chameleon or the veiled Chameleon is a big reptile found in the mountainous areas in Yemen, Oman, Saudi Arabia and the U.A.E.

to the transfer of resources to sectors other than nature conservation, some of which directly harm nature conservation efforts. Other factors that hinder biodiversity conservation are the unsustainable use of biodiversity, depletion of marine wealth, changes in land-use patterns, weak productivity, in addition to the aggravation of the invasive alien species (IAS) issue. Biodiversity conservation efforts are also impeded by water scarcity, poverty and the weak enforcement of laws and regulations. Consequently, reduction of biodiversity loss, to meet the Millennium Development Goal (MDG) 7 which was adopted by the CBD six-party conference, is doubtful unless significant changes take place at the macro-economic level in Arab countries.

Efforts are underway to achieve a breakthrough in biodiversity conservation, but a lot of challenges are still on the way. Successful implementation of the CBD in Arab countries, (according to its programme of action) particularly after 2010, requires an integrated approach that can strike a balance between biodiversity conservation and economic development at the national level. Nevertheless, setting strategies and action plans at the regional level, in cooperation with various organizations in the Arab region, will complement and strengthen national efforts. Consequently, formulating a common strategy for biodiversity conservation and the sustainable use of its resources, as well as the equitable sharing of the multiple benefits of its genetic resources, is an overarching priority and an opportunity that should be seized in the Arab region. In this respect, an Arab strategy should be developed to assess the status of biodiversity and contribute to the conservation and sustainable use of its components. This strategy should be based on implementation of a realistic framework that relies on experiences and capacity to achieve objectives. A major element of this strategy should be building partnerships with and among stakeholders, including the private sector, creating new opportunities for conservation initiatives, sharing biodiversity benefits as well as making sustainable use of its components. It could also benefit from an international policy framework environment that supports national and regional biodiversity programmes.

Additionally, mainstreaming biodiversity into the national planning process is of utmost importance to achieving sustainable development in biodiversity and its related cross-cutting issues. Furthermore, people and national institutions should be empowered to better manage biodiversity and ecosystem services in order to effectively conserve biodiversity resources. This requires an enabling framework that ensures integration between ecosystems and development at the national and regional levels in a way that realizes balance between available resources and people's needs. It is also necessary to turn weak economic factors to points of strength to further promote sustainable development in order to provide job opportunities and alleviate poverty.

The proper management of bio-safety in the Arab region requires the adoption of an integrated approach. This approach should include building institutional capacities and developing national laws and standards to handle specific issues related to the transfer and use of genetically modified organisms (GMOs) and their products. Among the issues currently included in the international agenda are the international system for acquisition of genetic resources, the adoption of standards for identification, handling, packaging and transport of GMOs, and the equitable sharing of their benefits. Issues also comprised risk assessment, adoption of related management strategies, in addition to reaching compliance with the Cartagena Bio-safety Protocol. Arab countries will need to make a genuine effort to develop national laws and standards related to bio-safety in order to catch up with other countries and meet internationally agreed-upon standards,

Dindir Federal National Park in Sudan

to conserve biodiversity and ensure human health and safety. Within this context, Arab countries should benefit from the experience of other states in the field of enforcing bio-safety legislation, regulating access to biological resources, implementing laws and issuing guiding lists for environmental assessment.

Conclusion

The Arab region features a great variety of biodiversity resources, including various terrestrial and aquatic ecosystems, diversified habitats, several endemic species of global significance, in addition to agrobiodiversity that has been introduced by Arab farmers throughout many years. Nevertheless, biodiversity has declined due to severe pressures exerted by the development process. Over the last thirty years, overexploitation of the region's ecosystems has led to habitat loss, reduction of the number of species and the shrinkage of their natural range of distribution. Invasive alien species started to expand in Arab environments as well. Moreover, habitat degradation and loss have been rapidly accelerating during the past three decades due to the unprecedented and exceptionally high rates of economic development activities along with population expansion and severe drought incidences in most Arab countries.

Arab countries have become parties to the Convention on Biological Diversity (CBD) and other related conventions and have set national action plans for biodiversity conservation. Protectorates and species conservation programmes, in addition to enforced legislation and regulations contributed to the reduction of biodiversity threats.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Chapter 7

ATMOSPHERE

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Main messages

- Air pollution is a continuing threat to human health and socio-economic conditions; thus, it has become one of the main environmental concerns of the Arab region. Unplanned urbanization, air-polluting industries, obsolete means of transportation, and energy production through the use of fossil fuels, are all pressures leading to air pollution problems. Many cities in the Arab world are experiencing excessive air pollution with gases, particulates and aerosols at levels often exceeding the WHO guidelines. The following are the main messages of this chapter:

- Past industrial emissions have placed the Arab environment under severe pressure, particularly in relation to atmosphere and climate change. These pressures are expected to be exacerbated by increasing population growth, accompanying economic development and the failure to adopt effective mechanisms to control emissions on the global level. In light of the aforementioned, further efforts should be exerted to deal with air pollution and global climate change as well as their potential impacts on the Arab region.

- Climate change has become a serious risk and its far reaching impacts on the Arab world need to be addressed. Considerable steps need to be taken to scientifically assess the vulnerability of social, economic and ecological systems to the climate change phenomenon. It is also important to undertake adaptation measures as a strategic option, rather than waiting for available opportunities. Climate change is a major challenge facing the peoples of the Arab region. It has multiple impacts at various levels, mainly decreased precipitation, recurrent drought events, scarcity of water resources and decline in agricultural production. Relevant responses should include integration between policies tackling climate change and its framework plans, and national and regional strategies. These strategies aim at rationalizing energy consumption, increasing efficient usage, creating job opportunities for youth, in addition to eliminating poverty and unemployment within the context of sustainable development.

- Generally, Arab countries have achieved considerable progress in phasing out Chlorofluorocarbons (CFCs) and have thus contributed, along with other world states, to removing these compounds from the Ozone layer and allow it to recover. However, there are serious challenges facing all developing countries (including Arab countries) to entirely eliminate the consumption of all substances included in the lists annexed to the Montreal Protocol, and to manage undesired CFC stocks.

Introduction

This chapter attempts to address the challenges encountering Arab countries to achieve sustainable development, with special emphasis on factors impacting the atmosphere and air quality. The atmospheric and climatic conditions of the Arab region are affected by many physical factors, such as radiation processes in the desert environment, sandstorms, and industrial activities, leading to air pollution which is considered one of the most serious problems threatening human health and socio-economic welfare at the local and regional levels. In Jordan, for example, it is estimated that over 600 people die prematurely each year while another 1 000 disability cases are diagnosed annually as a result of urban air pollution (Sarraf and others 2004).

Urbanization, industrialization, transportation, and energy production from fossil fuels are all forces leading to air pollution problems. Many cities in the Arab world are experiencing excessive air pollution with gases, particulates and aerosols at levels exceeding the WHO guidelines (CEDARE and others 2001).

In the wake of growing environmental awareness and encouragement by world organizations, the Arab region has voiced concern and commitment towards global atmospheric environmental issues, and governments have started to implement legislations to support social demands for the establishment of environmentally safe habitats. National Cleaner Production Centres (NCPCs) have been established in many Arab countries, such as Morocco, Tunisia, Egypt, Lebanon, and some Gulf Cooperation Council (GCC) countries. The main objective of these centres is to reduce pollution, build capacities, raise awareness and support stakeholders.

METEOROLOGICAL CONDITIONS IN THE ARAB REGION

The climate of the Arab region is characterized by prevailing arid and semi-arid conditions. A system is described as arid when characterized by a short rainy season extending for a few months during the winter, spring or summer seasons. In the Arab region, the annual rate of evapo-transpiration (sum of evaporation and plant transpiration from the Earth's land surface to atmosphere) significantly exceeds the precipitation annual rate for a prolonged season without precipitation. Detailed rainfall records in the region show wide inter-annual and seasonal variability, changing intensities and varied lengths of rainy seasons (FAO 1999 and El-Bagouri 2001). Still, the average annual rainfall in most of the Arab region varies considerably between 50 mm to 500 mm. In very few areas, the annual rainfall may be as high as 1 000 mm.

In most Arab countries the climate is extremely hot and humid in the summer season (which can last as long as nine months) with temperatures of 50oC, and humidity of 90 per cent. This hot/humid climate requires extensive use of indoor air conditioning. The lack of precipitation and the scarcity of water resources, particularly in GCC countries, dictate the need for high desalination capacity, leading to comparatively high rates of electricity consumption and increased rates of carbon dioxide (CO2) emissions (PME 2005, Ministry of Energy 2006).

Greenhouse gas (GHG) emissions vary widely among countries in the Arab region, reflecting variability in energy consumption, levels of development, fuel mix, and climatic conditions.

During the summer season, the Middle East and most Arab countries are affected for prolonged periods by the Indian Seasonal Depression, which covers the Gulf, Egypt and all of North Africa in general, extending in some cases to Spain. The Indian Seasonal depression is a heat depression that does not extend to upper atmospheric layers, so it is not associated with rain, but only heat waves and occasional sand storms.

The prevailing wind is easterly to north-easterly or the so called "commercial wind," which crosses the Indian Ocean towards the region. Though this wind is hot, carrying water vapour from the Indian Ocean, the widespread temperature inversion associated with commercial winds prevents formation of rain clouds (the temperature inversion implies the presence of a hot air mass above another colder air mass).

During the winter seasons, the atmospheric pressure increases due to movements of very cold Siberian air masses towards the south-eastern part of the world. At the same time, a series of depressions reach most of the African Sahel, causing heavy rains ranging from 100 mm/year to 700 mm/year. In the transitory seasons, local atmospheric phenomena occur, such as sand storms in North Africa in the spring, and flash floods in the mountains around the Red Sea and adjacent areas. However, storms very rarely reach the dangerous levels of tornadoes.

Most of the Middle East is a desert and does not significantly contribute to global climate change, since there is no deforestation, and GHG emissions do not exceed 4.7 per cent of the total world emissions. Nevertheless, it is still the area most affected by climate change, with the possibility of its contribution to mitigating the impacts of climate change through changing the Albedo (defined as the relative reflection of solar radiation from the Earth's surface) of the deserts in the region. The Albedo depends on the type of the Earth's surface. It is about 35 per cent for sandy soils, 4 per cent for seawater and 13 per cent for vegetated land (IPCC 2007).

There are some indicators that herald climate change like the extremity of some of its elements. The average surface temperature in the world has increased by 0.74oC during the last hundred years (1906–2005) (IPCC

2007). In Egypt, for example, the minimum temperature has increased by 0.5oC and the night temperature by 0.61oC. On the other hand, the surface temperatures during the day increased by 0.2oC while the maximum temperature decreased by 0.1oC and the thermal range declined by 0.4oC (El Asrag 1998).

Rainfall changes have also been observed in many locations. In particular, rainfall increase has reached as much as twice the average in many locations in Saudi Arabia. Hurricane Gonu, which recently hit the Gulf coasts of Oman, with surface wind speeds as high as 250 km/h, indicates a shift in the sort of severe storms that may be expected as a result of climate change, since this level of storm was an anomaly in the ROPME Sea Area. In addition, it has been recognized that the Arab region has suffered recurrent drought incidences of varied nature, severity and impact (ElAsrag 1998).

A severe and protracted drought that menaced the African Sahel countries at the southern fringes of the region during 1968–1972 had far-reaching effects. Drought continued till the early 1980s and spread eastward threatening the whole Sudano-Sahelian belt of countries and extending from the Atlantic Ocean to the Red Sea and the Horn of Africa. By 1984, 20 African countries, including several Arab countries such as Mauritania, Libya, Sudan and Somalia were severely affected. Recurring droughts in Sudan and Somalia have had significant adverse impacts during the late 1980s, 1990s, and recent years (Wilhite and Glantz 1985, Chbouki and others 1995, Al Labban 1999 and NASA 2000).

The North African countries including Morocco, Algeria, Tunisia, and the north coastal areas of Libya have suffered frequent episodes of drought since the late 1970s. In addition, droughts in the 1980s and 1990s were recorded in Jordan, Syria, Saudi Arabia and Sudan, with alarming shortages of rainfall and serious adverse impacts on natural resources and socio-economic conditions in major parts of these countries.

Sources of the Nile, particularly in Ethiopia, have been experiencing the worst drought ever for thousands of years. Scientists attributed this to varied atmospheric processes like turbulence, climate change, El Niño and other global patterns. Further research efforts are still needed to verify the probable causes of drought in the Arab region (Wilhite and Glantz 1985, UNESCO/WMO 1985, WMO 1989 and 1990, Chbouki and others 1995, Al-Labban 1999, NASA 2000).

AIR QUALITY

Sources and driving forces

Air quality conditions in the Arab region differ widely, due to variation of pollution sources on global and local scales. Generally, there are two main sources of air pollution:

1. natural sources, such as dust and sandstorms (local or imported); and
2. anthropogenic activities, including stationary sources, such as thermal power generating plants, refineries and industrial parks, in addition to mobile sources including vehicles (local or imported).

The continued increase in population, accompanied by urban migration, has led to an increase in the severity of air quality scenarios in cities of the region. Among the hazards (anthropogenic and natural) generally affecting megacities are:

- Aerosols and pollution, sand and dust storms (SDS)

- Severe weather, heat waves, fires and earthquakes.
- Phenomena such as desertification, pollution and climate change in particular may have more profound effects.
- Interlinkage between anthropogenic and natural hazards can also produce growing impacts.

Energy generation and use

The energy sector plays a vital role in the socio-economic development at the regional and global levels. This sector relies primarily on oil and gas exports and revenues that are used to meet requirements of socio-economic growth. However, energy production and consumption in the Arab region need to be further developed and upgraded, as a great number of urban and rural dwellers in the LDCs lack access to energy services.

Energy production and consumption are among the most important factors affecting the atmosphere as they emit several gases that greatly impact air quality. In their meeting on Climate Change held in Cairo in 2007, the Council of Arab Ministers Responsible for the Environment (CAMRE) underlined the necessity of producing and consuming cleaner fuel, improving energy-use efficiency in all sectors and diversifying energy sources according to prevailing socio-economic conditions. They also highlighted the importance of expanding the utilization of cleaner production technologies and environment-friendly technologies and the adoption of economic incentives to encourage the utilization of more efficient products and make use of carbon trade and its markets.

During the last three decades, Arab development policies were inclined towards meeting requirements of socio-economic development and upgrading the efficiencies and capacities of infrastructure. In the meantime, subsidizing energy prices led to an increasing energy demand with a remarkable decline in usage efficiency. With the intention of shifting to a policy that is more economical and sustainable to the energy sector, a number of Arab countries, like Egypt, Morocco, and Jordan embarked on reconsidering their policies concerning energy and incorporating sustainability as a major part of these policies. Great attention was given to adopting programmes aimed at improving energy production and consumption as well as enhancing efficiency of consumption especially in high energy consuming industries and transportation. The following are the major features of the newly adopted policies:

- Improving means of production of renewable energy and encouraging the optimal utilization thereof. With the exception of the usage of solar and light heaters, progress in the field of renewable energy is very limited in Arab countries. However, there are several wind farms currently used in few Arab countries; namely, Egypt, Tunisia, and Morocco. Moreover, some countries, like Egypt and the United Arab Emirates, were ambitious enough to establish generating stations relying on both solar and thermal energy.
- Adopting programmes aimed at producing clean energy. In this regard, cleaner production centres play a significant role in rationalizing energy usage and following the methods of "cleaner production" in industrial operations.
- Conversion to natural gas instead of other kinds of fuel in the fields of industry and transport as long as it is possible from the technical and economic point of view.

The Arab World's production of energy has increased from 51 256 quadrillion British Thermal Units (BTUs) in 1996 to 68 022 quadrillion BTUs in 2005 (EIA 2005). Moreover, its consumption has increased by about 46 per cent during the same period from 14 309 quadrillion to 20 868 quadrillion BTUs (EIA 2005). In addition, a number of Arab countries have become among the highest per capita commercial energy consumers in the world. In Kuwait, for example, the peak power demand increased annually by about 11 per cent in 1990 and 6–8 percent in 2000 onwards. Figure 1 shows energy consumption in different Arab countries while Figure 2 illustrates total energy consumption of OAPEC countries compared to other Arab countries (OAPEC 2008).

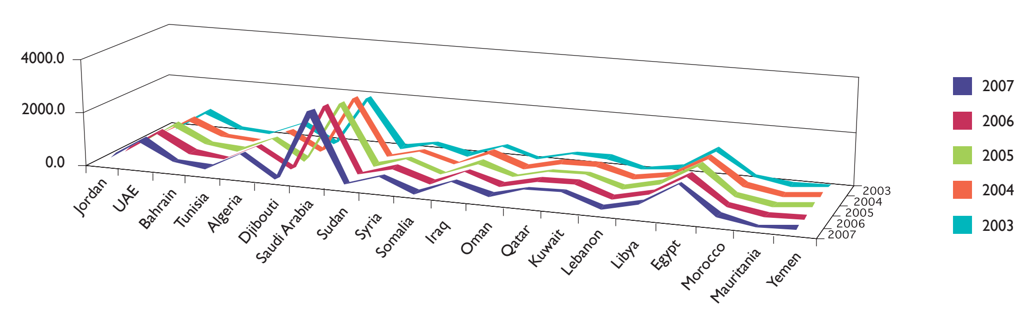
Industrial emissions

A large number of industries were developed during the 1960s in the Arab Region. Major manufacturing industries included: food, textile, petrochemical, fertilizer, cement, oil refineries, transport and mechanical, iron and aluminium industries, in addition to natural gas plants, and electricity generation. Today, most of these industries are old and highly polluting. The situation is further complicated by the lack of financial resources to modernize them to become capital intensive and high technology industries. In the Arab region, industry and power sectors are the major sources of SO2 and large contributors to NOx emissions (90 and 60 per cent, respectively). The cement and steel industries produce 50 per cent of the total particulate emissions (World Bank 1995b), and the region contributes about 2.8 per cent and 2.5 per cent of the global CFCs and methane, respectively.

Industry accounts for about 49.5 per cent of the GDP in Arab countries (LAS 2007). The contribution of the industry and power sectors is as high as 57, 53 and 47 per cent in UAE, Oman and Algeria respectively (related mostly to oil and gas), and as low as 9 per cent in Somalia and 13 per cent in the Comoros Islands (World Bank 1998).

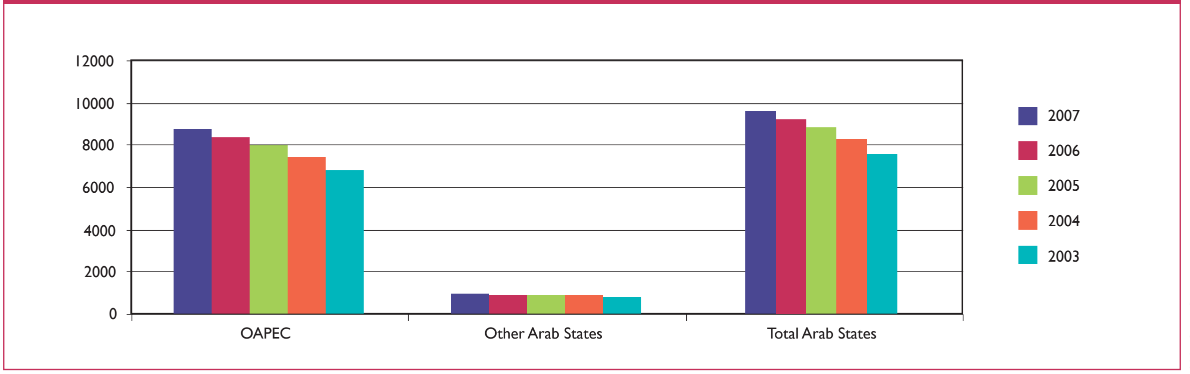
The region possesses about 57.6 per cent of the world's oil and 28 percent of its gas reserves (OAPEC 2005). It produces 29.6 per cent of the global oil and about 10.7 per cent of the world's gas (OAPEC 2005), a contribution that is expected to increase. Per capita energy consumption in the region varies significantly between oil producing and non-oil producing

Figure 1. Total energy consumption in some Arab countries (1 000 barrel of oil /day)



OAPEC 2008

Figure 2. Total energy consumption in Arab countries and OAPEC countries (1 000 barrel of oil /day)



countries. The Gulf region has witnessed significant progress in oil exploration and use, as well as oil refineries. Oil revenues have become a major source of national income where several countries have established various industrial and construction activities. Flourishing industries included: petrochemicals, fertilizers, oil refineries, chemicals and cement, iron and aluminium plants, in addition to other energy-consuming industries.

Energy exploration, exploitation and transfer led to an increase in gas emissions by 755 848 tonnes annually, of which carbon accounts for 28 per cent while sulphur and soot particulates are responsible for 27 and 23 per cent respectively (LAS/ ESCWA Undated). Energy demand is expected to increase by about 80 per cent (of the current generating capacity) by 2015 (Qader 2009 Laura 2008).

The cement industry in Morocco has become one of the principal sources of air emissions as a result of the increase in production capacity from 1 405 000 tonnes in 1970 to 3 879 000 tonnes in 1987 (Kingdom of Morocco 1992).

In Tunisia, industrial sources of air pollution are mainly from phosphate production, which is responsible for the emission of 3 800 kg/h sulphur oxides, about 600 kg/h ammonia and about 600 g/tonne of fluorides. Air emissions from the cement industry exceed the permissible limits in Tunisia (TSP * 2 g/ cm3) (Ministry of Environment and Land Use Planning 2004). In Yemen, polluting plants are restricted to a few oil refineries and power plants. As for Palestine, the main pollution-producing agents are textile factories, power stations and transportation.

Transportation systems

The level of atmospheric contamination from the transport sector depends on several factors, such as vehicle fleet size, speed, age, technology, fuel quality, vehicle kilometres travelled, and driving modes. Vehicle emissions are among the major sources of air pollution, especially, with respect to CO, CO2, VOC, NOx, SOx and fine particulates. Pollution from road transport is already high in all urban areas, whether due to the proliferation of private cars in rich countries, or the slow replacement of old and obsolete vehicles with their low fuel efficiency and poor maintenance in less-rich countries.

High dependency on old vehicles is a result of the high taxes many governments place on new vehicles, and the lack of financial resources

available to consumers. Old vehicles are prolific in some Arab countries (Egypt, Sudan, Syria and Palestine). In the GCC countries, most of the cars in use are relatively new. Vehicle proliferation, lack of emissions control, and poor monitoring and enforcement systems, exacerbate pollution problems in all Arab countries.

The transport sector (including passenger cars, buses, trucks and other transportation services) is the major consumer of energy in the Arab region. It consumes nearly 51 per cent of petroleum products and 32.1 per cent of total energy (OAPEC 2006). Vehicular transport accounts for 90 per cent of the total CO_2 emissions in Arab countries, which release an estimated 16 million tonnes/year of CO (UNEP 2003).According to 2003 statistics, the transportation sector's share of primary consumption of energy in the Arab region is about 26.3 per cent. It is one of the most significant sectors contributing to the deteriorating air quality in Arab cities and urban areas in general. There are several programmes aimed at solving the problems of the transportation sector, such as reduction of traffic jams, noise and air pollution, and the interval of time people take to travel within cities (see Chapter 5).

Motor vehicles emit 1.1 million tonnes/year of nitrogen oxides (NO_x), representing 40 per cent of total releases in the region (60 per cent emanates from the energy and industrial sectors). With 99.91 per cent dependence on petroleum products and negligible use of other cleaner technologies, the production of these emissions is primed to increase. NO_x and SO_x contribute to acid deposition in soil, vegetation and water, and cause damage to crops, forests, rangelands and fisheries. NO_x is also the precursor of fog and photochemical smog, which are increasingly observed in urban centres throughout the region (UNEP 2003).

Diesel engines are considered the major contributors of SO_2, lead and fine particulates, the latter of which are extremely small and can be easily inhaled into the respiratory system.

Egypt emits 49µg/m3 of SO_2 (compared to the WHO standard of 50µg/m3) (EEAA 2009). Chlorofluorocarbons (CFCs), found in air-conditioning systems and foams, also contribute to the depletion of the stratospheric ozone layer.

Hydrocarbons (HCs) result from incomplete fuel combustion or from evaporated unburned petrol from fuel tanks and carburettors. In Arab countries, vehicles emit 3 million tonnes/year of HC; the best known kind of which is gasoline. Between 70 and 80 per cent of total HC emissions originate from transport and play an important role in the formation of photochemical oxidants. Lead, used as an additive in petroleum, still accounts for more than half of the total lead atmospheric emissions in Arab countries and virtually 100 per cent in urban areas (World Bank 1995a). Most Arab countries use unleaded gasoline.

In 2001, Kuwait and Qatar had more vehicles per thousand people than other GCC countries (GRC 2006). The high share of transport sector pollution is an indicator of high vehicular ownership in the region. For example, the number of vehicles in Egypt in 2008 was 4.3 million versus 2.1 million in 1993 (EEAA 2009). There is a global increase in the number of motor vehicles, as more people prefer to have an independent mode of transportation. However, the problem in most Arab countries is vehicle fleet ageing, exceeding 15 years on average, and the slow pace of replacement.

These vehicles emit 25 times more hydrocarbons (HC) and CO, and 4 times more NOx. Particulate emissions from poorly maintained diesel-fuelled buses and trucks are 5–7 times higher than those of well-maintained vehicles (World Bank 1995b and Larsen 1995).

In addition, environmental safety standards were ignored in many cities, especially in countries that witnessed a rapid development in heavy metal based industries, power plants and cement factories (CEDARE and others 2001).

Egypt is one of the leading Arab countries to commercialize the use of Compressed Natural Gas (CNG). CNG is a promising alternative fuel in terms of the environment. Light-duty vehicles with natural gas engines can produce 85 per cent less reactive hydrocarbons (the precursor to smog and O_3) than gasoline engines, 90 per cent less CO, and approximately 18 to 30 per cent less GHGs. From a zero base in 1996, the market grew by the end of 2007 to a total of 2 274 governmental vehicles converted to CNG. Moreover, the number of taxis converted to CNG, with ageing fleet exceeding 35 years, reached 1 000 in 2008 (EEAA 2009).

Morocco, Algeria, and Tunisia have emphasized railways in their transportation infrastructures. The modern network includes new electrified lines, such as those between Casablanca and Rabat, and light rapid-transit systems in major cities like Algiers and Tunis. Egypt has built an underground metro system that has contributed considerably to reducing surface mass public transit and vehicular emissions.

A recent survey revealed that the problem of road traffic was considered a major environmental problem by 64 per cent of the respondents in the Arab world (Tolba and Saab 2006). Results from different regions were consistent: 72 per cent in Saudi Arabia and Jordan, 69 per cent in Egypt and 77 per cent in Tunisia.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Less than 50 per cent of the respondents from the Palestinian territories, Sudan, Morocco and Libya found traffic jam a major problem, while Kuwait, UAE and Bahrain scored over 80 per cent. This reflects rapidly expanding congestion problems in the latter three countries and the accompanying air pollution in the surrounding areas (Tolba and Saab 2006).

Dust storms, flash floods and heat waves

Dust is one of the least components of the Earth's atmosphere and it may have a greater importance for climate change than had been realized up until now (RGS 2004). Dust storms over the eastern plains of Somalia, Kuwait and northern Sudan are common phenomena throughout most of the year. The intensity and increased frequency of extreme weather events in the west Asian region during recent years have given indications of climate change. After seven years of continuous drought in Oman, the cycle of drought was interrupted in 2002–2003 and in 2007 with a record rainfall, which flooded rivers and agricultural areas in the region, causing the loss of many lives. Dust and sand storms increased in both number and intensity in 2003 in several countries like Syria and Iraq (GRC 2006).

Dust particles make up a large fraction of natural aerosols. Understanding their role on a global as well as regional scale is important if we are to study climate effects. They are generated by strong windstorms with velocities exceeding 48 km per hour, and dust carried by wind can reduce visibility to less than 0.8 km. Intense dust storms reduce visibility to nearly zero in and near source regions.

A typical dust storm can be several hundred kilometres in diameter and may carry more than 100 million tonnes of dust particles comprised of mineral particles less than 0.05 mm in diameter. Natural dust also contains small amounts of biological particles, such as spores and pollen. Thus, these dust storms can pose a significant health hazard for people with respiratory problems and may adversely impact urban areas, particularly megacities (El Askary and others 2003a, El Askary and others 2003b, Chavez and others 2002).

Large sand grains which are lifted into the air fall back to the ground in a few hours while smaller particles less than 0.01 mm remain suspended in the air for longer periods of time, being swept thousands of kilometres downwind. Unlike dust storms, sand storms are almost exclusively a desert phenomenon, blowing over deserts and arid regions, where sand is transported over a distance of about 30 m on land surface and may hurt people.

Severe or prolonged dust and sand storms result in major disasters. In mid-March 1998, the Middle East was hit by shocking sandstorms claiming 4 lives and injuring 29 people, forcing the Suez Canal and airports to close, which resulted in severe economic losses. On May 7, 2002, blowing sand from the Saharan interior caused an Egyptian aircraft to crash into a hillside when attempting an emergency landing near Tunisia, killing 18 people (Miller 2003).

Dust storms affect the atmosphere and regional climate as they modify the energy budget by cooling the atmosphere from reflection of solar radiation back into space, as well as by causing atmospheric heating due to the absorption of IR radiation. Dust affects rain, farming and cloud condensation. Dust deposition can affect marine ecosystems (algal blooms) and transport microbes. Dust storms are connected to a variety of phenomena such as precipitation, soil moisture, and human activities such as land-use and land cover practices.

Dust storms occur at different spatial scales ranging from local, regional, to continental. They have increasingly become a serious environmental issue with effects reaching far beyond the places of origin or the regions adjacent to the deserts, extending for hundreds or even thousands of kilometres, crossing the Mediterranean, Atlantic, and Pacific Oceans (Prospero and others 1996). Airborne particles from dust storms can alter the local climate conditions by intercepting sunlight.

They participate in modifying the energy budget through their behaviour by cooling or heating the atmosphere (Liepert 2002). The presence of an absorbing dust layer results in a substantial decrease in short wave solar radiation, leading to a major change in surface energy balance. Moreover, atmospheric stabilization is affected when dust differentially warms a layer of the atmosphere at the expense of near-surface cooling.

Aerosols

Aerosols are natural or man-made tiny particles suspended in the air. They originate from natural hazards such as volcanoes, dust storms, forest and grassland fires, as well as from living vegetation, and sea spray. They also result from some industrial operations that currently account for nearly 10 per cent of the total aerosol level in the atmosphere, such as activities produced by the burning of fossil fuels and the alteration of natural surface cover. Aerosol particles and gases in the atmosphere affect incoming solar radiation, causing scattering and absorption of light. How much scattering takes place depends on several factors including the wavelength of radiation, the abundance of particles or gases, and the distance the radiation travels through the atmosphere.

The Mediterranean Basin aerosols belong to a variety of sources, both natural and anthropogenic, as a result of increasing urbanization and industrialization. Over the last decade aerosols have been quantified regionally and globally by using satellite remote sensing due to the high need for such information in climate studies (Kaufman and others 2002, King and others 1999).

Table 1. Average concentrations of PM10 in outdoor urban air

11-15 µg/m3	16-20 µg/m3	21-25 µg/m3	higher than 25 µg/m3
The West Bank and Gaza	Jordan	Algeria	Djibouti
	U.A.E	Comoros Islands	Sudan
	Bahrain	Mauritania	Somalia
	Tunisia		Iraq
	Saudi Arabia		Egypt
	Syria		Morocco
	Oman		Yemen
	Qatar		
	Kuwait		
	Lebanon		
	Libya		

WHO 2004

In that context, Aerosol Optical Depth (AOD) obtained from the MODIS data was used to study urban air quality (AOD is a measure of the opaqueness of air, where high values of AOD indicate poor visibility) (Engel-Cox and others 2004). It is well-known that North Africa and the Middle East suffer from a variety of atmospheric pollutant sources, and hence the mixing processes scenario in the atmosphere is most likely a mixed aerosol one. The high presence of dust and smoke particles during certain periods throughout the year varies among different cities in the Arab region. This leads to a high absorption of sunlight and visibility reduction, which creates hazardous situations.

Particulates

Particulates are the most prevailing pollutants throughout most of the Arab region. Table 1 shows the average outdoor concentrations of PM10 in Morocco, Egypt, Sudan, Yemen and Iraq to be above 25 µg/m3, while Figure 3 illustrates (PM10) aerosol emission levels in tonne/h deduced from the GOCART Model for climatological 3D concentrations for April (Ajjaji and others 2008).

It is clear that on the regional scale, the average levels of PM10 are relatively high and may exceed Air Quality Limits (AQL), particularly during dust storms.

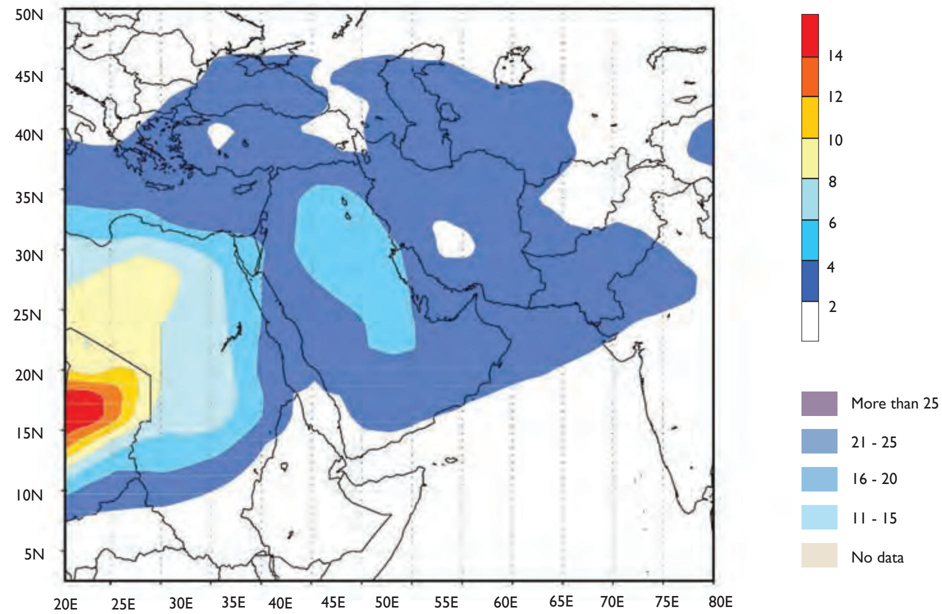
Extreme events, war and air pollution episodes

The Arab region is known for its frequent sandstorms and dust storms as well as periodic heat waves and flash floods. Occasional marine storms have also been observed particularly in Oman, the United Arab Emirates and Yemen. The frequency and severity of these events are expected to increase with climate change. Unfortunately, the impacts of these extreme events on the environment, productivity and human health as well as the associated risks to life and properties in the Arab region have not been well estimated (see Box 1).

Indoor air pollution

Despite the industrialization witnessed by many countries in the world, more than 3

Figure 3. Average concentrations of PM10 in outdoor urban air



Ajiaji and others 2008

billion people worldwide continue to depend on solid fuels (wood, dung, agricultural residues and coal) for their energy needs (WHO undated). The Arab world is not an exception. Cooking and heating with solid fuels on open fires or traditional stoves represent a widespread practice in some Arab countries like Somalia, Sudan, Egypt, Libya, Mauritania, Djibouti and Yemen. This results in high levels of indoor air pollution. The range of health-damaging pollutants (small particulates and CO) resulting from indoor smoke can be 20 times higher than accepted guideline values and is linked to pneumonia in children and chronic respiratory diseases in adults (WHO undated) (see Figure 4). At the national level, an assessment of the burden of disease due to indoor air pollution from solid fuel use was done in 2002 (WHO undated). While a quick change to cleaner and more efficient modern fuels (liquefied petroleum gas) can be difficult to achieve for poor Arab countries, simpler and more effective solutions based on more fuel-efficient and cleaner technologies exist and can be implemented. Some short-term simple solutions that can substantially reduce indoor air pollution and bring about many other conveniences and socio-economic benefits are smoke hoods and insulated retained heat cookers.

Air pollution impacts

Air pollutants not only cause a problem in the immediate vicinity of their emission, but can travel long distances, chemically reacting in the atmosphere to produce secondary pollutants such as acid rain or O3. A number of health and environmental impacts are reported as a result of Particulate Matter (PM) and are of concern due to their natural and anthropogenic sources. Many scientific studies have linked breathing particulate matter to a series of significant health problems, including aggravated asthma, increased respiratory symptoms like painful

Box 1. Ground based monitoring networks

Sunshine and high temperatures prevail in the Arab region most of the year. These parameters aid the conversion of primary pollutants to secondary ones such as O3 and sulphates, which can be more damaging to the environment and human health. Furthermore, sand storms and dust are other common weather events due to the topographic relief, scanty vegetation cover, lightly textured topsoil and strong winds. They serve as carriers of other pollutants to land and seas. Hence, monitoring and skilful seasonal climate predictions are crucial for proper planning and management of all climate-sensitive activities, including: agriculture, water resources, hydroelectric power generation, and others.

On the local scale, air quality standards have been set in many Arab countries. Monitoring is being implemented in most countries, although its starting date varies across the region. The accessibility of the data remains a sizable constraint in most Arab countries. In Egypt, for instance, an air-quality monitoring programme has been implemented for the whole country through the Ministry of the Environment's Egyptian Environmental Affairs Agency (EEAA). The programme presently operates about 78 measurement sites, with stations located at selected sites so as to represent various categories of air pollution sources. The Government of Egypt and the EEAA are collaborating with donor agencies to monitor pollution and to implement various measures that will improve the quality of the environment. Another project, the Cairo Air Improvement Project (CAIP) is implemented in partnership with the EEAA and the Organization for Energy Planning (OEP). Its goal is to initiate and implement measures to reduce those air pollutants that have the most serious impacts on human health in greater Cairo, especially suspended particulate and lead. One of the important objectives of CAIP is to collect air quality monitoring data to document improvements that result from pollution abatement measures implemented by EEAA, CAIP, and other organizations.

Air pollution monitoring was also established in Kuwait in 1984, and at present there are eight monitoring stations in operation. Levels of respirable suspended particulate matter (RSPM) in Kuwait may also sometimes violate WHO standards.

(EEAA 2009, Al Mutairi and Koushki 2009, Shahin 2007)

breathing, chronic bronchitis, decreased lung function and premature death. PM is also responsible for reducing visibility. Particles can be carried over long distances by wind and then settle down on the ground or in the sea and make lakes, rivers and streams acidic (GRC 2006).

CO2 emissions and other GHGs in Arab countries

Emissions from the consumption and flaring of fossil fuels have increased considerably from 749.5 million metric tonnes in 1990 to 1 318 million metric tonnes in 2005 (EIA 2008). The Arab region contributes about 4.7 per cent of total world emissions (EIA 2008). In 2005, the highest CO2 emissions per capita in the region were found in Qatar with 61.94 metric tonnes per capita, Bahrain with 36.58 metric tonnes per capita and the United Arab Emirates with 33.73 metric tonnes per capita. The lowest in the region were in Somalia and the Comoros Islands with 0.09 and 0.15 metric tonnes per capita respectively (EIA 2008), compared to average global emissions, which amounted to 4.37 metric tonnes per capita (EIA 2008).

In the GCC region, the major sources of CO2 emissions are oil production and refining activities. The GCC countries contribute about 2.4 per cent of world CO2 emission, whereas their total population does not exceed 0.5 per cent of the world's population. The level of industrialization in the GCC region is low compared to Europe and the United States, but population growth, urbanization and increased oil related activities have resulted in CO2 hot spots. Trends indicate wide fluctuations in CO2 emissions, being high in Saudi Arabia, owing to its large area and population. However, the emissions per capita of all GCC countries are higher than those in high income countries (GRC 2006).

The contribution of the transport sector to total CO2 emissions is 8–16 percent in GCC countries, while the housing sector has a small share of less than 5 per cent. In a recent unpublished study, it was reported that the main source of CO2 emissions was found to be the energy production sector (power stations and oil industries).

The transportation and household sectors in these countries contributed a share of 3.68 per cent and 1.65 per cent respectively, while CO2 emissions from the cement industry were negligible (0.4 per cent) (Al Ajmi and others 2006). In North African countries, most power generation plants were not exposed to environmental evaluation prior to their establishment. Their average pollution totalled 31 per cent which led to adverse effects on the surrounding residential areas (Engelstaedter and others 2006, El-Fadl and El-Fadel 2004).

The transportation sector is the top contributor to CO2 and lead emissions. CO2 emissions account for 92 per cent of the total GHG emissions, while methane and NOx emissions account for 7 and 1 percent respectively. Carbon dioxide emissions from the transport sector rose from 3.4 million tonnes to 5.8 million tonnes between 1994 and 2002, with an annual increase rate of approximately 9 per cent (El-Fadl and El-Fadel 2004).

Climate Change

Climate is the most important aspect of atmospheric phenomenon that affects human life. Climate changes and variability such as changes in rainfall patterns, rising temperatures and the increased frequency of extreme weather conditions such as floods, droughts and cyclones now represent an important developmental factor. These events are increasing in magnitude and frequency over the years. The most common indicator of climate variability is the amount of rainfall received over the years in addition to the wide year-to-year rainfall variability. Climate changes have far reaching impacts on socio-economic development and human well-being. Moreover, resulting extreme weather events contribute to population displacement; undermining social cohesion and cultures. It is well-known that climate change affects food production systems, leading to malnutrition and famines as well as increasing insect ranges and numbers, which escalate the incidence of diseases.

In 2007, The IPCC defined climate variability as the variations in the mean state and other statistics – such as standard deviations, statistics of extremes – of climate on all temporal and spatial scales. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forces. Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This definition differs from that of the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UN 1992).

According to the IPCC report, global warming is unequivocal, "as is now evident from observations of increases in global average air and ocean temperatures with the full range of projected temperature increase of 1.1oC to 6.4oC by the end of the century leading to widespread melting of snow and ice, and rising global mean sea level" (IPCC 2007). The most common indicator of climate variability is the amount of rainfall received over the years, and the high year-to-year rainfall variability.

The report also points out to the projected increase in extreme weather events (storms, precipitation, drought), noting that tropical cyclones are likely to become more intense, with higher peak wind speeds and heavier precipitation associated with warmer tropical seas. These extreme events are projected to increase in magnitude and frequency over the years. Cyclone Gonu that hit Oman's coasts in June 2007 is considered one of these events.

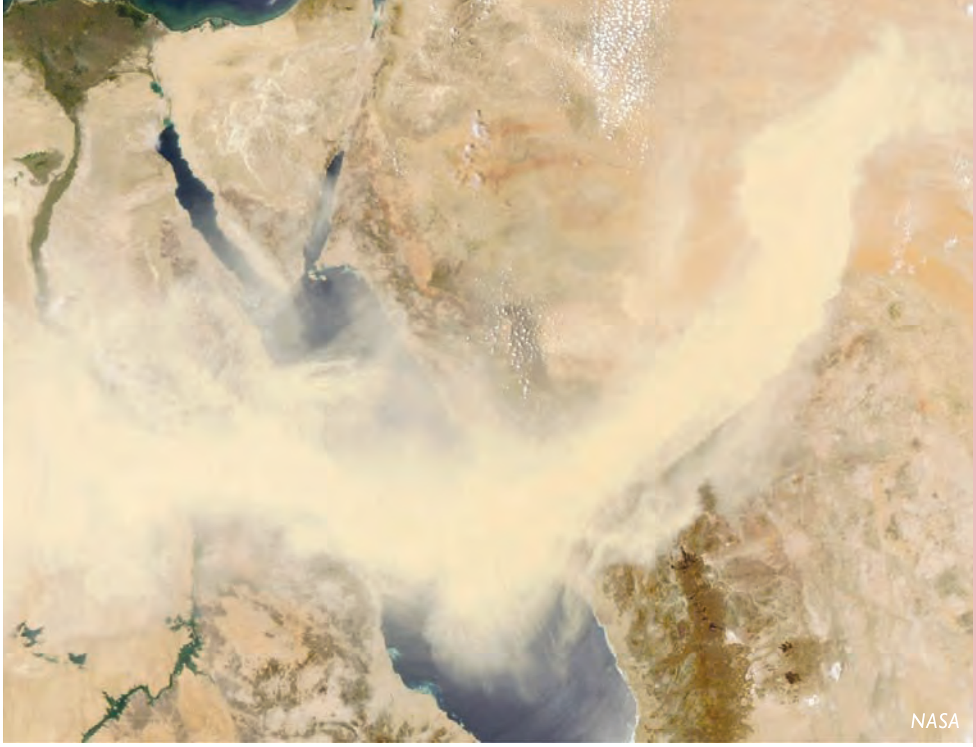
Projected climate change in the Arab region

Studies and research on climate change and its impacts on the Arab region are very limited despite primary studies that were conducted by several Arab countries on the implications of climate change, among national reports that were submitted to the UNFCCC Secretariat. The following reviews the most important information mentioned in the IPCC Fourth Assessment Report on Climate Change impacts in the Arab region.

This report is the only scientific reference that analyses the causes and effects of climate change at the global level. Based on the IPCC geographic assessment, the region lies within North Africa, Southwest Asia and the northern parts of Sub-Saharan Africa. The report describes North Africa and Southwest Asia as the Middle East region, which includes the following countries: Morocco, Tunisia, Libya, Algeria, Egypt, Mauritania Lebanon, Syria, the Occupied Palestinian Territories, Jordan, Saudi Arabia, United Arab Emirates, Qatar, Bahrain, Kuwait, as well as the northern parts of Sub-Saharan Africa (Sahel zone). This zone comprises Sudan, Somalia, Djibouti and the Comoros Islands.

Temperature and precipitation: Mean global temperatures are rising (Christy and others 2001). This rise in global temperature is attributed to anthropogenic GHG emissions, particularly CO2. Model projections of temperature changes by 2030, 2070 and 2100 indicate a steady rise in temperatures over most of the Arab region (North Africa and the Middle East) under the best and worst case scenarios (see Table 2 and Figure 4).

Precipitation: Projections of the IPCC Fourth Assessment Report indicate that an increase in the amount of high latitude precipitation is very likely, while a decrease is expected in most subtropical land regions. The zone of severely reduced rainfall in the IPCC projection extends throughout the Mediterranean region and the northern Sahara, and inland from the Atlantic coast down to about 15° N. Therefore, North Africa and the Middle East region are very likely to be exposed to extreme desiccation in the coming decades, with projected temperature increases in excess of 4°C throughout the far Northern part of Africa (Maghreb) in summer, and reductions in rainfall exceeding 30 per cent in some parts, according to A1B scenario (see Figure 5) (Christensen and others 2007).



A satellite photo from MODIS – Aqua illustrating sandstorms that cross seas and continents heading from Saudi Arabia towards Egypt, intercepting the Red Sea. This phenomenon recurs frequently in various parts of the Arab region.

In the case of sub-Saharan Africa, including northern Sudan, a number of regional models suggest a continued "greening" of the Sahel and southern Sahara (Brooks 2004). However, these projections are associated with considerable uncertainty and disagreement among models. The major climate change hazards facing the Sahel may therefore be defined as exaggerated climate variability coupled with greater uncertainty over a range of timescales.

This will potentially be accompanied by complex changes in variability and extremes on inter-annual and intra-annual timescales, such as: changes in the seasonal distribution and predictability of rainfall, more intense rainfall events associated with flash flood risks, changes in the distribution and occurrence of pests (locusts) and diseases (malaria) and possible changes in the occurrence of dust storms.

Impacts, vulnerability and adaptation to climate change

Vulnerability is defined by the IPCC as "The degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes." Improving adaptive capacity is important in order to reduce the vulnerability to climate change. In this respect vulnerability is seen as the function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (IPCC 2001).

The Middle East and North Africa (MENA) are the most vulnerable to climate change, on account of water scarcity (the highest in the world).

The IPCC report estimates an increase in temperature in the MENA region of up to 2oC in the next 15–20 years, and over 4oC till the end of the century (the increase is higher for faster emission scenarios). North Africa and the Mediterranean have been identified as the most physically sensitive areas to climate change (Giorgi 2006).

Water run-off is projected to drop by 20 to 30 per cent in most of the region by 2020, mainly due to rising temperatures and lower precipitation (Milly and others 2005). The combined effect of higher temperatures and reduced precipitation will increase the occurrence of droughts, an effect which is already materializing in the Northern parts of Africa, with an increase in drought frequency from once every 10 years in the beginning of the 20th century, to 5–6 times every 10 years at present (Agoumi, 2003).

The vulnerability of the region to climate change is aggravated by the significant dependence on climate-sensitive agriculture, the concentration of populations in certain areas, and the economic activity in flood-prone urban coastal zones. The situation is further exacerbated by the presence of conflict-ridden areas in which climate-induced resource scarcity could escalate violence and political instability even beyond the region's boundaries.

Arab countries in Sub-Saharan Africa are particularly vulnerable to the risk of environmental changes due to global warming. These parts are home to many of the world's poorest people, who will not be able to afford adaptation strategies on their own. The IPCC report highlights that between 1900 and 2005, the Sahel (the boundary zone between the Sahara desert and more fertile regions of Africa to the south), the Mediterranean, southern Africa, and parts of southern Asia have become drier, adding stress to water resources in these regions (IPCC 2007).

Table 2. Projected temperature range over parts of the Arab region

Increase in annual average temperature range in °C		
Years	Best scenario	Worst scenario
2030	0.5-1.0	1-1.5
2070	1.0 -1.5	2.0-2.5
2100	2.5-3.0	3.0-4.0

(IPCC 2007)

Impacts and vulnerability

Ecosystems

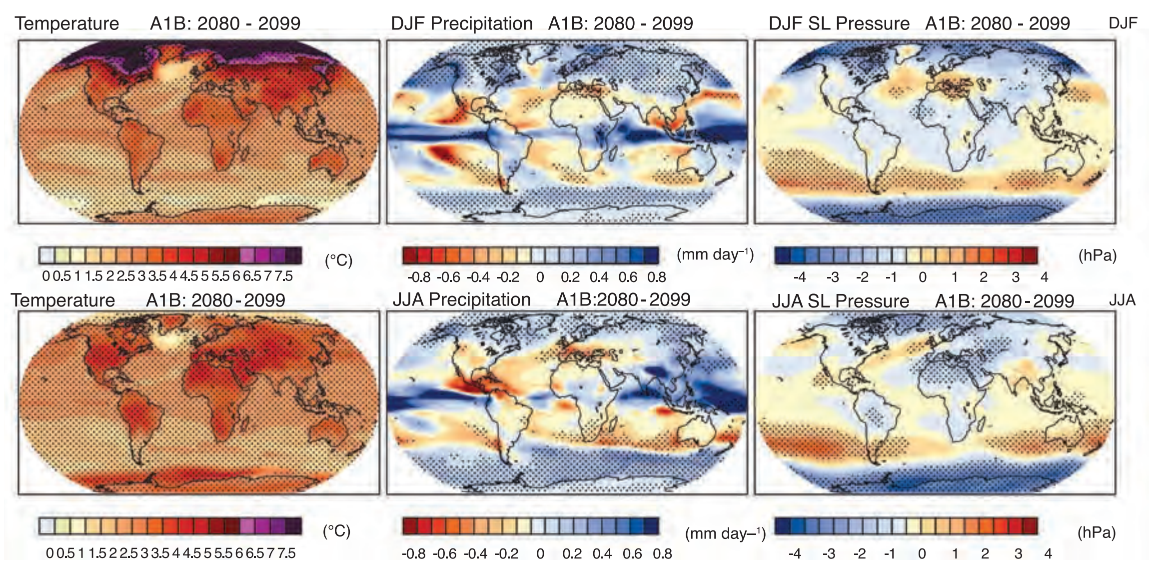
Climate change has multiple impacts on various scales and affects ecosystems in particular, which in turn impacts livelihoods and human well-being. The prevailing climatic conditions in the Arab region have highly significant effects on the different components of ecosystems. Major impacts could be attributed to the inherent fragility of the dominating arid ecosystems of the region, which are generally characterized by weak resilience of soil resources, and limited availability of surface and groundwater resources. The Middle East contains the world's hottest deserts, already inhospitable to most forms of life. Scientists have depicted an increasingly clear image of possible future changes that climate change can bring about to ecosystems and societies. Most of the region is expected to remain as very hot deserts under climate change scenarios.

Climate change may put stresses on those areas which are more hospitable, such as the Mediterranean basin. Moreover, the grasslands of the Sahel, a band of land running across the continent south of the Sahara desert, are already shrinking. As climate models predict, warmer temperatures and less rainfall for this region under global warming, land degradation, desertification, loss of productive land and biodiversity are all expected to accelerate.

Water supply

Future scenarios project water scarcity and increasing pressures on water resources. Based on some of these projections the water deficit

Figure 4. Projected changes in precipitation patterns



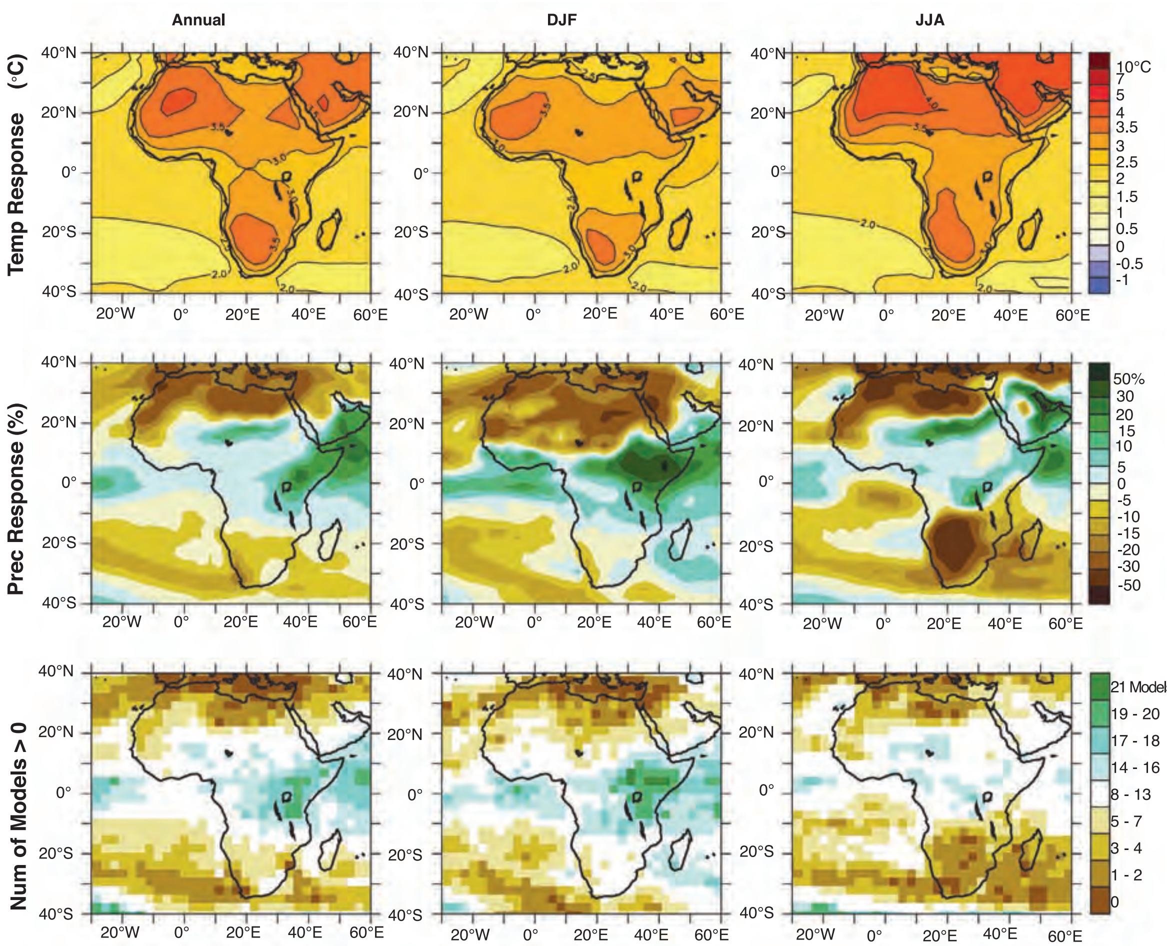
Meehl and others 2007

is likely to increase from about 28 300 million cubic metres in the year 2000 to 75 400 million cubic metres in 2030 due to climatic and non-climatic factors. Nine out of fourteen countries in the region already have average per capita water availability below the water scarcity threshold. A warm climate is expected to place additional stresses on water resources, whether or not future rainfall is significantly altered (Hulme and others 2000). Trends of reduced surface water availability, reduced groundwater reserves, and increased drought and flood events have been observed in several countries (as in Morocco over the last 30 years). Countries expected to experience decreased precipitation include: Egypt, Jordan, Lebanon, Syria and the Occupied Palestinian Territories (UNDP 2007).

Rising temperatures and changes in run-off patterns will influence the flow of rivers upon which some countries in the region depend. It is evident that climate change scenarios and their impacts on water in the Middle East cannot be viewed in isolation, as rapid population growth, industrial development, urbanization and the increasing demand for irrigation will exert additional pressures on water resources. There is a growing concern about future access to water, particularly where two or more countries share water resources, which is the case for several river basins in the Arab region.

A recent study presented much drier scenarios of Nile flow, with nine climate scenario impacts, ranging from no change to roughly a 40 per cent reduction in flow by 2025 (Strzepek and others 2001). The results of a study by Conway (2005) highlight the significance of natural variability for Nile water supply, primarily due to rainfall fluctuations over the Ethiopian highlands. The study also indicated that, while the modelled flow results for 2020 lie within the inter-decadal variability, the current observations reveal a real change, not just the periodic fluctuations that used to occur in the past.

Figure 5. Models of climate change scenarios



Top: Projected annual changes in tempratures: Dec- Jan, June- Aug. between 1980- 1999 and between 2088- 2099, taken from the averages of 21 models derived from AIB scenario data.
Middle: precipitation comparative partial change.
Bottom: some of the 21 models projected increased precipitation.

Christensen & Others 2007

Similarly, the Euphrates will experience a reduced flow by as much as 29–73 per cent along with the Jordan River (Kitoh and others 2008). According to research studies, some additional 80–100 million people will be exposed, by 2025, to water stress, defined as access to less than 1 000 m3 per capita per year. Compared to the 1995 baseline, this will exacerbate competition for water across sectors and geographic locations, and will put further pressure on groundwater, which is currently being extracted in most areas beyond aquifer recharge potential (Warren and Others 2006). Such water pressures have been associated in many areas with conflicts and political disputes at the national and regional levels (Osman-Elasha 2008) (see Figure 6).

Sea-level Rise (SLR), coastal inundation and erosion

The IPCC Fourth Assessment Report indicated that global sea level has already been rising at an average rate of 1.8 mm per year during the 20th century. With continued increase in global greenhouse gas (GHG) emissions and associated warming, sea level could rise by another 1 to 3 metres this century, based on GHG emission scenarios and other climatic conditions. Most of this anticipated increase is attributed to glacier melt and thermal expansion of oceans. While impacts on MENA's land areas are lower than the average of developing countries, when measured in social and economic terms, impacts on MENA are estimated to be relatively higher.

One metre SLR would affect 3.2 per cent of MENA's population (versus 1.28 per cent worldwide), 1.49 per cent of its GDP (versus 1.30 per cent worldwide), 1 per cent of its urban population (versus 1.02 per cent worldwide), and 3.32 per cent of its wetlands (versus 1.8 per cent worldwide) (Dasgupta and others 2007). Ocean and sea-level rise could lead to inundation of the lengthy low-lying coastal areas of the Arab region that may result in loss of productivity, saltwater intrusion, loss of valuable biodiversity in wetlands and salinity of groundwater aquifers. SLR impacts are considered a high priority in some island regions such as Bahrain (UNEP 2003), which is highly threatened by SLR. Assessments carried out under different climate change scenarios revealed that substantial land areas would be inundated in Bahrain due to climate change induced SLR. Even the lowest SLR scenario of 0.5 m is expected to result in an inundation of about 11 per cent of Bahrain's total land area by 2100 (Al-Jeneid and others 2008).

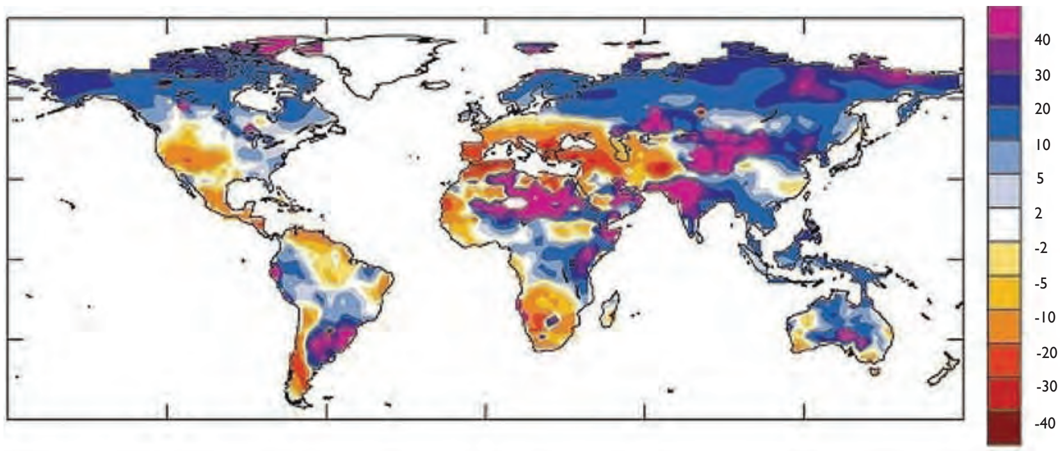
In urban areas in North Africa, between 6 and 25 million people are estimated to be exposed to coastal flooding under a temperature increase of 1–3oC. Sea-level rise poses a risk to low-lying coastal areas in Tunisia, Qatar, Libya, UAE, Kuwait, and Egypt, particularly in Alexandria, which is the second largest city after Cairo. An estimated 45 per cent of the population of Alexandria currently lives on land that will be submerged once expected SLR occurs. Water will also submerge an estimated 1.3 per cent of its beaches, 26 per cent of its residential areas, and about half of the city's industrial complexes. An estimated 17 per cent of those employed in the tourism sector will lose their jobs because of SLR (Eco-Plan 2007).

The extremely low elevation of arable cropland in the Nile Delta in Egypt makes SLR a real threat for the nation. This has been highlighted by a study in North Africa estimating the potential impacts of sea-level rise on the Nile Delta. It indicated that a 1 metre SLR would affect 13 per cent of the country's total agricultural area and destroy weak parts of the sand belt, which are essential for the protection of lagoons, low-lying reclaimed and other valuable agricultural lands. In addition, it is expected that the intrusion of seawater will change the water quality and affect most of the freshwater fish. Recreational tourism and beach facilities would also be endangered and salinity of essential groundwater would be observed (UNEP 2005).

Agriculture and food security

The main climate change risks in the MENA region will largely be linked to long-term climatic desiccation and drought associated with climatic variability. Water stress is of extreme importance, and decreases in water availability may have severe impacts on food security. According to FAO (1999) climate change in the already arid northern sub-region of the continent is expected to enhance desertification and bring a gradual decrease in forest cover. The economies of many countries are still based on subsistence agriculture.

Figure 6. Climate change impacts on water availability in MENA in 2050. Surface run-off rates are expected to decrease by 20–30 per cent by 2050



Milly and others 2005

Accordingly, an increased frequency of droughts and floods could lead to food shortages and famine. Agriculture yields, especially in rain-fed areas, are expected to decline and to fluctuate more widely over time, converging at a significantly lower long-term average or ending up in cultivation failure. A recent study estimates that for the region as a whole, agricultural output will decrease (in terms of quantity) by 21 per cent by 2080, with peaks of almost 40 per cent decrease in countries like Morocco and Algeria (World Bank 2007).

As for the Sahara and Sahel sub-regions, rainfall is predicted to decrease, resulting in soil degradation, desert encroachment and loss of productivity. In northeast Africa, more intense dry periods and shorter wet seasons are expected to affect even vast river systems such as the Blue Nile in Sudan, leading to serious water shortages and adverse impacts on the agriculture and forestry sectors throughout the region (UNFCCC 2006).

Peace and security

The IPCC Fourth Assessment Report highlighted the impacts of internal and cross-border migration as a response measure to climate-induced stresses, and related severe consequences, such as escalating conflicts and pressures on natural resources (IPCC 2007). Both MENA and Sub-Saharan regions are already hotspots for many of the world's conflicts. Scarcity of food and water has always triggered conflicts and civil wars, which are among the main reasons for mass migration and population displacement. Environmental stresses, especially diminishing water supplies, will also exacerbate animosities in the region. Migration is also expected to intensify in the different regions of Sub-Saharan Africa with projected increases in the number of environmental refugees (who are exposed to climatic shocks), as well as war refugees. Environmental pressures such as dwindling food and water supplies may lead to conflict among struggling nations, causing the migration of refugees in large numbers (Osman-Elasha 2008).

Health

If the already extreme temperatures in the Middle East rise, even very slightly, they could have severe impacts on human livelihood and health. Heat-related mortality is also expected to rise. A warmer climate in Africa could expand the range of carriers of malaria, yellow fever, Dengue fever and other vector-borne diseases. The lack of strong public health infrastructure in some countries, particularly in Sub-Saharan Africa, will render them more vulnerable to vector-borne diseases. Rift Valley fever, which afflicts people and livestock, is closely related to heavy rainfall and such conditions may increase with climate change.

An outbreak in 1997 associated with the El Niño storm killed up to 80 per cent of livestock in Somalia and northern Kenya. In addition, the "heat island effect" had its influence on heat waves. Water scarcity, decreasing water quality, worsening air quality, and ground ozone formation are likely to lead to an overall worsening of public health, and more generally, to a deterioration of living conditions. Climate change is also expected to affect food security in Northern Africa and the Middle East through its impact on agriculture and food production systems, contributing to malnutrition and famine.

Adaptation to climate change

Adaptation is defined by the IPCC as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." According to the IPCC Fourth Assessment Report, climate change is already happening, and will continue to happen even if global greenhouse gas (GHG) emissions are reduced significantly in the short to medium term.

The people from the MENA and Sahel region have grown accustomed to coping with a warm and arid climate. However, the projected changes in temperature and precipitation may be beyond the coping range of many communities. Therefore, selecting appropriate adaptation strategies will be critical.

Rapid actions are needed to improve the coping capacity and reduce vulnerability of sensitive sectors and systems to climate change. Promoting the diversification of productive livelihoods in rural areas away from heavy dependence on fragile ecosystems for crops or livestock activities, and building on traditional knowledge have been identified as among the most effective adaptation strategies by rural communities in arid parts of Sudan (Osman-Elasha unpublished).

Adopting national and regional action plans that address climate change issues is essential in order to assess possible impacts and develop effective adaptation programmes. Regional cooperation is crucial to mitigate climate change impacts, particularly those related to rising sea temperatures and SLR. This is to be accomplished through regional coastal zone management and the establishment of regional early warning systems for monitoring extreme climatic events such as storms, cyclones, droughts and floods. The League of Arab States is currently preparing a framework plan to address climate change in Arab countries. Mainstreaming adaptation strategies into national development plans, eradicating poverty, and incorporating policies dealing with climate change issues in all sectors at national and regional levels are considered crucial factors of utmost importance. Countries sharing the same freshwater sources, whether surface or groundwater, need to enhance cooperation and implement an integrated regional water management to ensure conservation and sustainable usage.

Arab States' Contribution To The Protection Of The Ozone Layer

The ozone layer shields people and plants from harmful ultraviolet radiation, which causes skin cancer and cataracts in people, stunts growth in plants, including food crops, and kills the micro-organisms which form the base of the marine and terrestrial food chain. The ozone layer is threatened by the production of industrial chemical emissions, particularly the Chloroflouro-carbons (CFCs). Due to the stable, persistent, physical and chemical characteristics of these compounds, they remain in the atmosphere for long periods of time that allow them to penetrate into the stratosphere, resulting in the erosion and depletion of the Ozone layer. The Montreal Protocol specified Ozone depleting substances in special lists and set mandatory timetables, whereby countries are committed to eliminate the emission of O3 depleting substances in accordance with the deadlines indicated in the timetables.

The Montreal Protocol is one of the most successful international environmental agreements as it includes mechanisms that provide necessary technical and financial support for developing countries, to enable them to phase out the production of the O3 depleting substances without disrupting or adversely affecting their development plans. All Arab countries were encouraged to accede to the Montreal Protocol. It was ratified by 195 states including all Arab countries with the exception of the Palestine National Authority which has submitted a request to join the Vienna Convention and the Montreal Protocol since 1997, but its request has been declined since it is not a registered UN member (Ozone Secretariat 2009).

Not all Arab countries produce O3 depleting substances, but they import them from producers like India, China, European countries and the United States. These substances are used by the industry, maintenance and services sectors in different fields such as cooling, air-conditioning, and fire-fighting. They are also utilized in the manufacture of foam (artificial sponge), sprays and solvents. Arab signatory states abided by the Montreal Protocol, and reduced the use of Chloroflouro-Carbons (CFCs) by 85 per cent in 2007. Iraq, which recently joined the Protocol, is intending to follow suit and eliminate these materials. Nevertheless, Somalia failed to adhere to the Protocol due to the difficult circumstances it is currently encountering. Success achieved by Arab countries in phasing out the use of these substances is attributed to the conversion of industry production lines from O3 depleting substance-based technology to Ozone-friendly alternatives, and to the enforcement of necessary legislation to control the importation and handling of these substances (see Table 3) (The Report of the Compliance Assistance Programme of West Asia 2008).

In general, Arab countries have achieved considerable progress in phasing out CFCs and have thus contributed, along with other countries, to eliminating these compounds from the Ozone layer, which according to scientists will allow recovery by the middle of this century. However, there are challenges facing all developing countries (including Arab states) concerning the complete phase-out of all substances included in the lists annexed to the Montreal Protocol, particularly after necessary revisions by the 19th Meeting of the Parties of the Convention. These revisions called on the developing states to accelerate the freeze and phase out of HCFCs (The Report of the 19th Meeting of the Parties 2007).

These compounds are used in Arab countries on a large-scale in certain industries such as the manufacture of coolers, air-conditioners (which booms in the region) as well as foam (artificial sponge). This increases the demand for these materials and associates them directly with the development programmes set and implemented by Arab states. It is evident that the growing demand for these substances in the industrial sector will also be accompanied by an increase in demand for maintenance and service sectors.

Therefore, Arab governments, especially those characterized by hot climates, will face major challenges during the next five years, which is the period during which they should start reducing their consumption of these substances. Arab countries should make use of the experience they gained in the last 20 years during the CFC reduction process, and carry out studies on all HCFC alternatives currently available in world markets. This is of great significance since social and climatic conditions are directly related to selection of suitable substitutes (The Report of the Compliance Assistance Programme 2009).

The second challenge facing developing countries, including Arab states, is managing undesired CFC stocks, and the devices and products that contain these compounds. The sound elimination of O_3 depleting substances ensures non-penetration of these compounds into the atmosphere. Very costly technology is needed to destroy these materials in order to ensure that they are not transferred into substances harmful to the environment during the destruction process.

The third challenge is represented in the increased use of methyl bromide by date-producing Arab countries. Methyl bromide is an O_3 depleting substance that should be eliminated by 2015. However, thus far, there aren't any alternatives that suit the extremely humid date manufacturing process. Accordingly, date-producing states have to conduct further studies and exchange information and experiences on other available substitutes in the world markets (Compliance Assistance Programme of West Asia – Report on Methyl Bromide Usages in the Date Sector 2008).

Challenges And Opportunities

Arab countries have shown commitment to implementing Agenda 21, which takes into consideration the principle of common responsibility. However, efforts toward this responsibility are limited and controversial and do not coincide with the magnitude of responsibility. Nevertheless, great strides have been taken in the Arab region over the past two decades in the development and strengthening of environmental institutions and legislation, with special emphasis on the quality of air, particularly at the level of environmental policies (formulation and implementation). Moreover, civil society organizations have become increasingly recognized in the region as powerful mechanisms to advance sustainable development.

Initiatives have been launched in the region to decrease industrial pollution and cut CO_2 emissions, through the financing of alternative fuels such as natural gas by industrial enterprises. The United Nations Framework Convention on Climate Change (UNFCCC) has been ratified, along with its relevant protocols. Many Arab countries are also implementing the Clean Development Mechanism (CDM) projects

Table 3. CFCs consumption in Arab countries

Country	1995	2000	2003	2005	2007
Jordan	535.0	354.0	74.4	59.6	24.0
U.A.E.	513.8	476.2	317.5	264.6	79.4
Bahrain	121.9	113.1	85.8	58.7	14.7
Tunis	758.0	555.0	362.5	205.0	17.7
Algeria	2 292.2	474.61	1 761.8	859.0	200.00
Djibouti	22.7	20.7	12.1	7.1	2.2
Saudi Arabia	1 828.4	1 593.6	1 300.0	878.5	657.8
Sudan	635.0	291.5	216.0	185.0	61.0
Syria	2 370.2	1 174.7	1 124.6	869.7	282.0
Somalia	241.1	65.6	108.2	88.2	79.5
Iraq	1 547.0				1 686.1
Oman	229.9	282.1	134.5	54.3	10.1
Qatar	90.9	85.8	95.1	37.0	13.0
Comoros Islands	2.3	2.7	1.2	0.9	0.3
Kuwait	484.6	419.9	247.4	152.7	68.0
Lebanon	819.8	527.9	480.2	287.3	74.5
Libya	772.8	985.4	704.1	252.0	57.5
Egypt	1 640.0	1 267.0	1 102.2	821.2	241.6
Morocco	706.8	564.0	474.8	38.7	24.1
Mauritania	23.2	14.2	14.3	6.1	1.3
Yemen	2 350.2	1 045.0	758.6	710.5	268.7
Total	17 985.80	8 434.90	6 412.20	4 089.20	3 863.50

Ozone Secretariat 2009

which have gained acceptance in the region. In addition, most Arab countries have acceded to the Stockholm Convention on Persistent Organic Pollutants (POPs). Under this convention, urgent global actions are being taken to reduce and eliminate release of these chemicals through the limitation of the use of pesticides as well as industrial chemicals such as Polychlorinated Biphenyls (PCBs).

Past industrial emissions, along with the region's modest releases, place the Arab environment under severe pressures, especially in relation to atmosphere and climate change. These pressures are expected to be exacerbated by increasing population growth, accompanying economic development and the failure to adopt an effective mechanism to control emissions at the global level. In light of the aforementioned, further efforts should be exerted to deal with air pollution and climate change problems in the Arab region.

Climate change has become a significant risk and its far reaching impacts on the Arab region need to be seriously addressed. Crucial steps should be taken to effectively contribute to international endeavours (despite the region's limited emissions) and scientifically assess the vulnerability of socio-economic and ecological systems to the climate change phenomenon. It is also important to undertake adaptation procedures as a strategic option rather than waiting for available opportunities.

Climate change is a major challenge facing the people of the Arab region. It has multiple impacts on various levels, mainly decreased precipitation, recurrent drought events, scarcity of water resources and decline in agricultural production. Relevant responses should ensure integration between policies tackling climate change and national and regional strategies aimed at rationalizing energy consumption, increasing efficient usages, creating job opportunities for youth, in addition to eliminating poverty and unemployment.

Reducing and limiting the release of atmospheric emissions and pollutant concentrations (including those affecting the climate) have become crucial for the achievement of sustainable development in the region. Mitigating the impacts of climate change on lives, livelihoods and infrastructure in the short-term is also of equal importance. Climate change preparedness should be reflected in the prompt implementation of adaptation measures. As an immediate step, regional integration should be enhanced in the region, especially with respect to gas transfer and distribution projects among Arab countries, considering them effective mechanisms instrumental in eliminating air pollution and reducing GHG emissions. Looking for other sources of renewable energy is inevitable as well. These include wind and solar energy which effectively contribute to global efforts to reduce atmospheric harmful emissions and achieve sustainable development for future generations that will need further sources of energy.

Arab countries have to play an effective and leading role in international discussions on climate change, especially in relation to reduction of emissions and adaptation measures, technology transfer, as well as means of funding. It is essential to launch a clear vision regarding means of addressing climate change issues in accordance with declared common stances and Arab consensus towards these issues.

Conclusion

It is an alarming fact that the world's air quality is worsening. Air quality in the Arab region is deteriorating fairly quickly as a result of increasing population, urbanization, transportation and the spread of polluting industries. Major pollutants include GHGs, sulphur dioxide, carbon monoxide, soot, dust and lead. These pollutants, with their apparent or hidden impacts (whether transboundary or local), adversely affect human health and well-being, as well as affect agricultural and industrial production. Initiatives to reduce air pollution and promote greater efficiency in energy generation and use require a variety of control strategies and policies, including capacity-building, and raising public awareness in a way which ensures contribution to the conservation of the atmosphere. Energy conservation programmes, solar energy research and cleaner production initiatives, if utilized more efficiently, will ultimately lead to better control of GHG emissions.

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Section

Three

Environmental Change and Human Dimensions

Chapter 8

HUMAN BEING AND ENVIRONMENT...INTERLINKAGES

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Moataz Ali

Main messages

Several environmental problems and challenges can be attributed to the relationship between the environment and human activities, particularly with respect to impacts and vulnerability. Knowing the potential and carrying capacities of ecosystems and understanding the interactions and linkages between human activities and these systems contribute to improving policy responses which positively affects the environmental conditions and enhances sustainable development. The following are the main messages of this chapter:

- The mutual relationship between impact and vulnerability and the consequential interactions, require recognizing the dynamic interlinkages among the elements of ecosystems. Adopting an interlinkages approach in addressing environmental issues is essential to the Arab region. Such an approach can develop opportunities for increased and closer local, national and regional cooperation, inclusive policies, as well as stronger and more sustainable partnerships. The ecosystems and societies of the Arab region are an integral part of the Earth's systems in which demographic, economic and technological drivers are all linked together. Environmental challenges and phenomena such as climate change, air pollution, biodiversity loss, land degradation and desertification, water resources depletion and chemical pollutants, contribute to declines in ecosystems and resources. This undermines the capacity of these ecosystems to provide environmental products and services, adversely affecting economies and human well-being.

- Ecosystems have thresholds that are difficult to be estimated. Exceeding these thresholds weakens the capability of ecosystems to provide various products and services, and could eventually lead to their deterioration.

- To improve the implementation of the interlinkages approach, and enhance multi-sectoral sustainable development policies, Arab countries should adapt and implement Multilateral Environmental Agreements (MEAs) at the local level, through developing specific implementation mechanisms and fulfilling obligations involving reporting, training, education, public awareness, and other related activities. They should also overcome the problems related to information and data sharing. Additionally, people should be empowered and national capacities built in order to enhance participation in policies and measures that sustainably address the relationship and interactions between environment and human well-being.

- Several global and regional environmental policy responses provide opportunities for enhancing synergies and promoting interlinkages between humans and the environment, within and across temporal and spatial institutional boundaries. The most important responses are: the World Summit on Sustainable Development (WSSD) Johannesburg Plan of Implementation (2002), the Sustainable Development Initiative in the Arab Region (2002), the Millennium Development Goals (MDGs) (2000), the Abu Dhabi Declaration on Environment and Energy (2003), and the Arab Ministerial Declaration on Climate Change (2007).

- Scarcity of water resources is a major obstacle to socio-economic development in the Arab region. The major drivers and challenges exacerbating this long-term situation are population growth, expansion of irrigated agriculture, industrial development, tourism and rapid urbanization. Adopting and applying an interlinkages approach provides good opportunities for assessment of the efficiency of local, national and regional water policies and programmes.

- The harsh and fragile characteristics of drylands in the Arab region require the integration of national and regional water, food and land-use policies. Land degradation, caused by anthropogenic activities, leads to biodiversity loss, water and wind erosion, salinization and climate change. Given that land degradation is also interlinked with food production in the agricultural sector, these strong interlinkages should be thoroughly considered when comprehensive and integrated policies are being formulated to alleviate land degradation problems in the region.

- Although the Arab region's contribution to global GHG emissions is low, its water resources, agricultural production, and coastal fisheries will be severely affected by global climate change. This will have severe repercussions on human health and other living organisms. In order to curb these effects, a vulnerability assessment of ecosystems in the region must be conducted, and policies created to implement proper climate change adaptation measures. The principle of "think globally and act locally" should guide measures to deal with the issue of CO_2 emissions in the Arab region since it is inextricably tied to climate change and human well-being.

- Sustainable development and environmental protection are closely interlinked in the Arab region. In order to transition to sustainable development policies, Arab governments should ensure that their integrated policies include the issues of environmental economies, economic costs of environmental resources, as well as strong partnerships. Environmental education and public awareness should also be given significant attention in order to achieve sustainable development targets. Awareness is a prelude to informed action which depends – in the field of environmental issues – on public understanding, awareness and support. Likewise, knowledge of environmental issues and sustainable development is essential not only for creating sound policies and mobilizing public support, but also for adopting a consultative and participatory approach. Such an approach should ensure interlinkages between humans and the environment and contribute to developing and implementing comprehensive policies. Arab countries should strengthen and engage civil society organizations in tackling and managing environmental issues through strong public awareness and educational campaigns and programmes.

Moataz Ali

INTRODUCTION

Like other parts of the world, the Arab region is witnessing a pattern of globalization characterized by increasing flows of goods, services, technologies, information, ideas, and labour, driven by liberalization policies and technological advancement. With increasingly interconnected Arab societies and globalization continuing to drive environmental change, there is an urgent need to understand how, and by whom, environmental challenges can best be addressed. Today, across the Arab region, many of the environmental problems and challenges facing its inhabitants can be attributed to the linkages between humans and the environment. Therefore, adopting an interlinkages approach to address the challenges and interconnection of Arab societies and their environments provides a logical structure for evaluation of environmental management policies.

The key objectives of the interlinkages approach (see Box 1) are to demonstrate to other sectors the importance of the environment, its sound management, and the necessity of adopting a holistic approach to problem solving which leads to advancement of human well-being. Upon formulating policies and programmes, the interlinkages approach can help ensure that interlinkages are both relevant and effective, and that related policies are based on principles that are cross-sectorial and interdisciplinary.

Box 1. The definition of interlinkages

Interlinkages are the interactions and cycles that lead to synergies or trade-offs within and among environmental changes, human activities, ecosystem services, elements of human well-being, and policy responses.

This is a strategic approach to manage sustainable development that seeks to promote greater connectivity between ecosystems and societal actions. More precisely, interlinkages refer to the processes of environmental management that reflect the systematic characteristics of ecosystems, development problems, and the interconnections of human and environmental processes.

Malabed 2001

Drawing on the findings of previous chapters, this chapter will explore and convey existing human-environment interlinkages in the Arab region. It will examine how the different drivers, human activities, social and environmental changes are interlinked through cause-and-effect relationships. It will also analyse to what extent human pressures on the environment may exceed critical thresholds, and result in potentially sudden, unexpected effects.

This chapter tries to address the following questions:

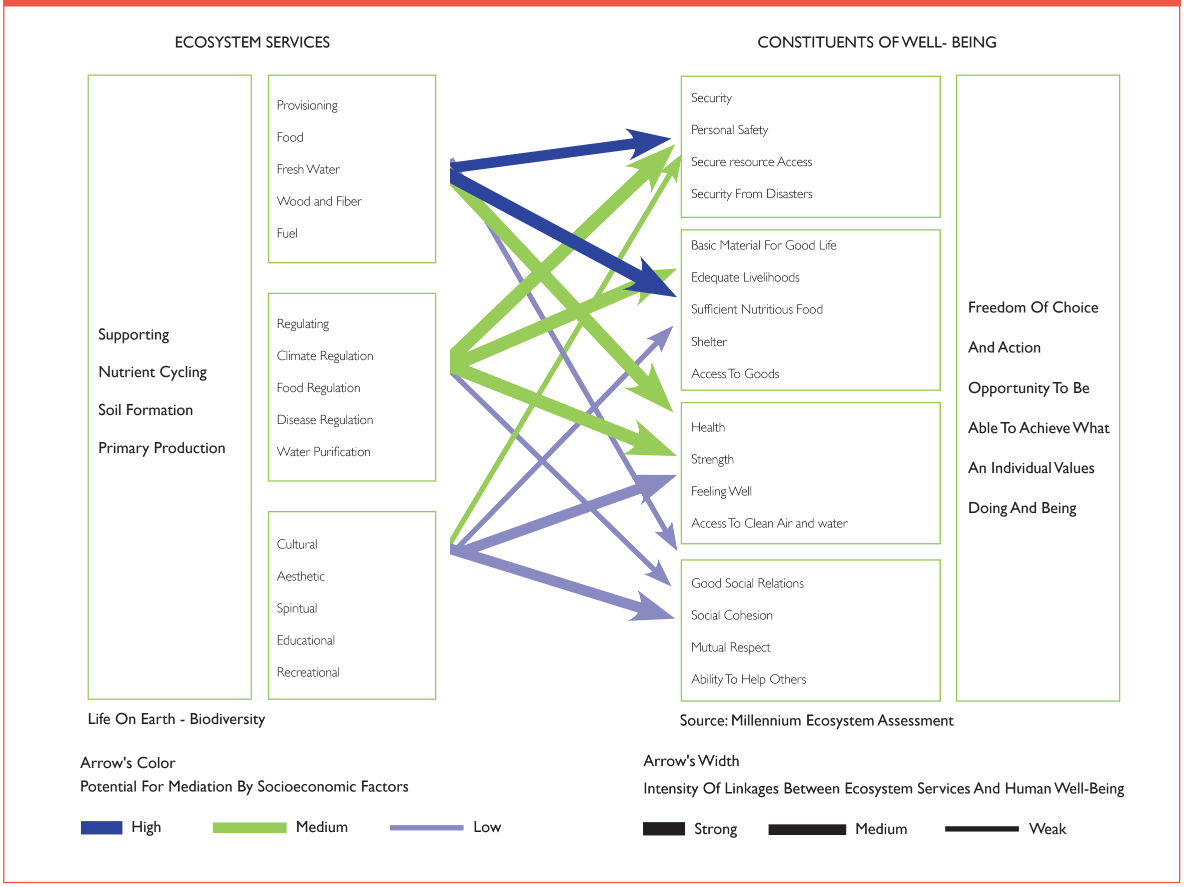
- What are the main interlinkages between environmental change and human activities and their consequences on human well-being? What are the best responses for mitigating and adjusting to these changes?
- What are the interlinkages among environmental drivers?
- How do these interlinkages affect human well being?
- What are the key policy responses to address interlinkages between the environment and human society in the Arab region?

The Millennium Ecosystem Assessment (MA) framework (see Figure 1) will be used to guide the discussion of the interlinkages between ecosystem services and human well-being.

Human-Environment interlinkages

The preceding chapters have assessed the state of resources, ecosystems and key environmental challenges in the Arab region. They have demonstrated that there are interlinkages within

Figure 1. MA conceptual framework showing the interlinkages between ecosystem services and human well-being



MA 2005

Some of the ecosystem provisioning services in the Arab region

and among environmental changes such as land degradation, fresh water stresses, coastal and marine ecosystem deterioration, biodiversity losses, and climate change. Environmental changes are linked across time and among geographical regions through both biophysical and social processes.

Interlinkages and tipping points

The ecosystems and societies of the Arab region are an integral part of the Earth's system in which land, water, biodiversity, human society and the atmosphere are all linked in a complex web of interactions and cycles. Environmental challenges such as climate change, air pollution, biodiversity loss, land degradation, shortage of water resources and chemical pollutants are all linked across the Arab region. For example, some ecosystem changes are caused in part by global climate change. These variations to ecosystems affect the region's climate, particularly through changes in nitrogen and carbon cycles, contributing to the decline in regional ecosystems and resources. Table 1 shows some examples of the linked impacts of environmental changes on human well-being (UNEP 2007).

Social and biophysical systems are dynamic, and characterized by thresholds, time-lags and feedback loops. Thresholds – sometimes also referred to as tipping points – are common in ecological systems, and represent the point of sudden, abrupt, or accelerating, and potentially irreversible change triggered by natural events or human activities (UNEP 2007).

Examples of possible tipping points in the Arab region include the degradation of the Mesopotamian plains, deterioration of groundwater resources, seawater intrusion in most of the coastal groundwater aquifers in the Gulf Cooperation Council (GCC) countries, groundwater depletion and loss of springs and natural habitats. Another illustration is the partial collapse of some fisheries in ROPME in the Arabian Gulf (see Box 2) due to eutrophication and red tide (Cynthia and others 2001, Gilbert and others 2001, Al Ali 2007). The potential for these issues to reach a point of no return – a point where societies lack the capacity to reverse the ecological degradation that undermines human well-being and social stability – suggests that interlinkages need to be kept under close review.

Demography and environmental change

Approximately 90 per cent of the total area of the Arab region lies within arid, semi-arid and sub-humid areas, most of which are characterized by harsh environments, fragile ecosystems, limited water resources, and arable land. Historically, there has been a long and well-established

Table 1. Examples of the linkages among environmental changes and their impacts on human well-being

State Changes	Environmental/ecosystem impacts	Human well-being impacts			
		Human health	Food security	Physical security and safety	Socio-economic
ATMOSPHERE: Increased greenhouse gas concentrations	☐ Temperature ☐ Extreme weather events ☐ Sea-surface temperature ☐☐ Precipitation ☐ Land and sea-ice melting ☐ Ocean acidification	☐ Deaths due to heat stress ☐ Diseases (diarrhoea, vector-borne disease)	☐ Risk of hunger ☐☐Crop production	☐ Human vulnerability	☐ Energy requirement for cooling/heating ☐ Loss of economic properties ☐ Threatened livelihood of communities
LAND: Cropland expansion and intensification	☐ Habitat and biodiversity, soil water retention and regulation ☐Soil erosion, nutrient depletion, salinity, eutrophication disturbance of biological cycles	☐Spread of disease vectors related to vegetation and water (schistosomiasis)	☐ Food and fibre production ☐ Competing demands for water	☐ Hazard from floods, dust storms and landslides during extreme weather events	☐ Secure livelihoods and economic growth ☐ Changes in social and power structures
LAND: Urban expansion	☐ Habitats and biodiversity ☐Concentration of pollutants, solid and organic wastes, urban Islands ☐Disruption of hydrological and biological cycles	☐ Respiratory and digestive tract diseases due to air pollution, poor water supply and sanitation ☐ Stress-and industry-related diseases ☐ Incidences of heat stroke	☐ Access to food and water	☐ Exposure to crime ☐ Traffic and transport hazards ☐ Hazard of flooding caused by soil sealing and occupation of hazardous sites	☐ Freedom of Choice ☐ Opportunity for social and economic interaction and access to services ☐ Competition for financial resources ☐ Sense of community ☐ Sense of isolation Satisfaction of material needs highly dependent on income
WATER: Lowering of groundwater levels	☐ Drying of shallow wells ☐ Salinity and pollution ☐ Land subsidence ☐ Saline water intrusion	☐ Available drinking water ☐ Pollution from land surface and canals	☐ Available irrigation water ☐ Water quality ☐ Salinity	☐ Competition for groundwater	☐ Access costs ☐ Premature well abandonment ☐ Buildings and infrastructure damage ☐ Water treatment costs ☐ Treatment costs for public supply ☐ Inequity
WATER: Surface water (rivers and lakes)	☐ Salinization and pollution	☐Availability of surface water ☐Availability of drinking water ☐Pollution	Availability of irrigation water ☐Quality of water ☐ Salinity	☐Competition for water	☐ Water access costs ☐ Water treatment costs ☐Inequity
WATER: Overfishing, pollution, invasive species	☐Disturbance of trophic balance, changes in plankton communities	☐ Coastal water quality	☐ Fish stocks	☐ Competition for fish resources	☐ Livelihoods
BIODIVERSITY: Habitat conversion for development	☐ Natural habitat ☐ Soil degradation ☐Homogenization of species composition ☐Fragmentation of ecosystems	☐ Species to rely on	☐Agricultural production ☐ Fisheries ☐ Water regulation potential	☐ Coastal protection	☐ Traditional knowledge
BIODIVERSITY: Introduction of invasive alien species	☐ Competition/predation of native species ☐ Species extinctions ☐Homogenization of species ☐ Genetic contamination ☐ Changes in ecosystem functions	☐ Costs	☐ Food production ☐ Traditionally available resources ☐ Potentially useful species		☐ Costs for agriculture, forestry, fisheries and water management

Key: Arrows show state trends and the impact of change ☐ = increase, ☐ = decrease.

UNEP 2007

Box 2. Eutrophication in Kuwait

Kuwait Bay is a shallow embayment lying amidst Kuwait's coastal line

Nutrient concentrations or eutrophication have often been in abundance in the Kuwait Bay especially in its northern parts. These rising nutrient concentrations have been cited as the cause of death of marine life. For example, in 1986, eutrophication was responsible for the death of tonnes of fish as well as other marine animals, including 527 dolphins, 7 dugongs, 58 turtles and more than 1 000 cuttle fish, along the shores of the Gulf of ROPME. During 1990 and 1991, 137 sea turtles were found dead along the Omani coast. Similar phenomena were reported along the coasts of Bahrain, Iran, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates between 1993 and 1998.

Kuwait Bay has experienced a series of changes over the years, including the release of both treated and untreated sewage and oils, and untreated wastes from sources connected directly to the storm water network. Two commercial ports and several marinas, three power stations, and a commercial fish farm exert pressure on the bay. While no adverse human health effects were associated with the bloom, the death of fish and subsequent closure of shellfish and selected finfish markets resulted in significant economic loss in the region. The toxic algal bloom event, the bad red tide that occurred in 1999 in ROPME within the Arabian Gulf, and an associated fish kill in the Kuwait Bay highlight the need to monitor and conduct research in the Arabian Gulf and Kuwait Bay. It is also necessary to focus on nutrients and eutrophication as well as oil-related pollution issues.

In August and September 2001, more than 2 500 metric tonnes of mullet died in the Gulf as a result of the propagation of water moss that produced great quantities of Streptococcus agalactiae. It is believed that this bacterium emerged as a result of the continuous release of organic substances (from human activities) to the waterway, or from contaminated fish food released to the water way (from fish farms in Kuwait Bay) where a combination of factors created the ideal environment for the propagation of water moss and bacteria. Moreover, the continual decrease in area of the Iraqi lakes which served as a natural system for wastewater treatment, in addition to the difficult conditions prevailing in the region, made the Gulf region more vulnerable to natural disasters.

UNEP 2002, Heil and others 2001, Glibert and others 2002

productive relationship between the desert's marginal resources and the population of the region. Throughout recorded history, the lands of the Arab region have generated needed grains and animal products for human consumption. Furthermore, Arab communities developed indigenous technologies and regulations to protect and improve their land and water resources. Their efforts kept the use of these resources balanced in order to meet their long-term food security needs. However, more recently the demand for land and water resources has begun to exceed the carrying capacity of these lands, and additional land degradation has further limited productivity (Abahussain and others 2002).

Social change processes such as population growth, economic growth, consumption and production patterns are increasingly seen as the major drivers of environmental change in the

Arab region (Vitousek and others 1997 and 2008, Schellnhuber 1999, UNEP 2003). Population growth has put considerable pressures on the limited land and water resources in the region. These pressures, along with changing lifestyles and consumption patterns, and increasing food demand combined with the aridity of the environment, have accelerated land degradation. They have also caused land-per-capita to drop from 18.8 ha/capita in 1950 to about 4.2 ha/capita in 2007 (see Figure 2), and is expected to be further reduced to 2.3 ha/capita by 2050 (WRI 2007) (see chapter 3).

This high population growth rate increases the demand for natural resources such as fresh water, land resources, and urban space; a demand that exceeds the carrying capacity of natural ecosystems. It also increases the production of waste and pollutants (UN-ESCWA 2002) (see chapter 10).

According to estimates used in this report, the population of the Arab region is expected to rise from about 334 million in 2008 to more than 586 million by 2050 (LAS and others). Programmes to address population issues need to be closely related to other policies, such as those for economic development, gender equality and empowerment of women.

The impacts of population growth on the environment are inextricably linked to people's consumption of raw materials and the subsequent production of waste, all of which place tremendous pressure on the environment. Consumption, particularly in richer Arab countries, has been increasing at a faster rate than that of population growth, though this contradicts most of the cultural and religious values in the Arab region (see Box 3).

Urbanization

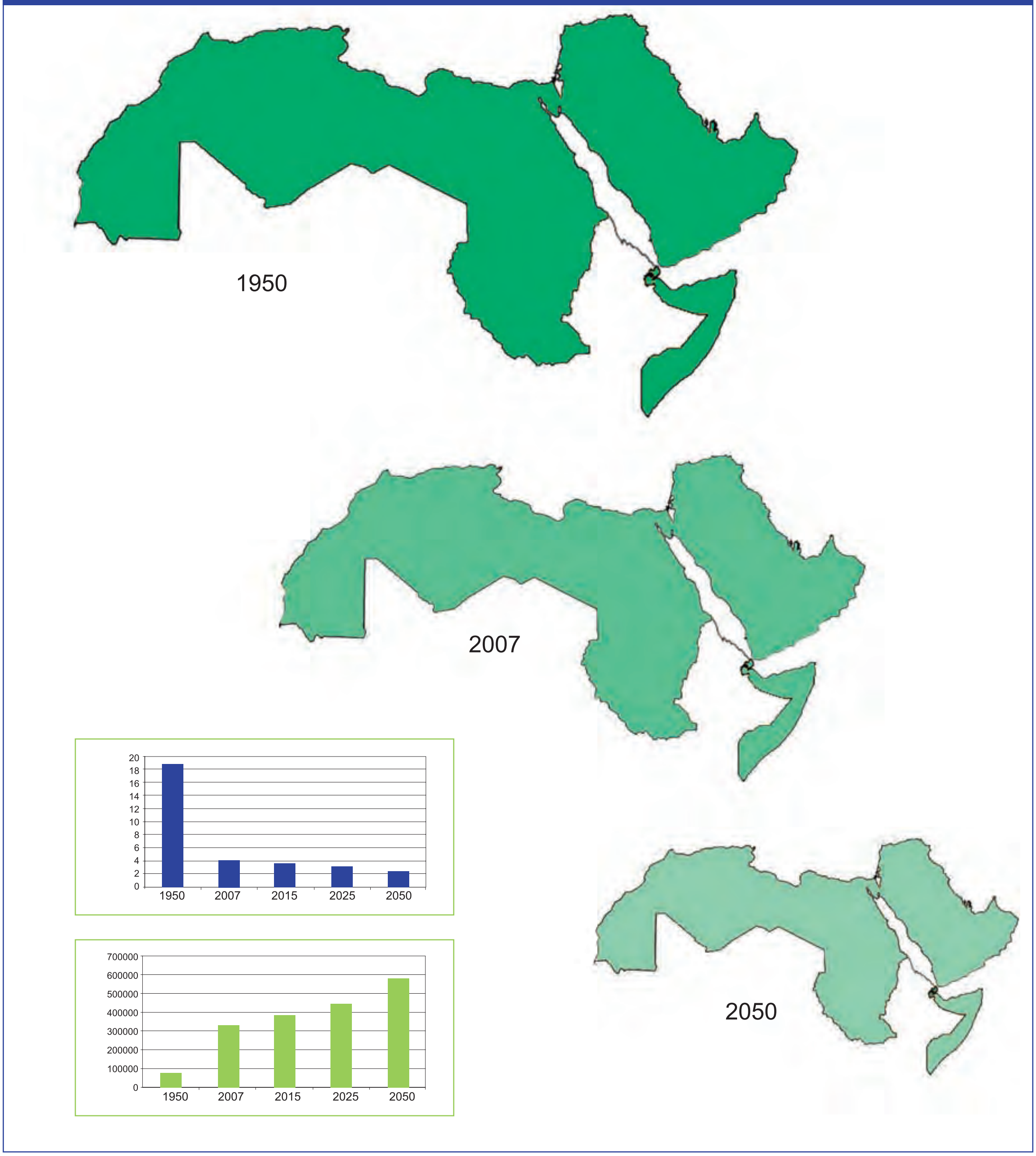
The Arab region has relatively high urban populations, as 70 per cent of inhabitants live in urban areas. This is in stark contrast to urban population figures in 1950, when only 30.2 per cent of the population was urban. In 1980, urban populations increased to 54.9 per cent of the total Arab population, and reached 69.2 per cent in 2005. Urbanization has increased since then and was predicted to reach 70.9 per cent, 74.4 per cent and 77.8 per cent in the years 2010, 2020 and 2030, respectively (UN-ESCWA and LAS 2007).

The figures vary in different sub-regions. For example, according to 2005 Statistics, Kuwait's urban population was 96.4 per cent, Qatar's was 92.3 per cent and Bahrain's urban

Landsat/ NASA

A landsat photo showing urban growth in Gaza in the occupied Palestinian territories in 1987- 2002

Figure 2. Our "shrinking" Arab region – the boxes show projected population growth in the Arab region and land share per capita



data from FAOSTAT 2008

population was 90.2 per cent. For the same year, countries like Yemen, the Comoros Islands and Sudan urbanized populations of only 26.3 per cent, 36.3 per cent and 40.8 per cent, respectively (UN-ESCWA and LAS 2007).

Both spatially and temporally, the rapid growth of the old urban centres as well as the new ones, lacked proper strategic planning and management. The result of this has been increasing urban poverty, the emergence of more slums, shortages in basic urban

Box 3. Religion, culture and consumption


Abdalrahem AL Arjan

Across the Arab region much of the traditional and indigenous laws associated with sound environmental practice and conservation, such as Hema, Falaj, water harvesting, and rationalizing consumption have fallen into disuse. Religious and cultural norms and values in the Arab region should be drivers for better environmental management, rational consumption, conservation of natural resources and pollution prevention.This allows each individual to take part in the protection and development of the environment and natural resources in the region which is the cradle of civilization and religions. Currently, socio-cultural concerns and priorities are not addressed because of the lack of public awareness and knowledge about interlinkages between religion, environment and human well-being.

and sanitary services, and urban encroachment on coastal ecosystems (see Chapter 4). Moreover, several cities in the region are congested, leading to serious deterioration of social environments, widening of economic gaps between areas and increase in traffic congestion. Other adverse impacts included mounting production of pollution from industrial and domestic wastes as well as transport pollutants (solid and liquid) (see Chapter 5).

The intensification of agricultural production to meet urban demand for food has led to heavy use of fertilizers and pesticides, causing pollution and degradation of land and water resources (see Chapters 2 and 3). The rapid urbanization rates across the region have caused even more decrease in income, increase in illiteracy and health problems, inaccessibility to sanitation, air and water pollution, deterioration of cultural heritage and overall low living standards (see Chapter 5). Such conditions delay or potentially prevent Arab countries from achieving the Millennium Sustainable Development Goals. .

Water demand

In addition to the severity of climatic conditions, the socio-economic growth and demographic changes in Arab countries have invariably put great and sustained pressures on the region's limited water resources. This has resulted in the reduction of river flows, the silting up of estuaries and pollution of coastal water by suspended particles. Depletion of underground fossil water reserves led to the lowering of groundwater levels, encroachment of saltwater into aquifers, and salinity. All of these effects adversely impact the agricultural sector, food production, biodiversity and human well-being.

Fresh water is the most precious and limited resource in many countries of the Arab region (ACSAD 1997). Estimates of water resources in the region indicate that the total available natural water resources are 262 900 million cubic metres per year, made up of 226 500 million cubic metres surface water and 36 300 million cubic metres renewable groundwater resources, in addition to 11 874 000 million cubic metres of non-renewable fossil groundwater (ACSAD 1997). There is, however, great variability in the share of these water resources in Arab countries. Figures show that in 1990 most Arab countries were already suffering from chronic water scarcity. If rapid population growth and fast urbanization continue, the water per capita is likely to be reduced in Arab

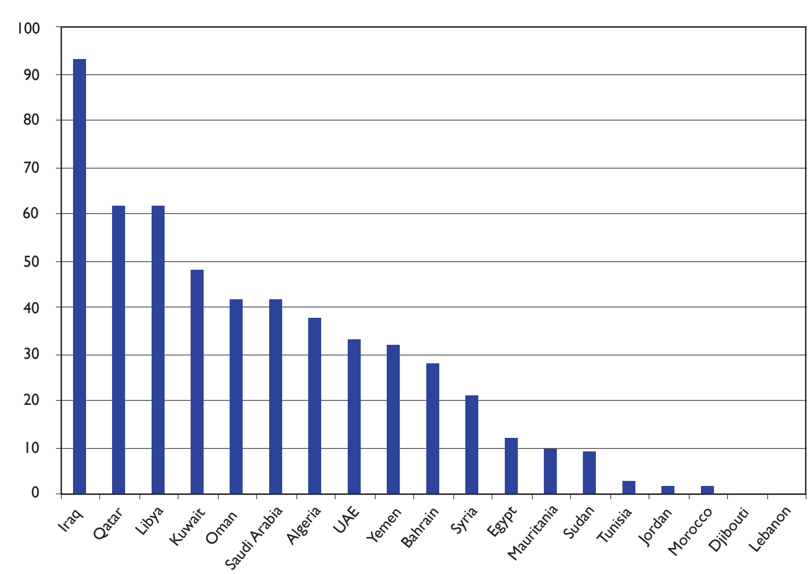
Youssef Sabry

countries by about 50 per cent by the year 2025 (Abahussain and others 2002). The increased use of water resources in response to rising water demands is not only reducing availability but also jeopardizing the quality of these resources, both of which have a direct impact on ecosystem services and human well-being in the region (see Chapter 2).

Economic development

In the Arab region, social and economic sectors have transformed natural resources (equated to natural capital) into forms that support development and human well-being. High dependence on natural resources has made Arab countries extremely vulnerable to economic shocks and fluctuations in international prices, which result in profound repercussions on economic growth, employment, and economic stability, as well as on the environment. A clear example is the decline of oil prices in the 1980s that plunged the region into a decade of macro-economic instability, characterized by rising debts, high unemployment rates and balance of payment difficulties. With the

Figure 3. The share of the oil sector in the GDP (%) in Arab economies



Al-Moneef 2006

economic reforms of the late 1980s and early 1990s, and the recovery of oil markets, the region witnessed some economic stabilization during the 1990s, reflected in reduced inflation rates, lower public and foreign deficits and a noticeable increase in investments. Nevertheless, the impacts on economic growth were limited (World Bank 2005).

By 2002, population increases eroded economic achievements in Egypt, Yemen and Sudan (UNEP 2007b). Nevertheless, the sharp increases in oil prices in 2002 caused economic growth to pick up significantly, particularly in the GCC countries and Libya, which experienced remarkable capital inflows and rising investments (World Bank 2005).

Table 2. GDP per capita (PPP US$) in 2005 and CO2 emissions per capita (metric tonnes of CO2 per person) in 2003 in the Arab region

Country	GDP per capita (PPP US$)(2005)	CO2 (2003)
Algeria	7 062	2.5
Bahrain	21 482	22.5
Egypt	4 337	1.8
Jordan	5 530	2.8
Kuwait	26 321	24.1
Lebanon	5 584	4.9
Libya	1 335	8.2
Morocco	4 555	1
Oman	15 602	12.3
Qatar	27 664	44.4
Saudi Arabia	15 711	13.3
Sudan	2 083	0.3
Tunisia	8 371	1.9
UAE	25 514	23.7
Yemen	930	0.8

UNDP 2007

Oil revenue has since been used to modernize infrastructure, create employment and industries, and improve social services and human well-being, even for Arab non-oil exporting countries (Al-Moneef 2006).

Increasing oil prices and GDP have been critical drivers of this trend. Collectively, the Arab region holds 61 per cent of the world's oil reserves and 26 per cent of the world's gas reserves (UN-ESCWA 2007). Oil is the major source of income in the GCC, Iraq, and Libya, representing about 40 per cent of GDP and 70 per cent of government revenues (UN-ESCWA and API 2002) (see Figure 3). However, income per capita varies greatly among the sub-regions, especially where oil is not present, ranging from US$27 664 in Qatar to less than US$1 000 in Yemen (UNDP 2007).

There is a positive relationship between GDP and CO2 emissions per capita in the Arab region (see Table 2), which is related to total energy consumption. This is due to the fact that higher income per capita allows people to consume more CO2 producing energy sources. For example, the oil producing Arab countries have the highest GDP per capita, and the highest CO2 emissions per capita.

Rapidly expanding populations, rural-urban migration, and widespread subsidies have contributed to a rising demand for energy in the Arab region since 1990. On average, energy consumption per US$1 000 GDP increased by 10 per cent between 1990 and 2000. While the Mashriq and the Arab least developed countries (LDCs) witnessed decreases in energy consumption of 5 per cent and 22 per cent respectively, energy consumption (per US$1 000 GDP) in the GCC countries rose by 2 per cent. The Maghreb maintained a constant average level over the same period. In per capita terms, a large discrepancy in energy use persists between the GCC countries and all other Arab countries. In fact, energy consumption per capita in GCC countries remains among the highest in the world. The transport and power sectors have all used increasing shares of energy through electricity generation – especially for air conditioners and water desalination, which are both energy intensive processes (UN-ESCWA and LAS 2007).


Abdalrahem AL Arjan

Impacts of urbanization in some Arab countries

The total population of the Arab region was only 5 per cent of the world population in 2004 and its total CO_2 emissions were estimated to be around 134 840 million tonnes which only represent 4.7 per cent of world emissions. The average annual per capita share of CO_2 was 4.5 tonnes for both the Arab region and the world, compared to the largest energy consumer, the United States, at 20.6 tonnes of CO_2 per capita (see Figures 4 and 5).

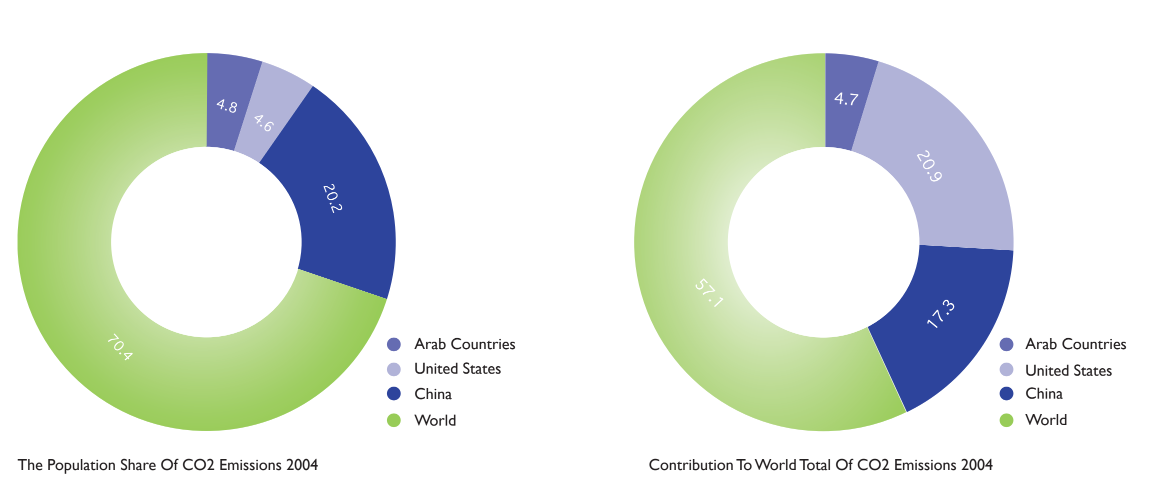
Although the Arab region's GHG emissions are low, the region will still be affected by climate change (FAO 2008, UNDP 2007) (see Box 4). Therefore, it is necessary to assess the vulnerability of the ecosystems in the region and develop specific policies to address crises and implement proper climate change adaptation measures. The principle of "think globally and act locally" should guide measures to deal with the issue of CO_2 emissions and climate change in the Arab region.

Climate change, biodiversity loss and desertification interlinkages

There is a strong interlinkage between climate change, biodiversity loss, and desertification. This is because climate change can be an important driver of desertification and biodiversity loss. Climate change may adversely affect biodiversity and exacerbate desertification due to increased evapo-transpiration and a likely decrease in rainfall in drylands (MA 2005). Land degradation can also lead to desertification, creating a major obstacle to sustainable development in the Arab region. Figure 6 highlights the interlinkages between aquatic and terrestrial ecosystems and the atmosphere and illustrates the links between climate change, desertification and biodiversity loss (Gitay and others 2002, IPCC 2007, SCBD 2003, Root and others 2003, Parmesan and Yohe 2003).

Biodiversity is, in many instances, under pressure from multiple sources. These include land degradation, land and water pollution, and invasive alien species. Changes in climate exert additional pressures on biodiversity, such as interference with the timing of animal and plant reproduction, plant productivity, animal migration, change of the growing season's length, species distribution and population size, in addition to the frequency of pest and disease outbreaks. This leads to the loss

Figure 4. The percentage of population share, the world total CO2 emissions and the Arab region's share for 2004



UNDP 2007

of species diversity, including many species that are potential sources of medicinal, commercial and industrial products. According to the Millennium Ecosystem Assessment (MA 2005), biological diversity is adversely affected by desertification, which also contributes to global climate change through soil and vegetation loss (see Chapter 6).

According to Figure 6, the major components of biodiversity loss (in green) directly affect major dryland services (in bold). The inner loops show the linkages formed between desertification, biodiversity and climate change through soil erosion. The outer loop interrelates biodiversity loss and climate change. On the top section of the outer loop, the decline in primary production and microbial activity reduces carbon sequestration and contributes to global warming.

On the bottom section of the outer loop, global warming increases evapo-transpiration, thus adversely affecting biodiversity. Changes in community structure are also expected because different species will react differently to the elevated CO2 concentrations.

Moataz Ali

While more work is needed to fully examine the consequences of climate change in the region, extreme weather events in Arab countries show early signs that climate change reflects global trends. Records of large amounts of rainfall, high and low temperatures, prolonged droughts, sand storms, heat waves, and shifts in temporal and spatial precipitation may suggest the beginnings of a blurred era of prolonged climate change in the region.

One example of an extreme climatic event is the heat waves that struck the region in the summer of 2007. These heat waves added a new dimension to the impact of extreme events on national

Box 4. Impacts of climate change in the Arab region (based on national communications)


UNEP

Tunisia: By 2030, a 1.1°C rise in temperature is expected, accompanied by severe drought incidences and a 28 per cent decrease in water resources. Additionally, a loss of 20 per cent of arable lands and 50 per cent of un-irrigated rangelands is predicted in the southern part of the country.

Egypt: Potential sharp decline in production of major crops (wheat and corn), erosion of the Delta shores, the intrusion of seawater into fresh water and the degradation of ecosystems as a result of climate change. Moreover, a potential 0.5-1 m increase in seawater level during the coming 100 years will lead to the submerging of 30 per cent of Alexandria by seawater, the displacement of 2 million people and the loss of 195 000 jobs. This will result in an economic loss estimated at around US$35 000 million if no measures are undertaken to face these problems. The most affected sectors will be agriculture, industry and tourism respectively.

Lebanon: The rise in temperature will likely lead to the movement of plants in the mountains and the migration of species to other places of higher altitude. Rainfall shortage is also expected in addition to the steeping of some coastal areas and small islands.

Morocco: By 2020, a 0.6–1.1°C rise in temperature is expected, in addition to a 4 per cent decrease in rainfall and an increase in the severity and recurrence of droughts, leading to a 15 per cent decline in water resources. Moreover, agricultural production is estimated to decrease by about 50 per cent in the years dominated by drought and 10 per cent in the years of rainfall. Irrigation requirements are also expected to increase by 7–12 per cent.

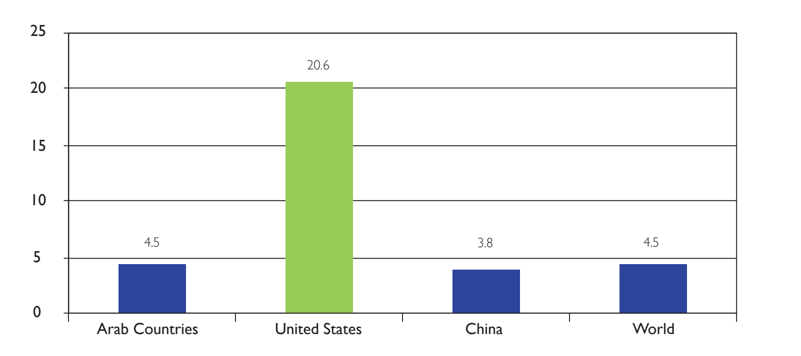
Saudi Arabia: In summer, temperatures are expected to increase by 2.2–2.7°C in the north western parts of the Kingdom and by 0.2–0.4°C in the south and south west. This rise in temperature will adversely affect agricultural production by 5–25 per cent in all areas. Furthermore, a 0.5 m increase in sea surface level by 2100 will submerge 2 663 hectares of sandy beaches.

Sudan: A significant rise in temperature by 1.5–3.1°C is expected by 2060, coupled with an estimated 6 mm/month decrease in precipitation rate during the rainfall season. These variations are expected to have adverse impacts on agriculture, water resources and public health sectors. North Kordefan climate scenarios refer to the expected rise in surface temperatures by 1.5°C between 2030 and 2060, accompanied by a 5 per cent decrease in rainfall which leads to a 70 per cent reduction of white corn production.

LAS 2008

economies. Temperatures reached 40°C in some areas in Jordan where unfavourable farming conditions existed, leading to a reduction in agricultural productivity and water shortages. Hot spots of heat waves were also recorded in the skies above the Arabian Peninsula sub-region (UNEP 2006). High temperatures associated with heat waves have caused the persistence of smog pollutants as well, especially in the morning hours when thermal heat inversion occurs in most Gulf cities. In addition, severe dust waves recurred in the Arabian Peninsula during 2008 and 2009.

Figure 5. CO2 emission per capita in 2004 (tonnes)



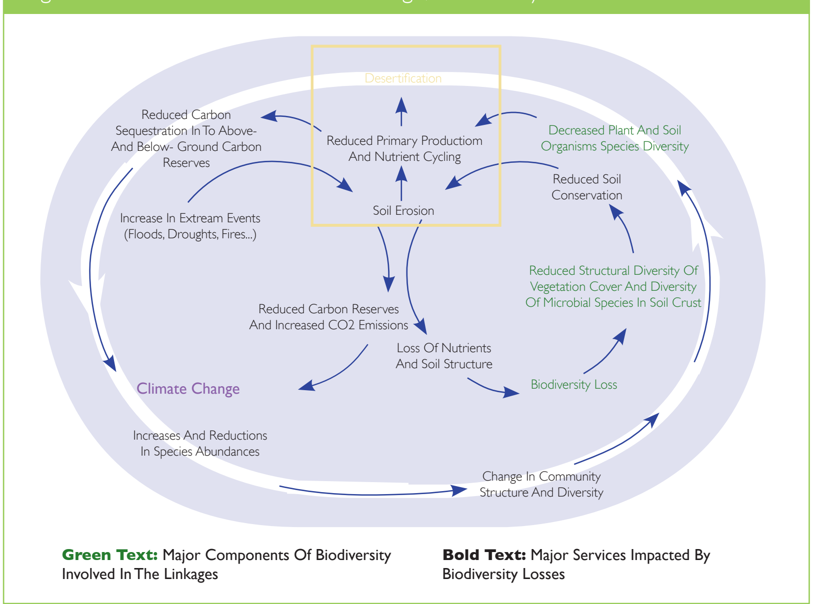
UNDP 2007

Although drylands are characterized by harsh environments, fragile ecosystems, limited water resources and arable plots, agriculture is the main economic activity in several Arab countries particularly in the Mashriq and Maghreb sub-regions as well as Yemen. Agriculture is the most important sector in low-income Arab countries, responsible for 25–50 per cent of their gross domestic product (GDP) (AOAD 2008), and for employing more than 40 per cent of the work force. Statistics indicate that all together, there were nearly 30 million agricultural labourers in the Arab region in 2005, representing 30.6 per cent of the total work force amounting to 97.7 million workers the same year.

Agriculture is also highly dependent on ecosystem services, such as predictable climatic conditions, genetic resources, water regulation, soil formation, pest regulation, and primary productivity of land and water. Accordingly, any change in global climate will adversely affect agricultural production.

The Food and Agricultural Organization (FAO 2008) indicated that if temperatures increase by 3–4°C there will be a reduction in agricultural productivity in the Arab region by 23–35 per cent. Ecosystem services must be secured if the sector is to meet the region's demand for food. Therefore,

Figure 6. The links between climate change, biodiversity and desertification



MA 2005


UNEP

given projections that the Arab region's population will increase to more than 586 million by 2050, increasing food production is required in order to meet the MDG on hunger.

A report published by CGIAR, GEF 2002, and UNEP 2007, indicated that agricultural growth is directly correlated to human well-being, notably in terms of income and livelihood of farmers. For every dollar earned by farmers in low-income countries, there is a US$2.60 increment in incomes in the economy as a whole. Therefore, an increase in crop yields has a significant impact on the upward mobility of those living on less than a dollar a day. The World Bank estimates that a 1 per cent increase in crop yields reduces the number of people living under US$1/day by 6.25 million.

As a major component of GDP, agriculture is a significant driver of various aspects of sustainable development, namely labour, rural-urban migration, water use, land management, research and technology development, food security, society and culture. Although considerable efforts have been made by Arab countries to improve field management techniques, most of the cropping patterns adopted under rain-fed and irrigated conditions need to take advantage of more innovative trends, such as drip irrigation. Furthermore, agricultural protectionism has led to unsustainable patterns of agricultural production, rendering the sector inefficient and particularly vulnerable to trade liberalization agreements (WTO) that seek to eliminate agricultural subsidies and reduce tariffs. Reform in the agricultural sector depends on progress made towards setting equitable standards and norms on an international basis, through WTO negotiations.

The main challenge for the agricultural sector in the Arab region is the availability of irrigation water. The proportion of water used in the different sectors in every Arab country indicates that 88 per cent is used by the agricultural sector compared to usages by other sectors. Water usage is inefficient in all sectors that use water, especially in agriculture. This inefficiency has generated a range of problems such as water logging, salinity, low productivity, soil infertility in addition to the deterioration of water quality. In Egypt, where 3.4 million ha of agricultural land are irrigated, about 1 million ha suffer from salinization. Salinity is increasing through both excessive irrigation and seawater intrusion into depleted coastal aquifers (Bazza 2005). Box 5 demonstrates the interlinkages of agriculture, irrigation and soil salinity in West Asian Arab countries.

Environmental change and human health

The causal links between environmental change and human health are complex because they are often indirect, displaced in space and time, and dependent on a number of forces (see Figure 8). Traditionally, concerns about water and human health have focused on the diseases that result from

Box 5. Irrigation and salinity in West Asia

Over the last 20 years, irrigated land in West Asia increased from 410 000 to 730 000 ha, raising food and fibre production, but at the expense of rangelands and non-renewable (fossil) groundwater. Agriculture consumes 60–90 per cent of the accessible water in this sub-region, but contributes only 10–25 per cent of GDP in Mashriq countries, and 1–7 per cent in GCC countries.

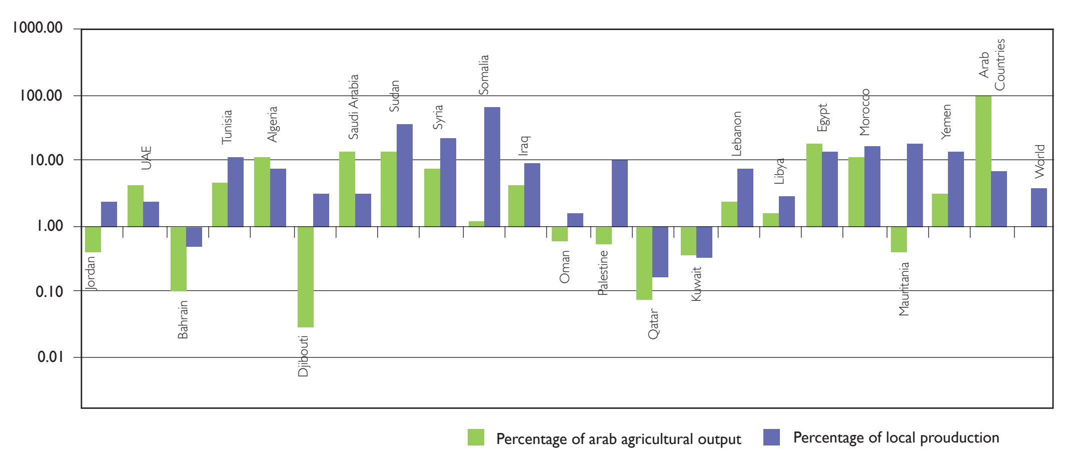
Generally, in the agricultural sector in Arab countries, water is used inefficiently in traditional flood and furrow irrigation systems as well as for crops with high water demand. Studies indicate that field water losses, combined with leakage from unlined canals, exceed half of the water withdrawn for irrigation.

UNEP 2007

inadequate or unsafe water supplies or sanitation. Climate change can place additional stress on water resources necessary for agricultural production or elements of coastal and marine ecosystems, like the integrity of coral reefs and coastal fisheries. This can lead to malnutrition, stunted childhood growth, susceptibility to infectious diseases, and other ailments. All this underlines the necessity of studying the relationship between environmental changes and human health (see Table 3).

Deforestation may affect human health by altering infectious disease patterns, such as disease vectors like mosquitoes, and their distributions over time. Table 3 shows that there are many environment-related diseases particularly in relation to water use, climate change and use of chemicals. Human use, management of, and contacts with water can affect disease incidence and transmission. This can happen on multiple scales, from a small puddle to a major irrigation system. Dam construction is a driving force for infectious diseases because it alters the nature of aquatic habitats and affects species survival, leading to changes in species populations, and increasing the number of disease vectors (Patz and others 2005) such as increased incidence of schistosomiasis (see Box 6). Moreover, there have been dramatic increases in morbidity and mortality due to malaria in Arab African countries.

Figure 7. Agricultural share of the GDP in selected Arab countries 2005



AOAD 2008

Another impact of climate change is the decrease in water availability and food production. This can have adverse effects on health as well, which is likely to be most detrimental in cases of heat stress, and can possibly cause increases in vector-borne diseases, such as malaria (see Box 6) and waterborne diseases, such as schistosomiasis (see Box 7) in addition to malnutrition related illnesses.

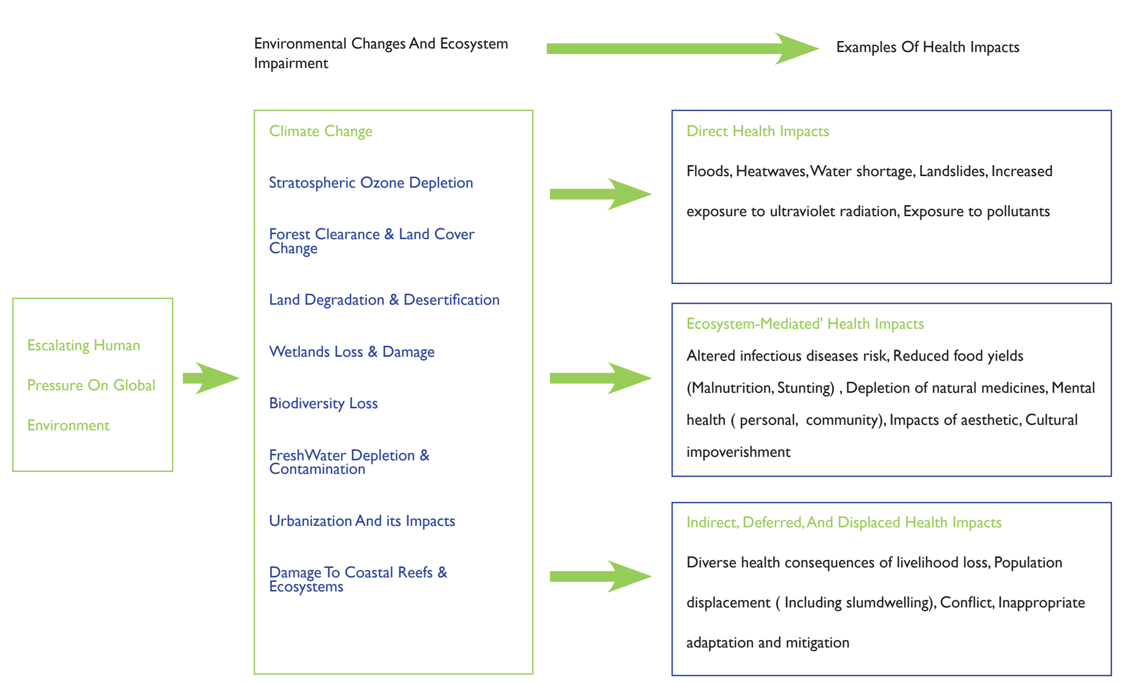
Policy, institutional and governance interlinkages

Understanding the human-environment connection with its complex interactions across human and natural ecosystems is vital for policy creation and interventions that contribute to achievement of sustainable development goals and enhancement of human well-being in the Arab region. Policy coherence requires addressing interlinkages at multiple levels and establishing institutional approaches that bridge decision making across regional, national and local levels.

Sand storm in Riyadh, Saudi Arabia , March 2009

In general, the interlinkages approach underlines the importance of the interaction between Arab societies and the environment. It also focuses on the synergies and coordination among multilateral environmental agreements (MEAs), such as the

Figure 8. Harmful effects of ecosystem change on human health



MA 2005

Table 3. The spread of infectious diseases and their linkage to human activities			
Drivers and pressures	**Impacts**	**Examples of implications**	**Examples of potentially infectious diseases**
Agriculture	Mono-culture destroys the natural balance, allowing the propagation of vectors. Concentration of domestic animals/cattle close to human settlements. Land erosion and gullying produces additional habitat for vectors. Environmental pollution (including contamination with pesticides).	More favourable conditions for the propagation of disease vectors. Vector numbers and habitats increase. Increased contact with vectors. Development of resistance by disease vectors.	Malaria, Schistosomiasis,
Dam building and irrigation	More open water. More stagnant water. More fertile soil and sand beds. Environmental pollution.	Increased habitat and breeding sites for vectors and carriers.	Rift Valley Fever, Schistosomiasis, West Nile fever, Malaria.
Rapid and unplanned urbanization	Ecosystem fragmentation. Destruction of natural balance. Lack of water, sewage and waste management systems.	More sites and favourable conditions for the propagation of disease vectors. Spread of vectors and parasites. Increased contact between uninfected and infected people.	Tuberculosis, Dengue fever hemorrhagic fever, Plague, hantavirus pulmonary syndrome.
Untreated drinking water and waste water; Inadequate sanitation	Settlements without clean water and sanitation. Water pollution.	Increased human contact with infection and increased mobility of infection as a result of poor water treatment and management	Leptospirosis, Malaria, Cholera, Cryptosporidia, Diarrhoeal diseases, Dengue fever hemorrhagic fever.
Industry and transport sectors	Deteriorating air quality. Anthropogenic greenhouse gas emissions leading to global warming.	Impaired lung function. Increased mobility of infected people. Spread of diseases and vectors.	Aggravated respiratory diseases and infections, Meningitis.
Chemical use; Antibiotics in livestock and livestock waste	Antibiotics in livestock products and waste.	Bacteria develop resistance to antibiotics.	Hepatitis, Dengue fever, hemorrhagic fever, Antibiotic-resistant bacterial diarrhoeal disease.
Deforestation	Ecosystem fragmentation. Destruction of natural balance leading to a decrease in natural predators and changes in species dominance. Easy access by farmers/workers/hunters to new land and natural areas. Habitat disturbance.	More favourable conditions for the propagation of disease vectors. Increased number of vectors in human settlements. Increased Vectors and habitats. Increased contact with animal reservoirs and vectors.	Yellow fever, Malaria, Kyasanur forest disease, Ebola and other hemorrhagic fevers, Zoonotic diseases begin to threaten human populations.

Note: This table is selective and illustrative. Some diseases have more than one environmental 'driver'. Many of the underlying drivers are primarily cultural, economic, demographic, and social.

UNEP 2007

United Nations Framework Convention on Climate Change (UNFCCC) and the UN Convention to Combat Desertification (UNCCD). As a result, this approach can improve the implementation of regional or MEAs as binding legal instruments that enhance human well-being in the Arab region.

Across much of the Arab region, interlinkages among institutions and within governance processes are poorly developed. Developing and institutionalizing the interlinkages approach can improve opportunities for more effective national and regional cooperation, inclusive policies, as well as stronger and more sustainable partnerships in order to realize the MDGs. The first step to be taken by institutions is to enhance the participation of all actors in the policy making processes. The inclusion of civil and private sector groups and citizens in policy making, environmental management and decision making processes has had positive effects, such as the formulation of environmental strategies in the UAE, Bahrain, Kuwait and various other Arab countries.

Nevertheless, Arab organizations face the challenge of effectively linking national responses and policies to those at the regional level. Therefore, the management of transboundary environmental problems, biodiversity issues, and other spatial development matters, requires the adoption of the interlinkages approach, which can bring together the relevant actors and players. The Arab region has already made progress in the planning and environmental management of its resources. Within the context of the linkages between environment and development issues, almost all Arab countries have established institutions, authorities or ministries that have accorded environmental issues utmost national priority, allowing them to be elevated within the realm of policy.

A major issue that has to be emphasized in the field of environmental policies is the inclusion of the environment's economic evaluation, the economic cost of its degradation as well as its rehabilitation in the body of the environmental policy. This has to be done through revising the economic system in the Arab states in terms of natural resources issues and adopting the following two economic principles, those who pollute the environment should bear its rehabilitation costs; those who use natural resources should pay their value to society. The first principle necessitates

Box 6. Malaria in Arab countries

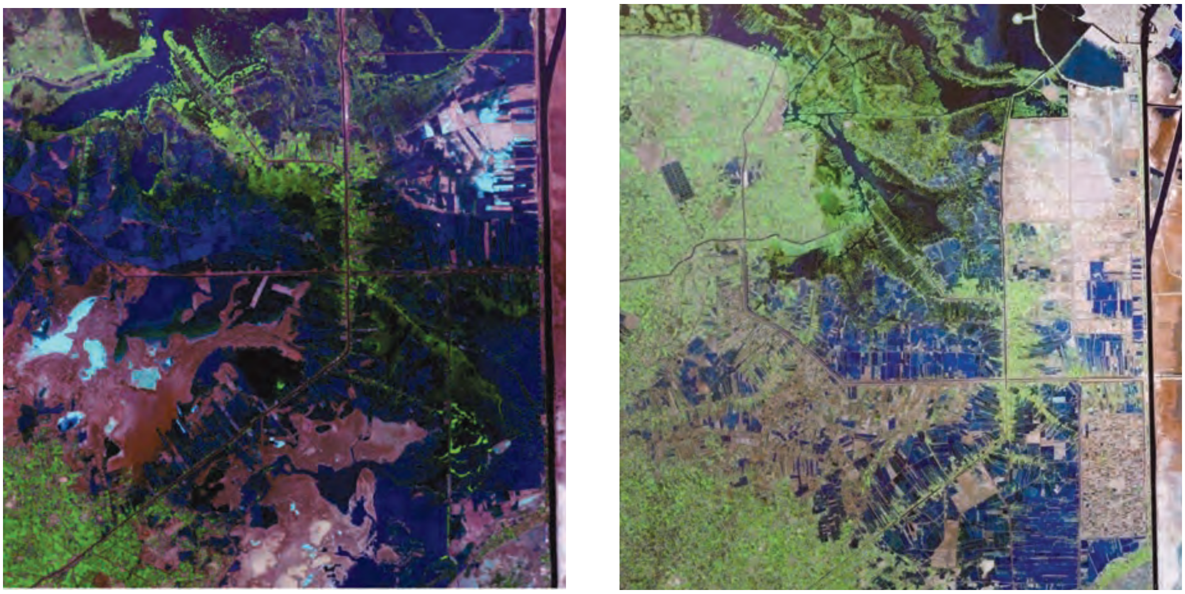
Waterborne diseases are a particularly severe problem due to lack of water supply and sewage infrastructure. While malaria has been almost eliminated in the majority of Arab countries, it remains highly endemic in the Arab LDCs, where, on average, 1 case per 100 000 people was reported in 2005. Djibouti, Somalia, Sudan and Yemen accounted for 98 per cent of notified cases in the region. Sudan alone bore 76 per cent of the regional burden.

UNDP 2007

Box 7. Irrigation, schistosomiasis and the West Nile Virus

Snails serve as an intermediate reservoir host for the debilitating disease schistosomiasis, and irrigation canals provide them with an ideal habitat. The increasing fecundity and growth of freshwater snails are associated with decreased water salinity and increased alkalinity following downstream irrigation. The growth of these snails is also related to water flow changes. (Abdel-Wahab and others 1979). Irrigation ponds, canals, and ditches can also provide larval habitat for vector mosquito species such as Culex tarsalis which preys upon both animals and humans. Culex tarsalis is a major bridge vector for enzootic diseases (diseases that are constantly present in non-human animal populations).

UNEP 2005



NASA

Degradation of wetlands and land seizure from the Mediterranean coastal lakes (Al Manzala lake-Egypt) by human activities in urban and agricultural development. Landsat 5 and 7 photos show variations between 1990 and 2002

that products' market prices reflect the total cost of environmental degradation which results from economic activity. On the other hand, the second principle requires that the products' prices reflect the total social cost of using or depleting natural resources.

The need to stop supporting any activities that lead to depletion of natural resources, particularly non-renewable resources, in addition to the imposition of fees, taxes or penalties on the consumption of these natural resources and using their returns to rehabilitate the destroyed environment (Al Kholi 2002).

The following are some major responses (options) or policies that have been developed to address the impacts of environmental changes on ecosystem services, human well-being and governance in the Arab region.

Land interlinkages

Land degradation is interlinked with a number of environmental changes in the Arab region. These changes include climate change, biodiversity loss, water and wind erosion, salinization, and water resources degradation, qualitatively and quantitatively. These resources are also interlinked with food production in the agricultural sector and rangelands. Therefore, these strong interlinkages should be taken into account when formulating policies to alleviate land degradation in the region (see Chapter 3). Land governance has social, economic and environmental dimensions that are interlinked, and thus require that all available options are properly considered in order to minimize potential conflicts among Arab societies and across economic and industrial activities. Land in the Arab region is one of the most critical resources for agriculture, mining, biodiversity conservation, urbanization, tourism as well as industrial and infrastructure development. Given the competition and interlinkage among these sectors, land governance matters and policies are thus considered complex issues that require capitalizing on potential synergies and interconnections among various sectors to satisfy competing demands (UNEP 2003).


UNEP

In strategic terms, management of both water resources and vegetative cover, particularly forests and rangelands, is a key concern in combating land degradation. Recognizing this fact, Arab countries endorsed the Sub-regional Action Programme (SRAP) initiative to address environmental changes associated with land degradation and desertification in 2000. The SRAP focuses on two strategic domains, namely, sustainable management of water resources and sustainable management of vegetative cover. It also underlines the importance of cooperation among countries to combat land and water degradation, and the promotion of experience and innovation sharing among stakeholders.

Land-use management policies have many implications on both spatial and temporal levels, from the local to the national and regional arenas. Poverty in many localities of the Arab region is closely linked to land tenure and resource use rights. Effective land-use management should take equity, issues of access and tenure rights into consideration in order to elevate the status of poor men and women, as well as to realize the MDGs and sustainable development goals.

Appropriate management of land and water resources is the key to sustainable development in the region, and is essential in order to combat land degradation and conserve soil and vegetation. The sound management of rangeland, forest and other vegetative resources is also essential in order to conserve biodiversity and prevent soil erosion by wind and water, as well as to maintain the inherent productivity of the resource base for future generations. Although considerable national efforts have been undertaken by Arab countries, and by international, regional and sub-regional organizations, the problem of continuing land degradation and desertification is still a serious threat to the livelihoods of people in the Arab region.

Furthermore, the Arab Maghreb Union countries were able to initiate a sub-regional action programme where eight priority action areas were identified and selected, namely; sustainable management of transboundary natural resources; coordination of programmes to develop alternative energy sources; cooperation for the management and control of efforts to combat pests as well as plant and animal diseases capacity building; scientific and technical cooperation; early warning system; exchange of experience and information; and fostering an enabling environment.

The strategy adopted to achieve the objectives of the SRAP follows a comprehensive and prudent approach based on the integrated efforts between the secretariat of the programme and the countries of the sub-region. These efforts set out to combat desertification within national strategies in order to alleviate poverty and improve the quality of life. The SRAP is based on the interlinkages between the global MEAs and national and regional institutions.

It is an example of Arab policy responses, with a view to contribute to the achievement of sustainable development (UNEP 2003).

Issues of land degradation and desertification in the Arab region are further exacerbated by global warming and change in precipitation patterns. The dramatic social, economic and ecological costs of global warming have been highlighted by the recent IPCC scientific assessment (IPCC 2007). The report underlined that future climate change will have great significance for those regions and countries most seriously affected by desertification, as potential linkages and the relationship between the two cannot be ignored or avoided, especially at the policy level (Thomas 2006). The coastal and desert areas in the Arab region have been identified among the areas that will be most negatively affected by global warming, climate change, and their implications (see Box 4).

Water polices and governance

The Arab region is considered one of the most water-stressed areas in the world, and its long-term water situation will be exacerbated by population growth, expansion of irrigated agriculture, and the increasing water demand by the industrial and tourism sectors. As a result, in most Arab countries, water balances have already slumped into serious deficit. Water management is a major challenge in the Arab region. Thus, Arab countries have given high priority to the development and management of their water resources.

It is generally recognized that the ability to implement several modern applications of water management is significantly hindered in many countries of the region by inadequate capacity of the existing water management institutions. Therefore, the water problem can be greatly offset by improving management capacity. Indeed, concepts such as integrated management (see chapter 2), decentralization, privatization and the shift from the current water management focus towards controlling demand, should be considered as a possible option. All countries of the region have developed national water plans to keep within the broad framework of Agenda 21. However, planning is still not conducted within an integrated framework that includes conventional water resources (such as rainfall, surface water, and groundwater) and non-conventional resources (such as desalinated seawater and treated wastewater).

Most Arab countries have recently focused their attention on water legislation to ensure sound implementation of water policies and management of this vital resource. Important strides have been made to increase financial incentives, and various mechanisms have been introduced to raise water usage efficiency, in addition to setting up national institutional frameworks to meet the demand for water resources management. However, problems still persist despite all these endeavours. Water policies vary significantly among Arab countries, particularly with regard to the extent to which cost recovery is sought. Additionally, water governance remains fragmented among ministries, which can generate conflicts of interest, lack of standardization of specifications and criteria and dispersal of information. Accordingly, many countries set up mechanisms to coordinate institutional frameworks in the water sector that were responsible for formulating water policies and developing plans and strategies, while ensuring decentralization of the water management.

On the other hand, participatory approaches to deal with the water sector have emerged in some countries. The best examples of this are the faggar system (small wells and canals in Syria and Jordan), the system of falagg (with user associations determining water allocations in Oman, UAE, Yemen and Saudi Arabia), the canal system in Egypt, and the agricultural drainage water system in Saudi Arabia and others.

Water resource integrated management policies should not negate those initiatives and traditions developed by local communities. Traditional knowledge and management have proven to be the most effective method for the sustainability of water resources and the adaptation of communities to any change in these resources (UNEP 2003).

Energy policy interlinkages

For the last three decades, the Arab energy sector has been playing a central role in the socio-economic development of several Arab countries. It is made up of an enormous oil and gas department and a large electric power sector dominated by thermal power generation.

However, while the demand for energy is growing, the prevailing energy production and consumption patterns are inefficient. Furthermore, over 20 per cent of the population in both rural and urban areas do not have access to electricity (UN-ESCWA, CAMRE, UNEP and OAPEC 2005).

In many countries of the region, energy consumption patterns are unsustainable. As a result, this sector in most countries has had significant adverse environmental impacts, particularly on air and water resources. Therefore, Arab countries have to deal simultaneously with the problem of energy consumption, and its environmental effects on natural and human ecosystems, as well as the potential impacts of climate change (see Box 8).

In most Arab countries, energy policies during the last three decades were directed mainly towards satisfying the energy needs of development programmes and upgrading the energy sector's infrastructure and capabilities. However, the management of the sector has not always been based purely on economic principles, given the highly subsidized nature of energy prices in most parts of the region. This has led to economic loss, accelerated increase in demand, a perpetual need for large state investments, inefficient energy use, in addition to adverse impacts on the environment.

Therefore, in recognition of this, and with current trends shifting towards a more economic and sustainable management of the energy sector, countries in the region have revised their energy policies to include one or more of the following directives:

- the gradual review of energy tariffs to support the economic management of the sector, while maintaining energy subsidies for the poor;
- enhancing investments in oil and gas exploration and production activities, using cleaner technologies, and adopting measures for reducing the sector's impacts on air and water resources;
- studying and implementing intra-regional electric grid interconnections and natural gas network projects, to enhance the efficiency of, and increase revenues from available resources;
- encouraging private sector participation in the establishment and management of energy facilities, such as electric power plants;
- adopting measures and programmes for upgrading energy production and consumption efficiencies, particularly in energy intensive fields such as transport, industry, and power sectors;
- increasing the use of cleaner fuels, particularly the use of natural gas in electric power plants and transport sectors; and
- considering the development of technologies and promoting their application, as appropriate. Furthermore, in response to global initiatives and the interlinkages of energy, development,

Box 8. GCC policy response to climate change

At the last OPEC summit held in Saudi Arabia in December 2007, the Gulf Arab countries decided to develop a US$750 million fund for climate change research. This money will be used for a comprehensive package that introduces environmentally friendly technologies in the Arab world and assists in the paradigm shift toward a sustainable future.

OFID 2007

and environment, Arab countries issued the Abu Dhabi Declaration on Environment and Energy in 2003 (see Box 9).

Multilateral Environmental Agreements (MEAs) interlinkages in the Arab region

Environmental problems represent major challenges to Arab societies. Their societal causes are deeply rooted in a range of activities such as resource consumption patterns, urbanization trends, population growth, global economy and trade. The attention paid to environmental problems and their challenges has placed such issues high on the agenda of countries in the region. Therefore, the interest in MEAs has been reflected in the signing, ratifying of and accession to most of the international and regional environmental conventions and agreements. This has presented new opportunities and challenges for Arab environmental institutions and policy-makers.

Locally, enforcement of legislative measures, establishment of administrative bodies, and institutionalization of environmental policies are a clear indication of the partial inclusion of environmental issues in the states' general policies. With the proliferation of MEAs at the global and regional levels, there has been an increased call for enhancing collaboration among MEAs, particularly among the three Rio Conventions: the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD). The three Rio Conventions share a number of cross-sectorial themes, such as those relating to research and monitoring, information exchange, technology transfer, capacity building, financial resources, and public awareness. The rationale for collaboration among the conventions stems from the interlinkages among the issues they address in the Arab region.

As stated earlier, climate change is an important driver of desertification and biodiversity loss in the region. Ecosystem dynamics can impact carbon, energy, and water cycles and therefore affect regional climate. However, measures undertaken under one convention to address climate change (including mitigation and adaptation activities) to combat desertification and land degradation, or to conserve biodiversity and ensure sustainability, may have consequences on the objectives of the other conventions (UN 1992).

One area of significance to the Arab region's environmental policy initiatives is the adaptation and implementation of global and regional conventions at the local level. It is also important for local issues, priorities, opportunities, and experiences to be transmitted back to the global level.

Both of these cyclical flows (see Figure 9) require extensive participation and partnership among all stakeholders. To achieve sustainable development, countries of the region will also have to develop specific implementation mechanisms and fulfil

Box 9. Abu Dhabi Declaration on Environment and Energy (2003)

The declaration emphasizes the following:

- the right of Arab countries to develop their natural resources, while securing oil and gas flows to international markets;
- the importance of achieving sustainable development and alleviating poverty in the region, through increasing access to reliable energy services, particularly in rural areas, using available conventional and renewable energy resources;
- the need for developing national strategies for promoting the sustainability of the Arab energy sector and reducing its GHG emissions, in addition to responding to the requirements of international agreements and protocols to eliminate GHGs in this sector;
- the importance of promoting regional energy integration projects, particularly electric grid interconnections and natural gas networks;
- calling on developed countries to adopt measures, programmes and financial resources to support the transfer of sustainable energy technologies to developing countries;
- urging Arab countries to develop and implement policies and programmes to change the current unsustainable energy production and consumption patterns, through improving energy efficiencies in all sectors, as well as promoting the use of cleaner fuels and renewable energy resources;
- appealing to Arab countries to support research and development, technology transfer and industrial development of sustainable energy technologies; and
- calling on Arab countries and regional organizations to put more emphasis on developing and implementing educational,

obligations involving reporting, training, awareness, public education and other related activities. This requires that Arab countries institutionalize MEAs through horizontal linkages among the conventions and vertical linkages from global to local levels (Srinivas and Yashiro 2002).

Environmental education and public awareness

Education – including training, public awareness and formal education – should be recognized as a process by which human beings and societies can reach their fullest potential. Education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues (UN 1992).

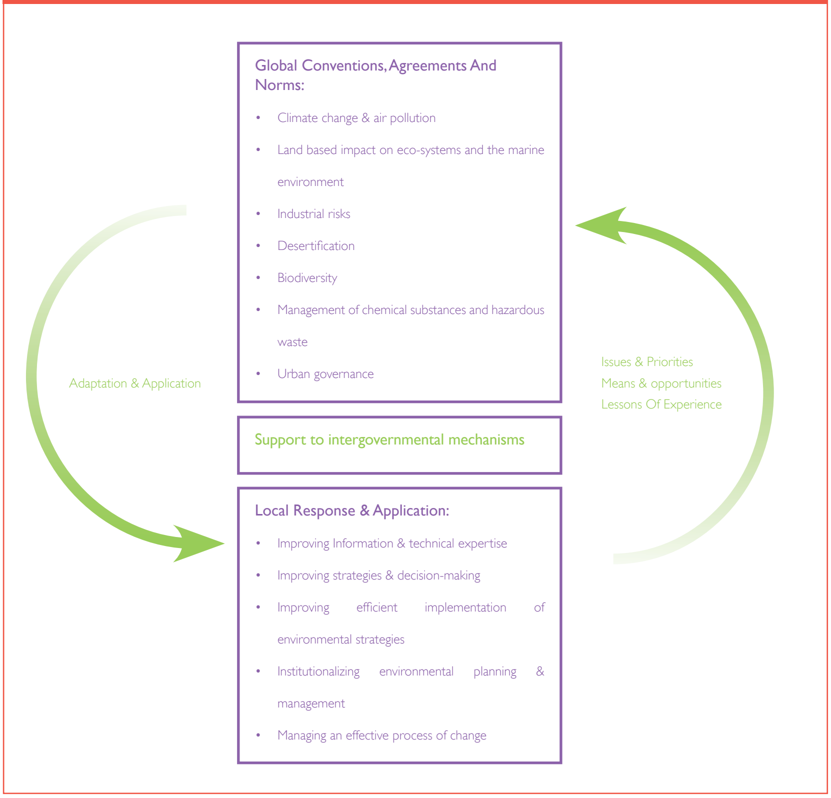
As established throughout this chapter, sustainable development and environment are closely interlinked in the Arab region. These are key elements for the formulation of integrated national strategies. With the advanced rate of natural resources degradation, fast growing population, and rapid urbanization, it is imperative that Arab countries transition to sustainable development policies to achieve economic and social prosperity goals.

Consequently, governments in the Arab region have given great attention to the significance of environmental education and public awareness.

CEDARE

They have recognized that formal and informal education is indispensable to changing people's attitudes and building their capacity to assess and address sustainable development and critical environmental issues. Education is also essential for achieving environmental awareness, changing values and attitudes, and fostering the skills and behaviour consistent with sustainable development. This knowledge also allows for effective public participation in planning and decision making.

Figure 9. The cyclical linkages between the global and local levels of environmental action



Srinivas and Yashiro 2002

Recognizing the significance of environmental education, most Arab countries are in support of upgrading and improving their national education systems. In fact, these countries have introduced environmental education within the primary and secondary curriculum, and in undergraduate and postgraduate studies. At the undergraduate level, environmental science courses are offered, and the main emphasis is to make clear human and environmental interactions, and the impacts of these interactions. Many countries of the region have established postgraduate environmental management programmes and have provided training courses including diploma and other higher degree courses. At other educational institutions, environmental education has been incorporated into several multidisciplinary courses as a cross-cutting theme.

At the informal level, environmental education activities include varied mass media programmes with the objective of raising people's awareness regarding the value of natural resources. They make clear possible environmental threats, including those factors contributing to the degradation of natural resources such as mismanagement, usage patterns as well as rational consumption and environmental economies. They also serve to motivate people to become involved in activities that improve environmental management (CEDARE and others 2001).

Public awareness and understanding major environmental issues are closely interlinked with formal and informal education. Awareness is a prelude to informed action in the field of environment protection, as solving environmental issues ultimately depends on public understanding, awareness, and support (Khalil 2004). Likewise, common information and shared understanding are

Box 10. The Arab ministerial declaration on climate change

The Council of Arab Ministers Responsible for the Environment (CAMRE) adopted the declaration on climate change, which constitutes the foundation for future action and reflects the Arab position in dealing with climate change issues, in accordance with the following:

- The integration of policies to deal with climate change issues in all sectors in a manner that copes with sustained economic growth and efforts to eradicate poverty.
- Adoption of national and regional action plans dealing with climate change issues, to assess potential impacts and develop mitigation and adaptation programmes in coordination and cooperation with all parties concerned, including scientific research centres, universities, civil society organizations as well as the private sector.
- Programmes aimed at mitigating climate change impacts shall focus on: the production and use of cleaner fuels, improvement of energy use efficiency, diversification of energy sources, expanded use of cleaner production techniques and environmentally-friendly technologies, as well as the use of economic incentives to encourage more efficient products.
- Adaptation measures that address climate change shall be fully consistent with socio-economic development. They shall be implemented through the development and dissemination of methodologies and tools that assess the impacts of climate change, as well as through planning for adaptation, and its integration into sustainable development policies.
- Understanding, developing and disseminating measures, methodologies and tools that achieve economic diversity with the aim of increasing the flexibility of economic sectors most vulnerable to climate change.
- Adaptation programmes shall focus on the provision of the necessary infrastructure to reduce potential risks. This includes: appropriate mechanisms for risk insurance, efficient management of natural resources, advanced monitoring, control and early warning systems, as well as adequate preparedness to confront disasters caused by climate change. Other measures comprise capacity building, providing and improving the exchange of information (including weather information), raising the level of public awareness and promoting partnerships.

essential for policy formulation and decision making through consultative and participatory approaches; ultimately mobilizing public support for the implementation of these policies. The commitment of Arab governments to environmental protection is reflected through outreach, training, and educational programmes undertaken by government institutions, civil society organizations, academic and research institutions, in addition to the private sector and the media.

Various institutions and NGOs have created multiple mechanisms for increasing public awareness, promoting environmental citizenship and enhancing research on the environmental problems confronting Arab countries. However, the role of Civil Society Organizations (CSOs), including NGOs, in environmental management policies remains limited because existing NGOs are very few, local in nature, and often dependent on national governments and international donors for budgetary support (World Bank 2001). Arab countries should strengthen the role of CSOs and engage them in addressing environmental issues through strong public awareness and education campaigns and programmes.

CONCLUSION

The issues discussed in this chapter demonstrate the significance of adopting an interlinkages approach in addressing environmental problems. This significance can be seen across the Arab region, as many environmental problems and challenges can be attributed directly or indirectly to the linkages between human beings and the environment.

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Interactions between Arab local and sub-regional ecosystems and social elements are interlinked spatially and temporally through both biophysical and social processes leading to environmental changes that affect economic aspects and human well-being.

The impacts are manifested in water resources depletion, desertification, biodiversity loss, air pollution, and marine and coastal degradation, adversely affecting the economy in the region. All of these impacts are aggravated by climate change and further exacerbated by continuous population growth, mismanagement and demographic changes. Recognizing and addressing these interactions, impacts and environmental challenges, as well as the economic assessment of the environment, all provide opportunities for improved policy responses, economic and social structural adjustments, regional cooperation, and more sustainable partnerships. Such regional policy initiatives require collaboration and cooperation across existing institutional and governance structures, NGOs, and the private sector in the Arab region.

To improve the implementation of the interlinkages approach, and enhance multisectorial sustainable development policies, the countries of the Arab region should adapt and implement MEAs at the local level through developing specific implementation mechanisms. It is also imperative that they fulfil obligations involving reporting, training, education, public awareness, and other related activities, as well as overcome the problems related to information and data sharing.

Furthermore, national capacities should be built in order to initiate policies and measures that sustainably and successfully address the relationship and interactions between the environment and human well-being.

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Chapter 9

CHALLENGES AND OPPORTUNITIES

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Main messages

Within the context of the environmental issues discussed in this report, challenges arise as a result of the inability to cope with and/or adapt to transformations that stem from phenomena such as population growth, poverty, health, globalization, conflicts and governance. This chapter attempts to identify the impacts of these changes on the environment of the Arab region and the overall well-being of the Arab people. They are the basis whereby potential opportunities for improvement of the environment and quality of life will be determined. The following are the main messages covered in this chapter:

- Improving the standard of living of Arab citizens enhances environmental management. Although Arab countries have achieved significant progress in human well-being, living conditions in many countries, particularly non-oil producing ones, still need special attention and improvement. It is not expected that they meet all of the Millennium Development Goals (MDG) by 2015. However, serious endeavours and actions to overcome difficulties and capitalizing on opportunities can improve the likelihood of reaching national targets.

- The impact of challenges on the Arab population is not uniform or equal within or among countries. The poor, women, and children are the most vulnerable sub-populations to impacts of environmental degradation. To reach sustainable development, it is necessary to provide people with goods and services that allow them to make use of opportunities made available to them. Enabling and empowering marginalized populations by adopting mechanisms for equitable and fair distribution of wealth, and access to decision making processes have positive economic, social and environmental impacts.

- Foreign Direct Investments (FDIs) have positive impacts on the national economy in terms of added value and job generation. However, they can also have negative effects on local communities in the form of resulting wastes, transformation of habits, values and traditions, and displacement of local inhabitants from their land for the activities that attract FDIs.

- In some Arab countries occupation and internal violence are responsible for instability that threatens livelihoods and is associated with widespread poverty. These conflicts are associated with compulsory migration and internal displacement of inhabitants which puts further pressure on the resources of host countries.

- .Overall, the Arab region is highly disaster prone in terms of geological hazards and climate change, with increasing risks due to rapid urbanization, population growth and poor responsiveness that impact vulnerability levels. The observed increase in disasters triggered by natural hazards may in part reflect a changing climate that necessitates hazard preparedness measures.

- Disaster risk reduction, and its linkage to environmental degradation and vulnerability, is considered an urgent necessity in order to avert or alleviate damages resulting from environmental, economic, developmental, or human catastrophes. Disaster risk reduction strategies should be integrated into national as well as regional action plans and strategies.

- Alleviating poverty and tackling environmental, social and economic transformations entail enabling people, improving access to food, shelter, natural and financial resources, in addition to infrastructure and social services. These actions should be accompanied by a just and equitable responsiveness.

- Adopting elements of good governance in the decision making process, such as participation, transparency, accountability, consensus-building, sovereignty of law, inclusiveness, responsiveness, and efficiency, enhances people's national feelings and consolidates their role in sustainable development. Health and education are two of the main pillars of human capital formation. Investing in these two sectors is bound to bring about overall improvements that allow for better adaptation to environmental challenges. Investing in science and technology can make up for the lack of natural resources in the region. This investment requires the proper management of resources, which should consider sustainable development a priority.

Cedare

INTRODUCTION

Undoubtedly, it is the right of individuals, societies, and states to improve their conditions. Limited resources, both natural and human, often serve as a barrier to people trying to enhance their circumstances. Additionally, as a result of people's attempts to improve their well-being, individually and collectively, there are both intentional and unintentional consequences that may contribute to the suffering of others. Environmental degradation may be both a consequence and a cause of socio-economic development. The economic theory known as Pareto Efficiency or Pareto Optimality explains this situation.

The theory states that an economy is Pareto inefficient when economic resources and outputs have been allocated in such a way that no individual can be made better off without sacrificing the well-being of at least one person. However, the opposite is true, which is the condition in which resources are allocated in such a way that no one is made worse off. To accomplish the latter effect, a certain set of rules and ethics as well as the principles of good governance should be adopted.

Despite many social, economic and environmental improvements in Arab countries, future efforts are required to make additional progress. These efforts will require identifying both challenges and opportunities that must be addressed. To identify challenges and opportunities, this necessitates specifying those factors and elements that shape the context within which people interact and their impacts on the environment and on marginalized sub-populations. These factors include, but are not limited to, population growth and density, poverty, health, globalization, trade and aid, conflict, changing levels of governance, and science and technology.

To assess the current challenges and opportunities this chapter focuses on key cross-cutting issues and recognizes environmental degradation as one of the issues and an impediment to overall societal progress. The impacts of environmental degradation and other cross-cutting issues on marginal sub-populations, species, ecosystems and locations are examined as well. The chapter also explores the effects of reduced access to resources, such as safe clean drinking water, and threats to human health and survival. Furthermore, the chapter examines the context of societal transformations and impacts on the environment, human well-being and vulnerability; in other words, the challenges and opportunities.

Population Growth and Densities

The population in Arab countries is growing quickly and experiencing a youth boom due to higher than average birth rates. Thus, the population momentum is less than the global average for other middle and low-income developing countries. The region's urban population is also growing. Many Arab countries, such as Libya, Algeria, Saudi Arabia and Sudan, have land that could accommodate growing populations but remains undeveloped due to many impediments to horizontal expansion and the required resources (see Figure1).

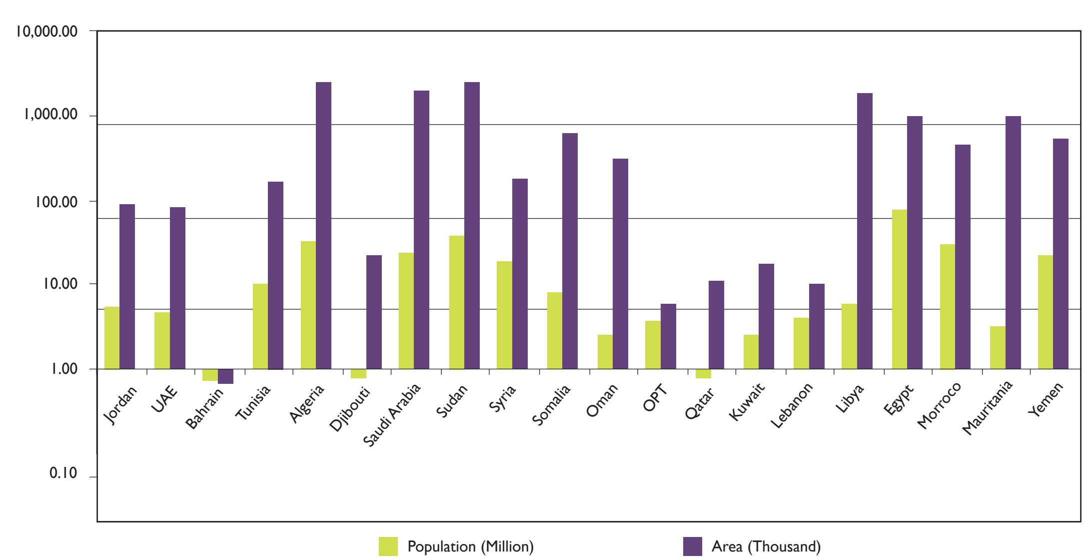
Population densities range from low to moderate in a number of Arab countries, such as the UAE, Algeria and Oman. However, there are other countries with high population densities, like Bahrain, the Occupied Palestinian Territories (OPT) and Lebanon. Nevertheless, gross densities might be misleading. For example, Egypt's population was around 73 million in 2006 (CAPMAS 2007), but they live in an area that does not exceed 5 per cent of the total gross area which amounts to almost one million square kilometres, meaning that the inhabited areas are much denser than what this figure shows (see Figure 2) .

Poverty

According to the United Nations, poverty is the condition that exists when an individual's income is less than US$2 per day, based on the purchasing power parities of the US dollar. This amount is considered the minimum income necessary for an individual to ensure adequate living conditions. This indicator allows for a comparison among countries and helps to identify where there is a need for assistance.

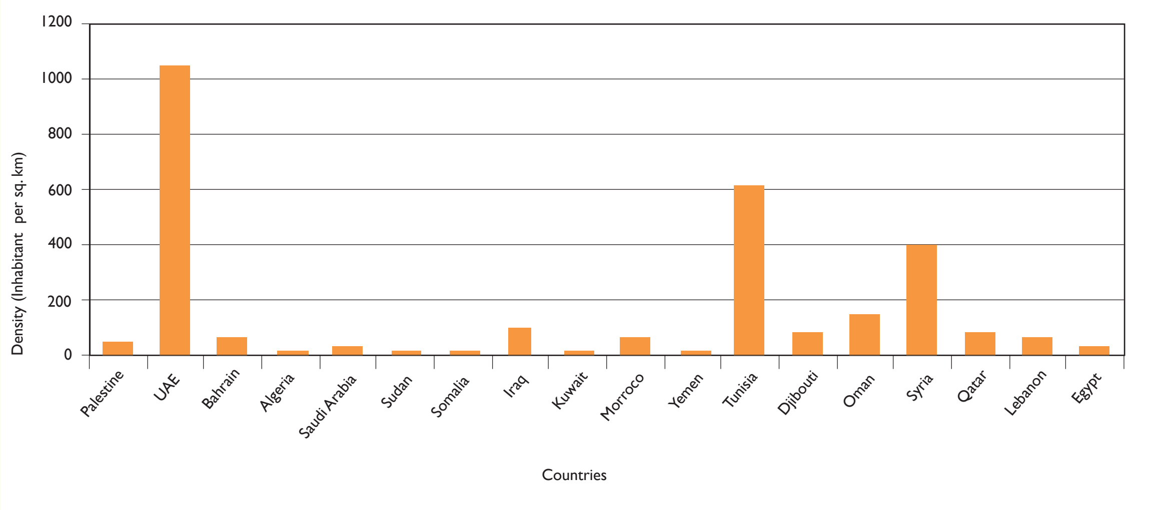
Based on data for 11 Arab countries, representing almost two-thirds of the region's total population, a decrease in poverty has been reported for the Arab region as a whole

Figure 1. Population versus total area for selected Arab countries



UNDP 2005

Figure 2. Densities in selected Arab countries (inhabitants per km2) 2007



World Bank 2007

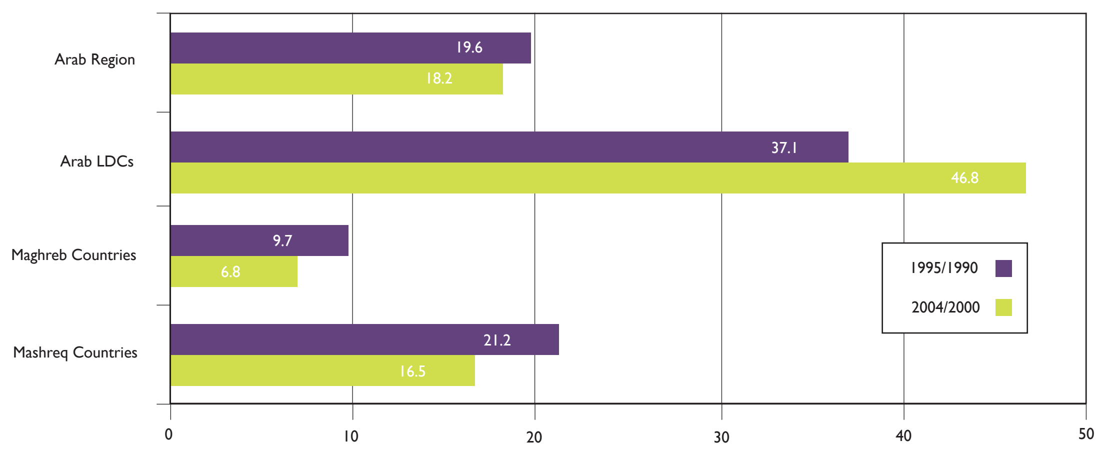
between the periods of 1990 to 1995 and 2000 to 2004. The proportion of the population living below the national poverty lines fell from 19.6 per cent in the first period to 18.2 per cent in the second period. At the sub-regional level, the proportion of poverty decreased between these two periods by 5 per cent in the Mashriq states and by 3 per cent in the Maghreb states. In contrast, it rose by almost 10 per cent in the Arab Least Developed Countries (LDCs), from 37.15 to 46.8 per cent. There is a lack of general data on income poverty in GCC countries. However, given the high per capita income in all countries of this sub-region, levels of income poverty are likely to decrease (UN-ESCWA and LAS 2007) (see Figures 3, 4 and 5).

According to World Bank analyses of the Middle East and North Africa (World Bank 2007), the poverty rate decreased from 1990 to 2000. Egypt, Jordan, and Tunisia have witnessed the most dramatic positive improvements. The poverty rate in Tunisia decreased by half and reached around 3.6 per cent in 2006. In Egypt, the poverty rate decreased from 25 to 16.7 per cent due, in part, to the reduction of poverty in urban areas. The rate in Jordan decreased from 14.4 to 11.7 per cent due to the efforts exerted to reduce poverty in both urban and rural areas.

Despite these decreases in reported poverty rates, the total proportion of people living below the national poverty lines indicates that the Arab region as a whole has not experienced significant progress in reducing income poverty. While there are vast disparities between the Arab LDCs and the other sub-regions, high poverty rates will remain throughout the region if effective measures are not taken soon to reduce poverty.

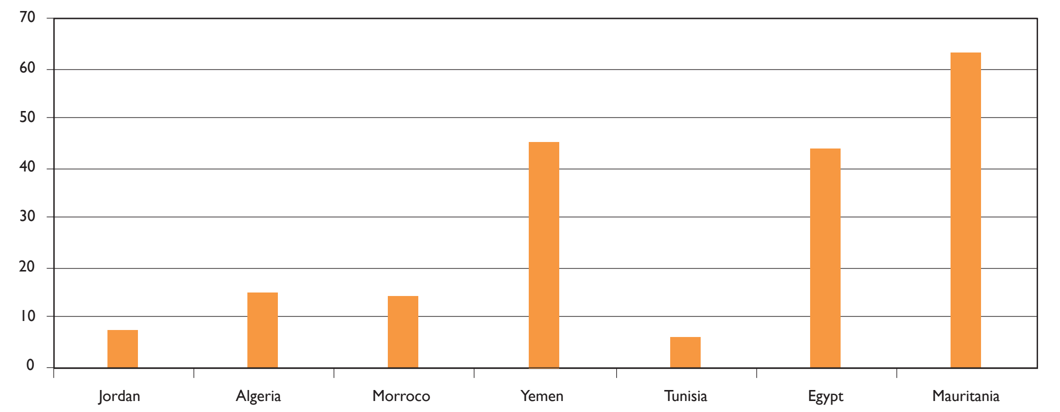
In Morocco, the poverty rate has increased in both urban and rural areas mainly as a result of slow economic growth and seasons of consecutive drought in the early 1990s. However, this situation has improved partially as economic conditions were enhanced. Similarly, the poverty rate in Algeria increased in the 1990s but then stabilized in 2000. The highest poverty rate in the region is in Mauritania, where it is estimated that 46.3 per cent of the population lives below the poverty line (World Bank 2006).

Figure 3. Proportion of population below national poverty line (%), 1990–2004



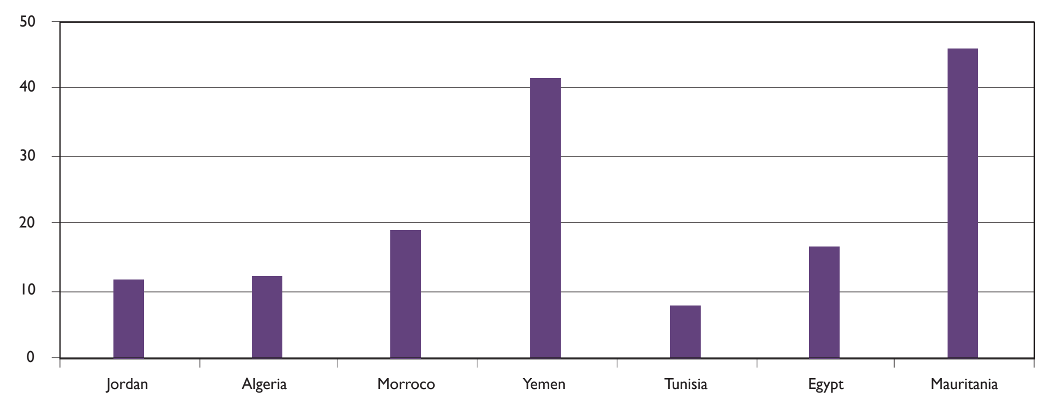
UN-ESCWA & LAS 2007

Figure 4. Population earning US$2 or less a day in selected Arab countries (%), 1990–2002



UNDP 2005

Figure 5. Population below income national poverty line (%), 1990–2002



UNDP 2005

Box 1. Tunisian attempts to alleviate poverty

In order to limit the significant wealth disparity between rural and urban areas, Tunisia has created a national plan to bridge the poverty gap. This plan is currently supported by the National Solidarity Fund, the National Fund of Work, different development programmes, the small loans system, and the National Programme of Assistance to Needy Families (PNAFN). Based on the great success that Tunisia achieved, the United Nations General Assembly approved (20 December 2002) a resolution to establish the World Solidarity Fund based on the proposal of Tunisian President Zine El Abidine Bin Ali to counteract the negative impacts of privatization in countries suffering from extreme poverty and to promote peace and development in the world.Source: The National Solidarity Fund undated

The National Solidarity Fund undated

The poverty rate in the Arab region is strongly correlated to rural life and educational level. Rural areas tend to have higher poverty rates than urban areas, which usually leads to income disparity between the two. Tunisia has the largest rural/urban gap in the region (World Bank 2006) (see Box1).

Health

The overall situation in the Arab world has improved due to the efforts of various Arab countries that have worked on improving their health systems in order to improve the general level of health and living conditions for all social segments. As a result, health expenditures have been continuously decreasing, allowing for the creation of new programmes and health care achievements. For example, the infant mortality rate has decreased by one-third throughout the past three decades in all Arab countries. Moreover, improved health services have led to a decrease in death rates (UNDP 2005).

The provision of vital public services to prevent diseases, such as sewage treatment, sanitation, and access to clean drinking water, have not reached the desired level in the Arab region and are less than the average global rates. Hence, all Arab countries are exerting a greater effort to increase these services. In accordance with the Blue Plan report on a Sustainable Future for the Mediterranean: The Blue Plan's Environment and Development Outlook (Benoit and Comeau 2005) as well as the World Health Organization, the percentage of people in all Arab countries with access to good sewage systems exceeded 85 per cent in 2000. The one exception is Morocco, where 68 per cent of the people had access. In Morocco, Egypt and Tunisia, the percentage of

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people with access to a good sewage system increased by 10 per cent during the period from 1990 to 2000.

Despite all of these achievements, Arab countries still face a number of obstacles/challenges that can be summed up as follows:

- **An increase of pressure on governments due to health care costs:** Due in part to changing lifestyles and economic development, the spread of contagious diseases has increased. However, non-contagious diseases, such as cancer, heart and arterial diseases have also increased. Based on World Bank data for the Middle East and North Africa, by 2020 non-contagious diseases will account for 56 per cent of deaths and 45 per cent of illnesses in the Middle East and North Africa (World Bank undated).
- **An increase in the number of road accidents:** Because of the purchasing power (translated into the ownership and operation of vehicles) of the most productive age group (15–45), road accidents are the first cause of death among populations in all countries. The expenditures arising from such accidents are expected to increase to 20.5 per cent of the disease load costs by the year 2020 (World Bank undated).
- **The emerging problem of contagious diseases and the spread of HIV/AIDS:** The spread of HIV/AIDS is relatively low in the Arab world. It is important, however, to prevent the spread of the disease and its effects in the region.
- **The disparity in health services between Arab countries and within each country:** Arab countries witness a huge disparity in health levels. In 2006, the infant mortality rate in the United Arab Emirates was 8 per thousand newborns, whereas the rate in Mauritania was 78 per thousand newborns (WHO 2008). Moreover, in 2006, the average life expectancy was 78 years in the United Arab Emirates compared to 58 and 56 years in Mauritania and Djibouti respectively (WHO 2008). The World Bank analysis of the Middle East and North Africa shows a disparity within each country as well. For instance, in Egypt and Morocco, the infant mortality rate among the poorest income groups is twice as much as the highest income groups (World Bank 2008).

The recommended methods to raise the overall level of health in the region are:

- supporting efforts in the field of human resources development and qualified medical services and ensuring the equitable distribution of such services in all areas;

Box 2. When Arab states joined the WTO

1995: Bahrain, Djibouti, Egypt, Kuwait, Mauritania, and Morocco

1996: Qatar and UAE

2000: Oman

2005: Saudi Arabia

A list of current members can be found on the WTO web site: http://www.wto.org/

- general basic infrastructure improvements of both private and public sectors will boost the self-financing of health entities and enable them to find the best means to increase their resources;
- improving coordination between the public and private sectors; and
- upgrading the health information system to assist decision-makers to advance programming, assessment and research, in addition to guaranteeing the best returns on investments and the best quality of services.

Globalization, trade and aid

Globalization has several definitions. In this section, globalization refers to the liberalization of trade and aid. Today, many politically independent countries are financially dependent on the export of raw materials to attain foreign currency, which is a highly unsustainable condition for economic growth. Others relax labour and environmental restrictions to attract migrating industries, such as chemical industries, which are often energy intensive and account for increased pollution.

The Arab region's share in world trade is small. In 2004, its share of world exports and imports was almost unchanged from the early 1990s, at 4.2 and 2.8 per cent respectively. The GCC sub-region holds by far the biggest share of regional exports and imports, almost exclusively due to the large volume of oil exports. In contrast, the Arab LDCs account for only 3 per cent of the region's total trade volume.

As such, the distribution of trade in the region reflects that Arab countries are exporters of primary products and account for a small share of the low-value added goods. Basically, fossil fuels dominate Arab exports (UN-ESCWA and LAS 2007) (see Box 2).

The rate of trade growth in the Middle East and North Africa remains low despite the numerous facilities in the Arab region that help to expand commercial ties and boost investments with other countries around the world. "At present, intra-regional exports are about 9 per cent of all merchandise exports and about 25 per cent of all non-oil merchandise exports" (World Bank 2009).

Several Arab countries have already taken serious steps towards trade liberalization. Twelve Arab countries are WTO members, while six are in the process of negotiating WTO membership. Intra-regional trade accounts for a mere 10 per cent of total trade in the Arab world. Many countries in the Arab region seek to:

- achieve balance between trade liberalization and protection at the same time;
- develop industry by raising production capacity and increasing export opportunities;
- increase the number of free zones;
- facilitate commercial transactions by reducing high custom tariffs, facilitating customs and payment systems, financing trade and

supporting transportation and services;

- increase benefits from information technology and communication in order to spread knowledge, build capacities and encourage trade. Tunisia, Morocco and Egypt have already succeeded in doing this;
- carry out reforms in financial institutions in order to increase the level of transparency and improve the administration of services; and
- develop regional financial integration mechanisms by finalizing cooperation agreements that follow international criteria for the supervision of banks and funds to prevent crises and shocks at both the regional and international levels

Occupation and internal aggression in some Arab countries cause instability which threatens livelihoods, spreads poverty and leads to population migration and internal displacement, thus exerting further pressure on countries' resources.

Conflicts

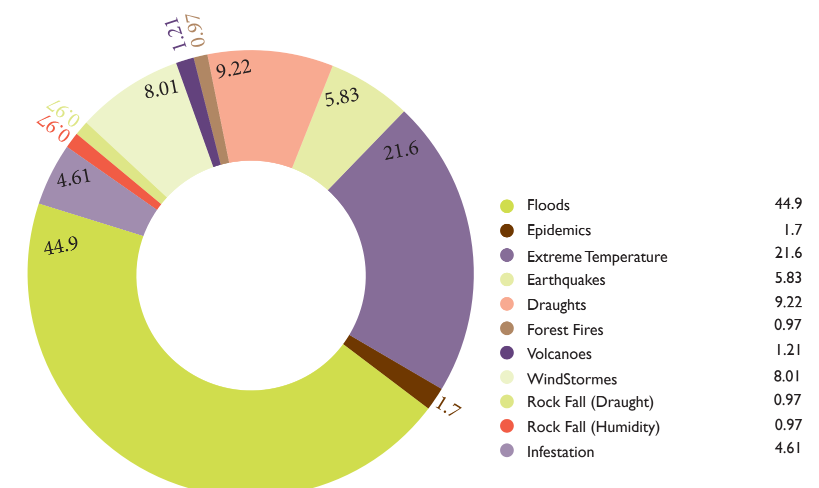
Several areas of the Arab region experience conflicts: Darfur in Sudan, the OPT, and Iraq. Algeria, Yemen and Lebanon are also subject to internal disputes. Terrorist attacks are another source of conflict and have occurred several times in a number of Arab countries over the past decade. Persistent conflict, in whatever form it takes, has very negative impacts on society. Educated, wealthy individuals often seek asylum outside their country and poorer populations get displaced, leading to a financial drain and loss of jobs for displaced persons. For example, in 2006, Sudan had the highest number of internally displaced persons (IDPs) among Arab countries. Iraq and Algeria had the second and third highest numbers, respectively. Internally displaced persons require employment, health care and other urban and social services in their new locations (see Chapter 5).

Conflicts have a negative impact on development and natural resources as well. The environmental consequences of the first and second Gulf Wars were evident in both Iraq and Kuwait. Moreover, the invasion of Iraq had negative impacts on the country, its neighbours and the local ecosystems in that part of the Arab world. Another example in the region is the armed conflict between Israel and Lebanon in 2006 which took its toll on the natural resources and infrastructure of Lebanon. When people forcefully move to other parts within their countries, or are pushed to leave their countries to other parts of the world, they become aliens (as often described) and most of them find tremendous difficulties to thrive in their new societies. This, in turn, affects their status and ability to sustain their livelihoods, particularly if they are refugees for long periods of time, such as the case of the Palestinians (UNEP 2007a).

Disasters Caused By Natural Hazards And Human Error

The frequency and impact of disasters are rising globally, with disproportionate impacts on poor nations and vulnerable communities. Disasters threaten human lives and livelihoods as well as international and national efforts to advance socio-economic development and eradicate poverty.

Figure 6 Distribution of Natural Disasters in MENA Region (1980-2009)



OFDA/CRED 2009

The risk of disasters caused by natural hazards or human error is intimately connected to the process of development, which can increase or decrease the impact of disasters. Natural hazards cannot be prevented but – through collective actions – there can be reduction of risks and potential impact of disasters induced by natural hazards. Reducing disasters by understanding the underlying risk factors and building knowledge and capacities to mitigate hazards, risks and vulnerabilities will help protect sustainable development gains.

The Arab States do not only share a common language and a common cultural and historical heritage but also regional and transboundary natural hazards and risks. The Arab region is disaster prone in terms of geological hazards such as earthquakes, landslides, tsunamis as well as weather-related hazards such as floods and droughts. Growing impacts of climate change, accompanied by rapid urbanization, population growth and environmental degradation, are amplifying the levels of vulnerability to disaster risk. A 2005 World Bank study on global natural disaster risk found that six Arab countries (Jordan, Tunisia, Algeria, Syria, Djibouti and Morocco) are at a relatively high economic risk from multiple hazards, with around 30 per cent of the gross domestic product (GDP) and/or 30 per cent of the population at high risk. There is undoubtedly a link between the growing probability of disasters and climate change (Dilley and others 2005) (see Figure 6).

Planning for development not only overlooks disaster preparedness but it also increases vulnerability to natural hazards. There are two trends in the region that increase probability for disasters and their consequential hazards. These two trends are rapid population growth and urbanization. Currently, more than 50 per cent of the Arab population is living in urban areas that are rapidly growing and stressing natural resources and development (UN-ESCWA 2003).

Coastal zones are the most populated and the most vulnerable areas. According to WMO, more than 80 per cent of disasters caused by natural hazards in the Arab region were caused by weather, climate and water-related hazards. The coastal zones of Egypt, Morocco and Tunisia are facing sea-level rise due to climate change, which in turn will have significant implications on the environment, lives, livelihoods and the economies of those countries with an estimated loss of billions of dollars in property and income (UN-HABITAT 2008).

Seismic risks

The Arab region is dominated by the interaction of Arabian, African and Eurasian tectonic plates, resulting in high levels of seismicity, known as the Dead Sea Fault System. Moreover, the region contains active sea-floor spreading in the Red

Sea and the Gulf of Aden and active tectonics in the Atlas Mountains of the Maghreb countries. Earthquakes were recorded and felt in the Arab region, particularly in Jordan (IFRC 2004) (2004) and in Lebanon (2008). Furthermore, the 1960 earthquake in Morocco resulted in about 12 000 fatalities and the one that swept Algeria in 1980 led to about 2 500 deaths. Egypt's 1992 earthquake left more than 500 people killed and at least 90 000 injured (OFDA/CRED 2008).

A sand storm in Iraq

Earthquakes have so far affected more than 1.3 million people and caused more than US$11 000 million in economic damage in the Arab region between 1980 and 2008 (see Table 1). Seismic proof construction and building codes are hardly observed or enforced in the region. Risk reduction measures and disaster preparedness will not only minimize damages in case of disasters but will also protect development gains and prevent adverse effects on national economies.

Hydro-meteorological hazards

The region has been suffering from water scarcity for years, with intensified impacts of drought and desertification affecting not only the rural areas and agricultural sectors but also stressed urban centres and economic development. In the last 30 years, more than 28 million people were affected by drought in the Arab region. Flash flooding has claimed many lives and impacted severely the livelihoods and lives of thousands of people across the region. In March 2003, flooding in the Jordan River caused extensive damage to farmland leading to the loss of almost an entire season's crops (OFDA/CRED 2008). In 2008, Algeria, Morocco and Yemen have experienced unprecedented flooding. Floods in Yemen displaced approximately 25 000 people and destroyed almost 3 000 homes beyond repair. Algeria and Morocco were also hit by the worst flooding for decades affecting 12 000 families (OCHA/ROMENACA 2008).

Table 1. Number of total affected population and total damage in thousands of US$ in Arab countries due to disasters caused by natural hazards between 1980 and 2008*

Disaster Type	Droughts	Earthquakes	Floods	Storms	(total)
Total Affected	28 199 657	1 342 296	7 404 613	252 074	37 198 640
Economic Losses U.S.$	900 000	11 862 929	2 889 336	4 149 854	19 802 119

***Data cover the following countries: Algeria, Comoros Islands, Djibouti, Egypt, Iraq, Jordan, Libya, Lebanon, Mauritania, Morocco, Oman, OPT, Sudan, Syria, Tunisia, and Yemen (OFDA/CRED 2008).**

Table 2. Probability and impacts of some disasters		
Phenomenon	Likelihood	Major Projected Impacts
Increased frequency of heat waves	Very likely	Increased risk of heat-related mortality
Increased frequency of heavy precipitation events	Very likely	Increased loss of life and property due to flooding. and infectious, respiratory and skin diseases
Area affected by draught increases	Likely	Increased risk of food and water shortage
Intense tropical eyelone activity increases	Likely	Increased risk of deaths, injuries, water-and food-borne diseases disruption by flood and high winds, potential for population migrations, loss of property
Increased incidence of extreme high sea level	Likely	Increased risk of deaths and injuries by drowning in floods, potential for movement of populations and infrastructure

WMO Undated

Moreover, in 2007 Cyclone Guno hit the Omani Coast. This resulted in the flooding of hundreds of homes and farms and caused landslides and millions of dollars in economic damage (OCHA 2007, Saadeh 2007).

Vulnerability to impacts of climate change and sea-level rise

The assessment reports developed by the Intergovernmental Panel on Climate Change (IPCC) provide scientific analysis and review of the impacts of climate variability and change, as well as trends and characteristics of meteorological, hydrological and climate-related hazards such as tropical cyclones, floods, droughts, desertification and storms (WMO undated). It is expected that climate change would result in increasing vulnerabilities with intensified – and relatively new – patterns of risk. The World Meteorological Organization (WMO) highlights some of the potential implications of climate change (see Table 2).

The Arab region is affected by these changes and their consequences. It is one of the most vulnerable regions to the potential impacts of climate change through increased vulnerability to coastal zone flooding, in addition to desertification and droughts in other areas (IPCC 1997). Climate change will also exacerbate the region's scarce water resources, increase the salinity of groundwater and accelerate the spread of pest epidemics and diseases in an unprecedented manner. Climate change and global warming threaten the development of the Arab region, particularly affecting agricultural production and vegetation, in addition to causing damage to biodiversity (El Bagouri 2007) (see Box 3).

According to UN-HABITAT report on "The State of African Cities 2008", about 18 per cent of North African urban dwellers live in low elevation coastal zones, especially Alexandria, Algiers, and Casablanca. As for Tunisia, it is particularly vulnerable to increase in sea levels. The UN-HABITAT report further states that, "without human intervention to prevent

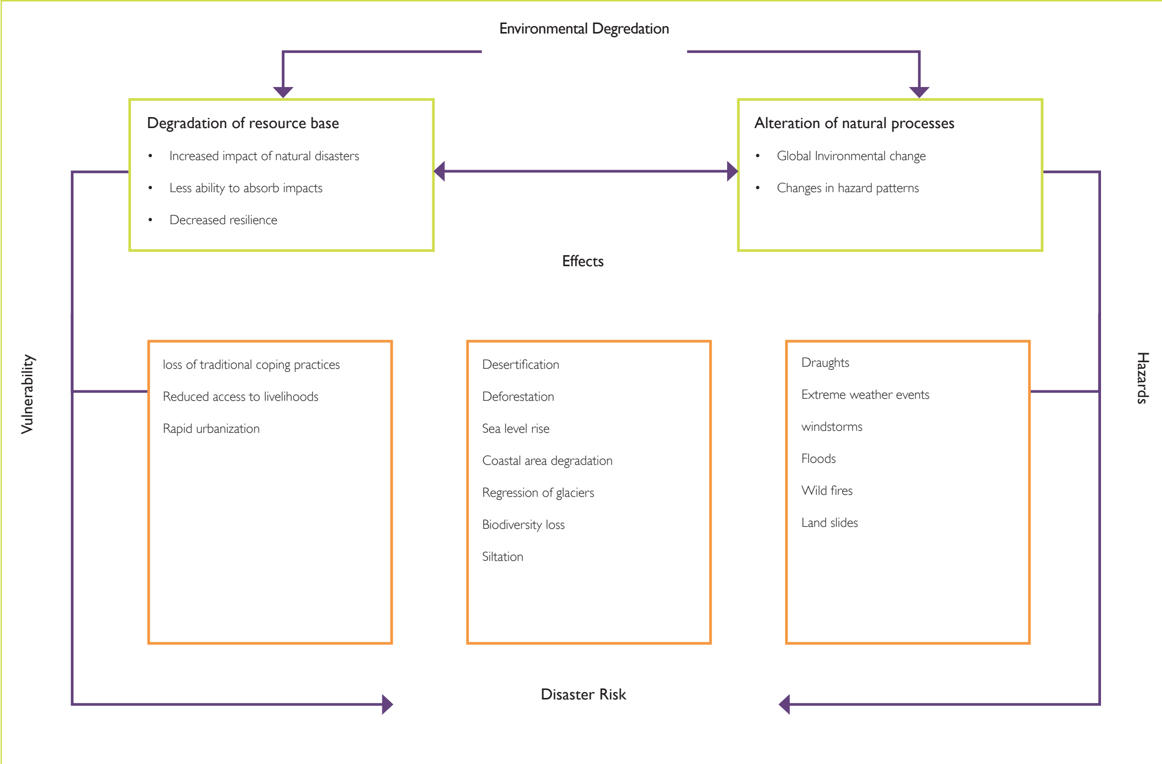
Box 3. The Invoice for climate change

"The invoice for our climate-changing emissions will include more droughts,floods and other natural disasters. we need to `climate proof´ our farms our infrastructure and our livelihoods in order to minimize our vulnerability to future disasters.,,

Achim Steiner, UNEP Executive Director Environment and Disaster Risk, ISDR system paper, July 2008

UNEP-2008

Figure 7. Linking environment, disasters and risk reduction



UN/ISDR 2004

catastrophes, a 50 cm increase is predicted to displace over two million people, destroy 214 000 jobs and cost over US$35 000 million in the coastal area between Alexandria and Port Said" (UN-HABITAT 2008).

Several studies on global warming highlighted the serious and potentially catastrophic impacts of climate change on the Nile Delta, the breadbasket of Egypt and the home for almost one-third of Egyptian people. Not only will lives be lost with rising water levels and increasing salinity in the Delta, but people's livelihoods will be devastated and ecosystems damaged. The 2009 World Assessment Report on Disaster Risk Reduction highlighted that Egypt, Djibouti and Bahrain are the most vulnerable to the risks of sea-level rise, as more than 10 million Egyptians live in low-level coastal cities and nearly 50 per cent of the people in Djibouti live at the sea surface level or slightly higher. Also, 75 per cent of the Bahraini people live in low coastal areas (UN/ISDR 2009a).

Linking environment, disasters and risk reduction

Natural hazards, environmental degradation and disaster risk reduction are all linked in the context of sustainable development. "Natural hazards and disasters are products of both natural variability and human-environmental interactions" (MA 2005). Disasters not only reveal underlying social, economic, political and environmental problems but also contribute to aggravating them and causing serious challenges to sustainable development. As disasters are the convergence of natural hazards and vulnerable conditions, and vulnerabilities are increased by environmental degradation, settlement patterns, livelihood choices and behaviour, one has to address the environmental dimensions in order to reduce disaster risks. Environmental degradation multiplies the actual impacts of hazards and limits the area's ability to absorb those impacts, which in turn decreases the overall resilience to hazards, impacts and recovery from disasters (see Figure7).

Understanding and recognizing the linkages and interconnections among environmental degradation, vulnerabilities and disaster risk will lead to the development of comprehensive approaches to disaster risk reduction that should take into consideration the role of the environment in triggering disasters and protecting communities. At the same time, these approaches should also recognize that as much as environmental degradation is a hazard in itself, the environment is vulnerable to disaster events and post-disaster recovery (see Box 4).

This comprehensive approach to protect the environment is further emphasized in the global disaster risk reduction framework known as the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters. The Hyogo Framework for Action (HFA) is a ten-year global plan, which was adopted by 168 countries at the World Conference on Disaster Reduction held in Kobe, Japan in January 2005. HFA reflects the intention and need to take a holistic approach in identifying and putting into action complex multidisciplinary disaster risk reduction measures. It urges governments to pursue the "substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries". Furthermore, it defines "reducing the underlying risk factors" as one of its five Priorities for Action. HFA recognizes that environmental degradation contributes to disaster risk and that disasters occur when hazards interact with environmental vulnerability (UN/ISDR 2005).

Box 4. Disaster risk reduction is

"The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events"

UN/ ISDR 2009b

In the Arab region, the League of Arab States (LAS) is taking the lead in promoting integration of disaster risk reduction measures through adopting a number of key regional policies on climate change, environment and disaster management coordination mechanisms. It also supports and calls for the implementation of HFA at the regional and national levels. The Council of Arab Ministers Responsible for Environment (CAMRE), in its 20th session held on 20–21 December 2008, has reaffirmed commitment to reduce disaster risk and increase cooperation and coordination with the International Strategy for Disaster Reduction (ISDR) to ensure implementation and follow-up of HFA and establishment of national platforms or committees for risk reduction across the region (LAS 2008).

In general, there is a progressive trend of understanding and recognizing the negative impacts of environmental degradation and the need to cope with environmental emergencies and disasters. But the linkages among environmental degradation, vulnerabilities and disaster risk reduction are not yet that apparent nor appreciated across national environmental policies or disaster management plans. The integration of the concept of disaster risk reduction into environmental management and climate change adaptation became clear – may be for the first time – in the Arab Ministerial Declaration on Climate Change, adopted by the Council of Arab Ministers Responsible for the Environment in their 19th session held on 5–6 December 2007.

Justice is the basis for rule

The Declaration, among other recommendations, emphasizes the potential risks of climate change and calls for adaptation programmes to "include appropriate mechanisms for risks insurance, improvement in the management efficiency of natural resources through the use of appropriate techniques and advanced monitoring, control and early warning systems, as well as adequate preparedness to confront disasters caused by climate change" (LAS 2007).

Changing levels of governance

Certain countries are working hard to nurture democracy and freedom. In this context, the 1990s witnessed a great deal of activity at the level of political discourse, which included issues like human rights, sovereignty of law, and civil society development. This was all done in an attempt to achieve democratic and political plurality and to organize free and fair elections. To ensure success, a number of legislative and institutional reforms were implemented to improve the political atmosphere in Arab countries.

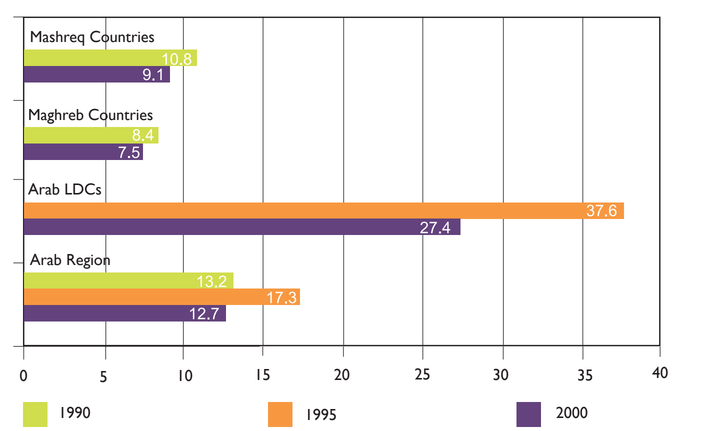
These Arab countries made sure that they were able to bridge the gap between the government and the people by implementing a sound election policy based on integrity, transparency and impartiality. Arab countries also supported sovereignty of law and plurality among institutions and allowed various active civil society organizations and political parties to take part in building and applying development strategies. The accomplishments of these efforts included:

- creating national charters based on reconciliation, which involved all active parties in the process, and provided a space for the opposition to participate as well;
- building new institutional structures based on the constitutional reforms that established pluralism and created new laws that allowed free elections;
- establishing an election path based on competition and freedom; and
- organizing constitutional elections to build new systems of political plurality and organized productive communication between people and the government

Science and technology

Knowledge, information technology and communication are crucial to future development, wherein bridging the gap of information technology is considered a pathway between developed and developing countries.

Figure 8. Proportion of underweight children under five years of age (%)



UN-ESCWA & LAS 2007

Developing countries have already benefitted from global technological and scientific advances. This is because developing countries are fully aware of the important role of Information and Communication Technology (ICT) in the fields of education, business, and scientific research.

Despite the noticeable development in all Arab countries, they are yet to be classified as developing countries, with different levels. One of the best means of achieving rapid growth in the field of ICT and e-governance is to work on diversifying the services that enable access to information and communication technology, in addition to developing the digital community by means of connecting all the institutions through the internet and effectively investing their services (see Box 5).

Mobile phones are considered to be the primary communication technology. The rate of mobile service subscribers has noticeably increased in different Arab countries. The proportion of subscribers in Tunisia reached 70.6 per cent in 2007, while subscribers in North Africa reached 60 million in 2006. Markets are expected to witness great advancements during the coming years. The still limited spread of mobile service in North Africa, estimated at 25.9 per cent of its capacity, is considered a vital factor attracting investors. Algeria, Egypt, Morocco and Tunisia are the major countries leading the market's growth in the region (Tunis Afrique Presse 2006).

Human Well-Being And Environment

Despite general improvements in human well-being in the Arab world, there is still a need to exert additional effort and allocate available resources to reach the Millennium Development Goals (MDGs) as poverty still persists in many Arab countries. A UN-ESCWA and LAS report issued in 2007 suggests that the region's malnutrition rate decreased very slowly, indicating a deficiency in the region's development efforts. The proportion of underweight children under five years of age (U5) remained relatively high in 2000 at 12.7 per cent with no significant improvement from its 1990 level of 13.2 per cent (see Figure 8).

According to the report, these outcomes are due to the slow pace of economic and social progress, modest growth of the region as a whole, relatively high female illiteracy rate, particularly in the Arab

Box 5. Dubai e-Government

The Dubai e-Government Programme was a multistage programme that aimed to transform government operations. After its launch in 2001, the Dubai e-Government worked with different governmental administrations to establish and provide public services through various innovative electronic channels. The programme met its goal to provide 90 per cent of all government services and to facilitate 50 per cent of government transactions through direct, online communication by the beginning of 2007.

Government of Dubai undated

LDCs, low access of the poor and underprivileged to primary health care services, comprehensive sanctions imposed on Iraq, and conflicts in the OPT, Somalia, and Sudan.

The report confirms that in per capita terms, there is a large discrepancy in energy use between the GCC countries and all other Arab countries. In fact, per capita electricity consumption in the GCC countries is among the highest in the world. The transport, water, and power sectors are responsible for increasing shares of energy use, as electricity generation and water desalination are energy intensive processes. Electrification rates also varied widely among Arab countries, averaging 80 per cent in 2005. While Kuwait boasted a 100 per cent electrification rate, some Arab countries, including LDCs, have limited electricity coverage (UN-ESCWA and LAS 2007) (see Figure 9).

As a result of energy use, total CO2 emissions in the region soared to 1.2 trillion metric tonnes in 2003, an 81 per cent increase since 1990. Maghreb and Mashriq countries and the Arab LDCs witnessed an increase of total CO2 emissions by 66 per cent, 80 per cent and 57 per cent, respectively. In terms of water, the overall proportion of the region's population using improved drinking water sources remained constant, at 82 per cent, between 1990 and 2004. It increased in the GCC, Mashriq, and Maghreb to 100 per cent, 94 per cent, and 86 per cent, respectively, whereas it fell from 68 per cent to 63 per cent in the Arab LDCs. The lack of overall improvement in the Arab region suggests that significant efforts are still required to halve the proportion of people without sustainable access to safe drinking water by 2015 (MDG 7).

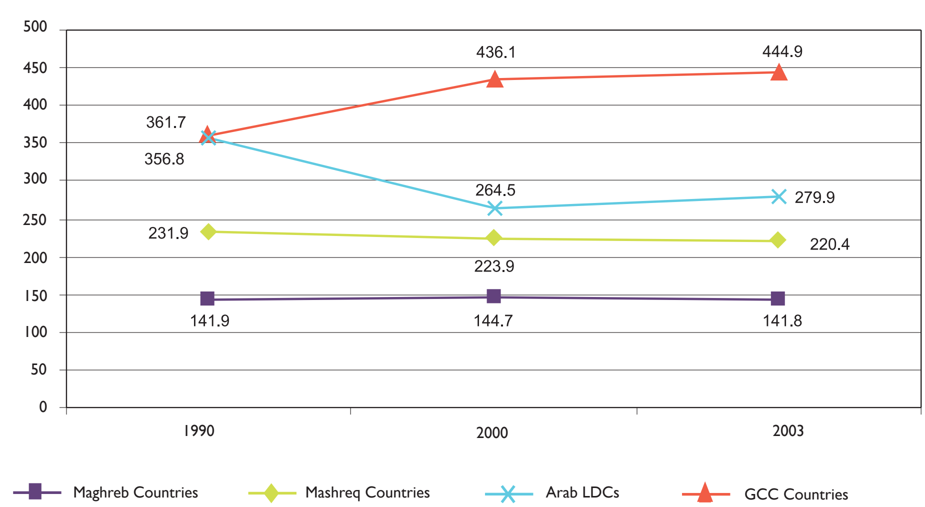
There has been slow improvement in access to sanitation facilities in the Arab sub-regions in the last 15 years as well. Major disparities in access to sanitation facilities are evident when urban and rural areas are compared. In the Arab LDCs, only 26 per cent of the rural population has access to sanitation facilities, compared to 60 per cent in urban areas (UN-ESCWA and LAS 2007).

CHALLENGES

Rapid population growth

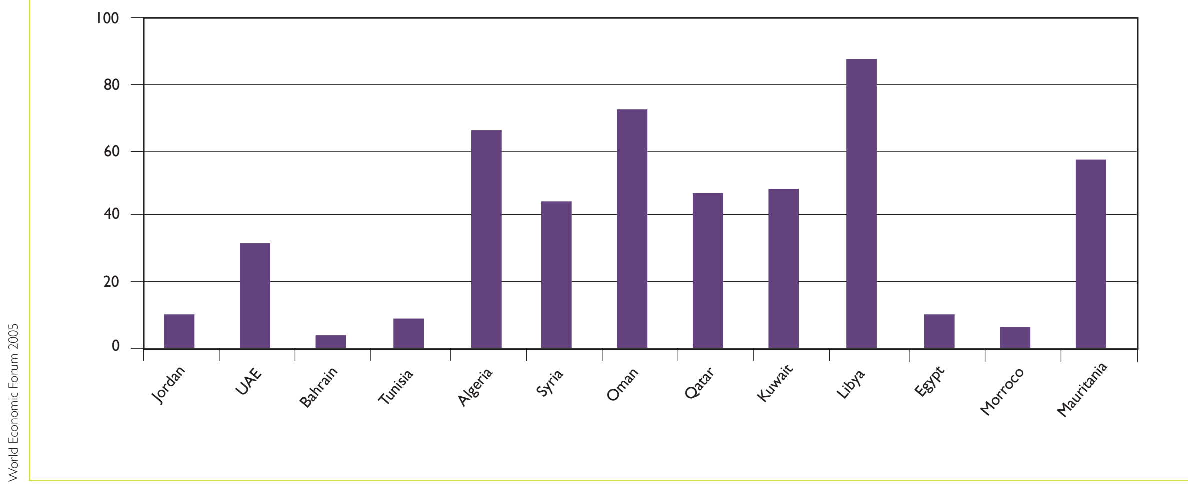
Many officials and scholars in the Arab region argue that rapid population growth is the

Figure 9. Energy use (Kilogrammes of oil equivalent) per US$1 000 GDP (PPP)



UN-ESCWA & LAS 2007

Figure 10. Primary exports as part of total exports for Arab world countries, (%)



foremost challenge to sustainable development in the region. As populations grow they put increasing pressure on the natural resource base to fulfil their needs. The pace of economic growth is often dwarfed by the population growth rate. Some of the results are: limited success in alleviating poverty, the inability to provide social services, such as health care and proper education, and the inability to provide physical infrastructure, such as safe drinking water and proper sanitation.

The need to diversify the economic base

Economic growth in many Arab countries is a direct result of exports of raw material and cash crops. The high energy prices of the past few years have brought the Arab world their highest growth rates in nearly three decades. However, this prosperity is largely linked to fluctuating oil prices. It is therefore vital that those Arab countries heavily reliant on oil exports adopt the necessary structural reforms to achieve international competitiveness and sustainable current growth momentum. Traditionally, oil booms have often provided governments with enough revenue to delay implementing economic reform programmes, and little effort is exerted to diversify the economic base of the region. Many of the returns from oil were invested outside the region (see Figure 10). Several issues are responsible for the moderate economic performance in the region. They are due to lack of a diversified economic base, limited natural resources and lack of adequate human resources.

The need to boost competitiveness

The Arab Competitiveness Report 2005 identified the following nine indicators for measuring competitiveness: (1)institution setup, (2)infrastructure, (3)market efficiency, (4)macroeconomic stability, (5)technological readiness, (6)health and primary education, (7) higher education and training, (8)innovation, (9) business sophistication, The report identified the following challenges that need to be addressed to improve competition and maintain the momentum of growth in the region: (1)Education reform is a high priority. Educational outputs remain mismatched with the needs of the business sector, depriving the region's economies of the trained talents needed to raise productivity. (2)Since innovation is the key to future growth, investment in research institutions as well as the private sector is necessary to increase research and development spending. (3)High unemployment and rapid labour force growth put pressure on natural resources. They also put pressure on governments to thoroughly restructure and reform labour markets that rely heavily on the public sector and migrant workers. The report noted that some of the most impressive success stories in the region have demonstrated the possibility of sustained and aggressive reforms irrespective of conditions in oil markets, such as in the UAE. However, this has often required the participation of the business community as well as society at large in supporting measures aimed at long-term economic prosperity (World Economic Forum 2005).

UNEP

The conditions in the region, its extended history, natural and cultural wealth are the basis for economic growth and social development if natural resources are properly managed, maintained, regenerated and conserved.

Social inequity

Some Arab oil producing countries have achieved significant improvements in human well-being. Unfortunately, many others are still struggling to improve the basic quality of life for their citizens. Poverty, poor health services and education systems, especially in rural areas, are among the many obstacles that hinder improved well-being. Moreover, lack of physical infrastructure and social services is often associated with poverty and deteriorated living conditions. Hence, these challenges require increased government spending on social programmes, including health and efforts to stop the spread of viral diseases such as HIV/AIDS and Hepatitis C (see Chapter 5).

The need to properly manage resources

Decision making and the management of both natural and human resources are another challenge facing Arab countries. Some countries formulated a National Environmental Action Plan (NEAP) and others developed a National Sustainable Development Strategy (NSDS). Many of these countries have included in their NEAPs intentions to combat desertification, protect and conserve biodiversity, and manage resources like water and land. However, there is still a question of whether these reforms will actually lead to environmental sustainability because decision making at the policy, planning and management levels in many Arab countries is still broken down along sectorial lines. Applying the principles of good governance is one strategy for achieving sustainable development.

To properly manage available natural resources there is a need to review and combine law enforcement with the use of economic tools, such as market instruments. Law enforcement (command and control) and penalty are not enough to properly manage resources but can be effective when used together with economic instruments. Some of the economic tools that can be used to improve resource management are green accounting, and economic indicators like real environmental GNP (see Chapters 10 and 12).

Globalization and the new scramble for the Arab region

Worldwide transformations and the inability to cope with these changes is another challenge. As globalization promotes and supports free trade, it is also associated with environmental and energy crises. For example, the global demand for energy impacts the economies of both oil and non-oil producing countries. Oil producing countries enjoy the additional revenues produced when oil prices increase. These returns are invested in the markets of Europe and the United States rather than non-oil producing Arab countries, which suffer from inflation rates, growing budget deficits and a loss of competitiveness.

Globalization is associated with the rise of new corporations in the field of technology, such as software and genetically modified agricultural products, which are defended by international conventions and treaties through protecting intellectual property rights. The brain drain is another phenomenon that is affecting Arab countries, where a significant number of specialists are annually migrating to the United States and Western European countries. Other areas associated with globalization include information and communication technologies, which can play a significant role in shaping values, and affecting preferences, and in turn can transform demand for produced goods and services. They may also introduce ideas that are contrary to existing traditions, values and culture.

Peace, security and the environment

Natural resources are inextricably linked to human conflict. When natural resources are insufficient to meet the human demands for them or when human demand seeks to monopolize the resource, conflict (typically armed) erupts, and natural resources, as well as individuals and communities are negatively affected. With the further deterioration in the environment and its natural resources, the prospects for conflicts increase, thereby inducing a downward spiral of ecological and humanitarian degradation. Research has shown that environmental stress and the exploitation of natural resources can increase the severity and duration of conflict, and complicate its resolution (PBSO and UNEP 2008) (see Box 6).

This link has been demonstrated clearly in Sudan, where the direct and indirect impacts of conflict, such as population displacement, lack of governance, conflict-related resource exploitation and underinvestment in sustainable development have had their implications on the environment. Conflict has also affected competition over oil and gas reserves, Nile waters and timber, in addition to land-use issues related to agricultural land."There is a very strong link between land degradation, desertification and conflict in Darfur. Exponential population growth and related environmental stress have created the conditions for conflicts" (UNEP 2007c).

There are a number of intertwined elements in the Arab region; namely, the high population growth rate, the decrease in available water per capita, growing development projects and shortage of renewable water sources (internally), as well as the non-control of water quantity coming from outside the region. These factors necessitate the rational management of water resources and crises, and are considered a political rather than a scientific challenge. Due to the nature of joint water resources and the growing demand at the regional level, integrated water resources management represents a significant opportunity for cooperation among countries in the region.

Box 6. Peace, security and environment

"Warfare is inherently destructive to sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and cooperate in its further development, as necessary." – (UN 1992) 1992 Rio Declaration

"It is prohibited to attack, destroy, remove, or render useless objects indispensable to the agricultural areas for the production of foodstuffs, crops, livestock, drinking water installations and supplies, and irrigation works, for the specific purpose of denying them their sustenance value to the civilian population or to the adverse Party, whatever the motive, whether in order to starve out civilians, to cause them to move away, or for any other motive."

Geneva Convention (1977 Protocol 1) (ICRC 2005)

Moataz Ali

Population displacement resulting from conflicts causes a cascade of environmental problems. Internal strife in Sudan has led to un-sustained usage of natural resources and the increase in the number of poor quarters. It is worth mentioning that there is an estimated five million Sudanese nationals internationally and internally displaced into camps and urban fringes (UNEP 2007c).

Furthermore, as is the case in Sudan, Iraq, Somalia, and the OPT, the health and sanitation conditions in internally displaced settlements are typically inferior (IDMC 2006). Infrastructure, such as water, sewage networks and rain-water drainage, were not designed for an expanding population. The original networks have seriously deteriorated and networks constructed several years ago are no longer adequate to serve today's displaced population. According to UNRWA (2008), winter rains often result in flooding in low-lying areas and poor housing means that Palestinian refugees live in damp, cold conditions. The summer months bring heat, dust, humidity as well as serious problems of pest infection and diseases.

Conflict-based pollution occurs when sensitive sites are directly targeted. The destruction of an abandoned pesticide storage depot by an air raid in northwest Somalia in 1988 led to release of hazardous chemicals, some of which were carcinogenic, including DDT (UNEP 2005). In Iraq, the destruction of plants producing fertilizers, chemicals and refineries, and the destruction of small and medium-sized electroplating facilities, tanneries, workshops and garages have resulted in the spread of hazardous wastes (UNEP 2003a). Moreover, the 2006 Israeli targeting of a power plant in Lebanon resulted in the direct spillage of 12 000 to 15 000 tonnes of heavy fuel oil, which


Moataz Ali

Though Arab countries have achieved considerable progress in human well-being, livelihoods in many countries still need attention, improvement and serious endeavours to overcome difficulties. Seizing opportunities will increase prospects of achieving nationally desired objectives.

spread in varying degrees along the Lebanese coast and reached the southern coastline of the Syrian Arab Republic (UNDP 2007b). The oil spill and the bombing of the power plant caused numerous problems, including air pollution and marine and coast pollution, due to the burning of the power plant for 27 days, releasing soot, methane, range hydrocarbons, and soil pollution from deposited contaminants of fuel burning (UNEP 2007b, UN General Assembly 2007).

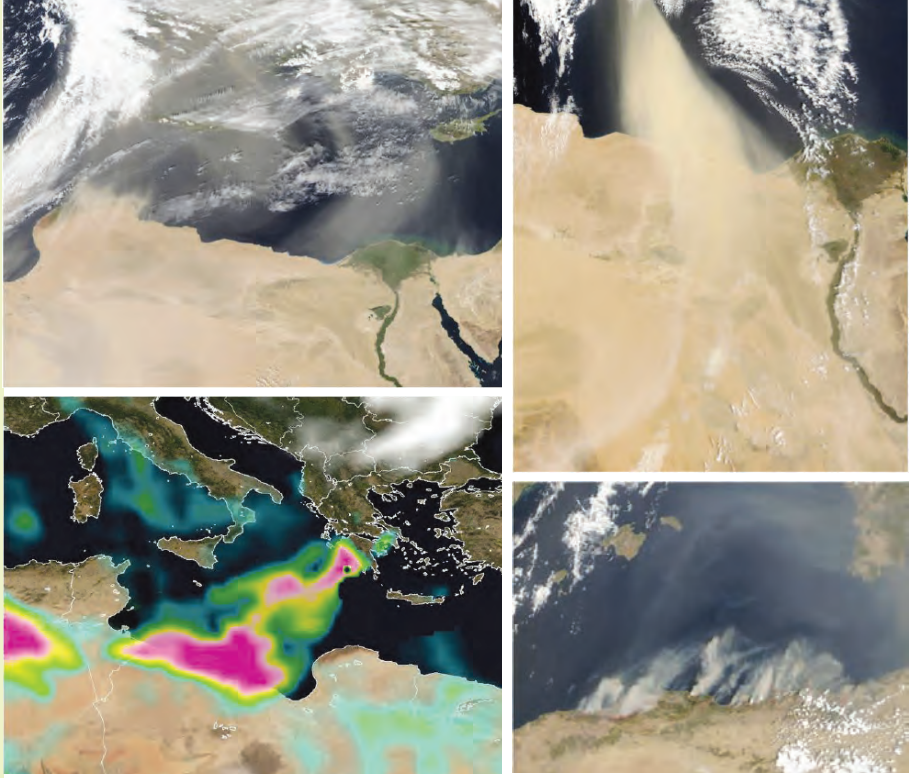
Direct targeting of sensitive sites has been most significant in Iraq, where at least 18 chemical, 10 biological, and 3 nuclear sites were deliberately attacked in 1991 (Clark 1992). Chemical fallout, including nerve and mustard gas, from chemical weapons released by the bombing, was detected throughout Iraq. In addition, numerous industrial facilities have been destroyed since 1991, including the Al Mishraq sulphur mining complex, causing the release of 300 000 metric tonnes of sulphur waste, increasing air pollution and crop damage (UNEP 2003a).

Significant conflict-based pollution also arises with overall destruction. In Sudan, large amounts of rubble and steel waste have developed as a result of war. In Lebanon, many experts believe that the release of asbestos from the complete Israeli destruction of more than 230 apartment buildings, 2 million m2 of masonry surfaces and 1.2 million m3 in debris in southern suburbs of Beirut in 2006 is the worst environmental effect on health from the war. They anticipate that environmental repercussions will persist for decades due to the liberation of chrysotile asbestos fibres (Jernelov 2006).

In addition to pollution of environmental areas and natural resources through their direct targeting, trees, crops, pastures and wells have been targeted in Sudan – for example – along with reports of poisoning (UNEP 2007c). In the OPT, Israeli forces routinely bulldoze and uproot olive trees (which account for 80 per cent of cultivated land in the West Bank and Gaza), in addition to other types of fruit trees (UNEP 2003b). According to a report released by the Applied Research Institute in Jerusalem, more than one million olive trees have been destroyed since 1967 (ARIJ 2004).

All weaponry is destructive, by its very nature, and leaves a negative impact on the environment and human health. However, some weapons have a more lasting environmental effect. Most significant of the weapons used in the region is depleted uranium, a radioactive by-product of the uranium enrichment process. At least 350 metric tonnes of Depleted Uranium (DU) were used in the 1991 Gulf War alone and in military attacks since then. Remnants of this radioactive waste litter much of southern Iraq. According to the US Army Environmental Policy Institute, "If DU enters the body it has the potential to generate significant medical consequences. The risks associated with DU in the body are both chemical and radiological.

Short-term effects of high doses can result in death, while long-term effects of low doses have been implicated in cancer" (AEPI 1995). Studies have uncovered the possibility that DU entered the food chain (Saleh and Meqwar 1998). The specific manner through which DU contamination has affected plants, animals, and micro-organisms in the region – or will affect them in the future – is not yet known. What is clear is that, at the very least, the DU contamination of the food chain will increase the opportunities for human ingestion of DU – and thus increase the potential risks to human health.



Terra Modis 19 - 2007

A satellite photo showing overseas sandstorms heading from the north African desert to south Europe, crossing the Mediterranean, and carrying fire smoke from Greece to North Africa, across the Mediterranean Sea.

North Africa and the Middle East were the scenes of several confrontations throughout the last century that still have serious implications on today's development initiatives in the region. Land mines and Explosive Remnants of War (ERW) are some of the products of these confrontations, and remain a common obstacle to land development in all Arab countries. In Egypt, irrigation projects essential for land reclamation and cultivation have experienced delays and increased costs because of the need to clear mines and ERW from prospective sites and routes, totalling about 349 913 hectares. The need to remove land mines and ERW delayed large-scale "wind farm" projects in the western desert and have negatively affected the petroleum sector in Egypt as well. In Libya, the agricultural sector is most affected as approximately 295 059 hectares are not useable because of mines and ERW. In 1972, the Ministry of Agriculture and Land Reclamation published an estimate of the total loss as a result of the non-use of this affected land at 18 897 760 Libyan Dinars (about US$14 475 728). In 1976, Libyan authorities estimated 1 452 077 hectares of affected land could not be used for grazing (Sorour 2006).

Perhaps the harshest impact that conflict has on natural resources and on the environment in general is neither the weapons used nor the targets destroyed nor the direct consequences of pollution; rather, perhaps it is that conflict shifts the priorities of the state away from the protection of natural resources and away from sustainable environmental management. Armed conflicts have pushed governments to decrease funding for development and conservation programmes, as in Sudan where the "financial burden of virtually continuous warfare and the ensuing poverty can thus be considered as one of the root causes of the current state of the environment" (UNEP 2007c). In Somalia, the conflict has turned attention away from vital international fishing protocols and has led to overfishing by unlicensed boats. This has far reaching effects both ecologically and economically on Somali fishermen (UNEP 2005).

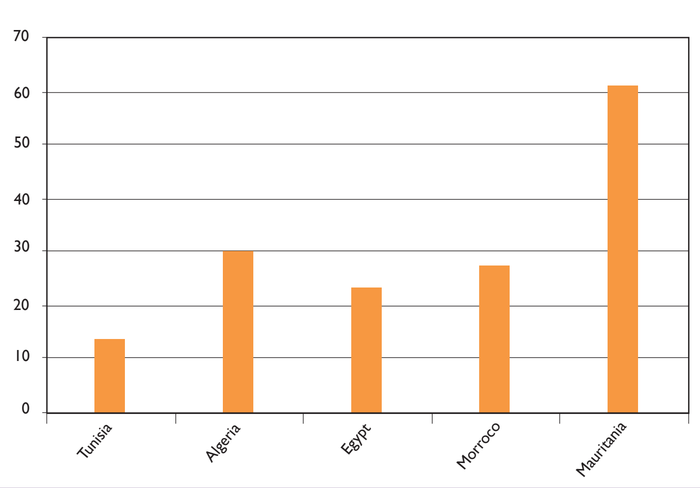
In the OPT, occupation and conflict have rendered environmental management difficult. The environment-related issues include land clearing and obstacles facing waste disposal such as curfews and closure of crossing points. Long-term environmental degradation is evident in the pollution of groundwater resources, lack of proper waste management, and shortcomings in environmental legislation (UNEP 2003b).

Alleviating poverty

Poverty is evident in many Arab countries, particularly within the LDCs such as Yemen, Somalia and Sudan. Even in moderate-income countries like Tunisia, Morocco and Egypt, poverty is evident in the old quarters of urban and rural areas. Poverty still persists in some Gulf States despite the wealth derived from oil and natural gas exports (see Figure 11).

There are several measures of poverty including when income falls under a defined poverty line. "How much of the population earns either one or two US dollars a day" represents another measure. There are also several non-monetary measurements for poverty and deprivation. These include the percentage of households residing in informal settlements; the per cent of female headed-households; the provision of social and physical infrastructure, including education, health care, safe drinking water, sanitation, and the proper collection and disposal of solid waste. An individual's access to formal financial institutions is another indicator of poverty because the poor do not have sufficient income to receive credit or loans.

Figure 11. Percentage of the poor in rural areas in North Africa, 1990–2004



WRI 2007

Gender inequality in the Arab region is another facet of poverty. For example, women play an important role in agriculture in the region. In Tunisia, statistics show that the proportion of women in agricultural family labour is as high as 64 per cent. However, when land reform measures in the late 1950s and early 1960s were applied, the percentage of women with access to land did not exceed 10 per cent at best (Zaibet and El-Kholei 2008). Findings in Egypt are similar, as most of the agricultural land holdings belong to men alone (see Box 7).

The economic hypothesis that the poor pay more for goods and services is valid and generally accepted in the Arab region. They are often denied proper safe drinking water, and thus have to buy bottled water at market cost. In informal areas they do not have access to adequate education and medical care, and hence have to depend on services provided through private channels, which offer these services at higher prices than the public institutions. In some cases, the poor seek these services from religious or charitable NGOs. Poverty can also lead the poor to degrade their natural environment in order to sustain their livelihoods. Thus, persistent poverty is among the many threats to sustainable development in Arab states.

Moderate economic performance is one of the numerous reasons for poverty in the region. Some of the significant reasons for poverty are lack of equitable distribution of wealth, and access to power and decision making processes. Still, economic growth is an important target for Arab countries, many of which have applied the World

Bank–IMF liberalization strategy, which entailed removing subsidies, minimizing state control of market forces, encouraging the participation of foreign and local private sector companies in many productive sectors, such as agriculture and manufacturing, and enhancing productive-service sectors, such as transportation which improved according to national economy indicators. However, many studies and papers indicate that the trickle-down process has not been effective and, therefore, the benefits of economic growth have not reached the majority of the lower socio-economic classes. Recent neo-liberal economic policies that favour large scale production and limit state intervention and subsidies to small farmers have been adopted in many Arab countries, particularly in North Africa, resulting in small-scale farmers and peasants abandoning their small fields to the benefit of the large farm owners. Others resorted to production for mere subsistence and many left their land in search of a better opportunity in the large cities, oil producing countries or illegally migrating to Europe (Zaibet and El-Kholei 2008).

Another significant reason for poverty stems from planning and management, and decision making at large. The Arab region, due to the level of intermittent and ongoing conflict, has significant military expenditures. In fact, the data shows that military expenditures in many Arab countries exceed expenditures for health and/or education. For example, Oman and Saudi Arabia allocate a significant share of their GDP for military expenditures. In contrast, Tunisia allocated 1.7 per cent of its GDP to military expenditures in 2000, and 6.8 and 2.9 per cent for education and health, respectively. This helps to explain the relative improvements in the sphere of human resources, economic growth and social development in Tunisia.

Box7. Discrimination against women


Abdalrahem AL Arjan

The United Nations Commission for Human Rights' Resolutions 2000/13 and 2001/34 stress that there is an acute impact of gender-based discrimination and violence against women on their equal ownership of, access to, and control over land; adequate housing as well as equal rights to own property. These resolutions affirm that laws discriminate against women with respect to their access to, financing and acquisition of land, property and housing. These obstacles constitute a violation of human rights which protect women from discrimination and re-affirm the need to promote their right to an adequate standard of living, including adequate housing. The Commission urged states to design and revise laws to ensure that women are accorded full and equal ownership rights to land and other property, adequate housing, and inheritance.

OHCHR 2000,2001

Limited natural resources

The three main environmental characteristics of the region are: the fragile ecosystems, limited agricultural potential, and water scarcity. Almost

5.1 per cent of the gross area of the Arab region is cultivated, compared to 11.9 per cent globally. The per capita share of renewable freshwater resources is about 16.3 per cent of the average per capita share globally, which indicates a serious shortage and limitation of water resources. According to information from both the Food and Agriculture Organization (FAO) and the Arab Organization for Agricultural Development (AOAD), Arab countries have a significant share of the world's farm animals, while the production of fish is limited despite the potential for improvement (El-Naggar 2005).

The Arab region does not have significant metallic deposits, like iron or copper, yet some countries, such as Morocco and Egypt, have significant non-metallic deposits including phosphate and sulphur (El-Naggar 2005). Meanwhile, the Arab region possesses significant reserves of oil and natural gas. Currently, Saudi Arabia, Iraq, Kuwait, Qatar, Libya and Algeria are among the largest oil producers in the world. However, the revenue from oil and gas exports often does not contribute directly to local economies, firstly, because exploration companies retain a significant share of the profits from oil and natural gas. Secondly, Arab countries invest most of the profits from oil and natural gas sales in American and European companies (El-Naggar 2005).

For example, in 2000 oil producing Arab countries invested an estimated US$1.4 trillion outside the region, despite the fact that economic and social development initiatives in the region are desperately seeking funding. Thirdly, many Arab oil producing countries depend on foreign labour, which often means that earnings are transferred outside the Arab region in the form of remittances rather than reinvested locally (El-Naggar 2005).

Google Earth 2005

Investment in science and technology could compensate the region for the loss of natural resources provided they are managed in a way that considers sustainable development a priority.

One example of this could be seen in the agricultural sector in the Middle East and North Africa in the 1970s. Despite the high revenues from oil sales, the agricultural sector did not benefit significantly from high oil prices. This was despite the potential for these revenues to fund dramatic and far-reaching agrarian reforms. Research shows that investment in agriculture across the Arab world slumped in the 1970s and 1980s as regimes imported food and consumer goods instead of producing them nationally (Bush and Abdel Aal 2004).

Having limited natural resources is a real obstacle to achieving development aims, and improper decision making processes, planning and management can complicate the matter. According to the FAO and AOAD, despite Egypt's limited arable land and water resources, it has the highest agricultural productivity among the Arab countries. The reason for this is that labour and appropriate technologies are used to compensate for lack of natural resources (El-Naggar 2005).

Limited access to technology

Technology transfer to the Arab region faces several barriers. At the top of the list is the extent to which new technologies are appropriate for local conditions and capacities. For example, adult illiteracy is a major hindrance to the transfer of technology in Arab countries. Adult illiteracy is not just limited to the ability to read and write, but also the ability to function. The education system in most Arab countries does not train students to think critically and reasonably, rather to rehearse facts as stated in the book. Thus, many school and university graduates are not able to function properly and innovatively to accept and enhance the imported technology and adapt it to local conditions.

"Unfortunately, today the common style of child rearing in the Arab family is authoritarian and over-protective. Hence, children become accustomed to suppressing their inquisitive and exploratory tendencies. Systems of education based on rote memory do not help as much as systems that teach creative thinking" (Lewis 2006).

"The lack of creativity is seen in research output. Arab countries produce 26 research papers per million people. This is comparable with other advanced developing countries, but the average for developed countries is about 1 200 papers per million people" (Lewis 2006). Lewis continues to argue that research activity in the Arab world is mostly not innovative. Applied research constitutes the significant share, and basic research represents only a small portion. He further argues that research in advanced fields, such as information technology and microbiology, is extremely rare. Most of the research produced in the Arab world is not competitive with what international markets offer.

Stimulating research and development requires the political will to indigenize science and establish the necessary infrastructure. This calls for greater research and development outlays than the fractional sums Arab countries currently invest, which do not exceed 0.2 per cent of GNP. The ratios spent by developed countries vary from 2.5 to 5 per cent.

Furthermore, 89 per cent of expenditure on research and development in Arab countries comes from governmental sources, while productive and service sectors spend only 3 per cent, as against more than 50 per cent in developed countries (Lewis 2006).

According to several of the UNDP Arab Human Development reports (2003–2005), the capacities of many Arab countries to generate adaptive technology conducive to their sustainability are

Investment in science and technology is an opportunity for the future of Arab generations.

limited. Moreover, in many cases, the transfer of technologies in the production sphere is too capital-intensive. On the other hand, the Arab population is growing and retains high population momentum given the limited natural resources. Thus, the solution should be a labour-intensive production system.

Yet another hindrance is the financing required to import technologies to the region. This is particularly true of the many technologies, particularly those that require the acknowledgment of intellectual property rights. Presently, the PCs, laptops, mobile phones and other ICT components, cost much less than the human resources used to develop them. With the exception of the Gulf States, many Arab countries, especially the LDCs, cannot afford the costs of these advanced technologies.

Even when these new technologies are accessible, the inability of proper usage is a hindrance to technology transfer. For example, qualitative measures including the type of information exchanged and the sites visited can demonstrate that they are not used to their full capacity despite quantitative measures that show high numbers of internet and mobile phone users.

Accessing technology is important for economic growth, social development and environmental protection. The inability to access technological advances or develop these technologies locally is a challenge to the sustainable development of the Arab region. Countries have the potential to allocate a significant share of their GDP to education and research and development to improve the access to, and development and application of new technology.

Limited experience of civil society participation in planning

Since the late 1980s, the number of registered Non-Governmental Organizations (NGOs), or Civil Society Organizations (CSOs), has been growing in the Arab region. Among them, local environmental NGOs came to coexist with


Abdalrahem AL Arjan

international NGOs participating in community development and addressing systematic global environmental issues such as climate change and land and water degradation.

CSOs have expanded to include: community groups; private voluntary organizations; business associations, which have grown rapidly in numbers over the past two decades; and labour syndicates with an agenda to serve the local community. An important civil society trend is the shift of CSOs from charitable and philanthropic work to the defence of vulnerable and marginalized populations, marking a noticeable political transformation.

Civil Volunteer Organizations (CVOs) are another means of civil society participation. However, several obstacles face full integration of CVOs into the development processes. Many regulations in Arab states are not conducive to the full development, independence and autonomy of CVOs. Some of these CVOs develop religious and ethnic lines that are believed to constitute a threat to internal stability in some countries. Other CVOs develop as non-formal political parties that are banned by national legislation. In many cases, unlike NGOs, these CVOs are not permitted to receive funding from abroad.

Embargoes imposed on some Arab countries

Many Arab countries, such as Libya, Sudan and Iraq have been subject to international economic embargoes and sanctions, which can have serious negative impacts on the sustainability of their development and hinder their efforts to improve the well-being of their residents.

OPPORTUNITIES

Rational use of natural resources

Since the early 1990s, many Arab countries, regardless of their economic status, and with the support of international organizations, have embarked on mainstreaming environmental management into their economic and social planning. This is evident in the creation of laws to protect natural and human environments, National Environmental Action Plans (NEAPs), National Strategies for Environmental Sustainability (NSES) and National Strategies for Sustainable Development (NSSD).

Many Arab governments have also signed international conventions and protocols, such as the United Nations Framework Convention on Climate Change (UNFCCC). Today, the fiscal plans of many Arab states include a special section on environmental management that allocates funds to invest in environmental protection and regeneration.

However, environmental management and rational use of natural resources, require capacities that many Arab countries lack. As a result, Arab countries initiated a number of National Capacity Self Assessments (NCSA), as a step towards institutional development conducive to sustainable development. NCSA is a modality that aims to help countries to assess their national capacity to meet Multilateral Environmental Agreements (MEAs). These MEAs include the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention on Biodiversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD), the Stockholm Convention on Persistent Organic Pollutants (POPs) and International Waters (IW).

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The NCSA is unique in that it promotes synergy among the MEAs and specifically helps countries to assess their capabilities, and to define their priorities and constraints with regard to global environmental management.

Establishing a friendly investment environment

The simplification of business procedures in the UAE and Jordan is reflected in their World Bank Business report rankings, and is closely associated with improved global competitiveness, as presented in the annual World Economic Forum reports. General economic improvements have a positive impact on human resources, quality of life and the protection of natural resources.

Since the late 1980s, many Arab countries have come to realize the importance of engaging the private sector in the development process. For example, since the early 1990s, Egypt, Yemen, Tunisia, Morocco and Djibouti have embarked on implementing programmes for Economic Reform and Structural Adjustments (ERSA) that have had a positive impact on macro-economic indicators, such as bridging the gap between savings and investments, controlling inflation, and attracting FDI. However, the mechanisms of trickle-down economics remain idle in many countries, which may explain the persistence of poverty.

Mechanisms for achieving social security

The rise of America's Reaganomics and British Thatcherism in the late 1970s and early 1980s promoted limiting government intervention; the privatization of state assets, such as railways; and ultimately depended on the private sector to lead development and provide various municipal services, tax cuts and relax economic constraints. The current economic and financial crisis may be due, at least in part, to the old liberal economic

Civil Society Organizations (CSOs) have recently played a greater role in defending the rights of the weak and marginalized populations in Arab countries.

policies, which are present in western, as well as developing countries like many of the Arab non-oil producing countries. Thus, this crisis may reflect the inadequacy of these policies to meet the demands of today's markets.

Many experts have called for government intervention to: (A)mitigate market failures and imperfections resulting from the lack of perfect competition; (B)provide public goods, such as clean air; (C)minimize negative externalities, such as the negative impacts of economic activity of one agent on the economic activities of others; (D)bring about institutional transformations necessary to sustain the outcomes of reforms and development initiatives; and (E)distribute the benefits of economic growth to all population groups

One of the reasons for persistent poverty is the enduring disparity of wealth in the region. In order to alleviate poverty, several Arab countries such as Egypt, Morocco, Yemen and Djibouti have written Poverty Reduction Strategies (PRSs) with the assistance of the World Bank. These strategies are in themselves a positive move towards social security. However, there are many remaining actions needed in this sphere. Developing safety nets and Social Funds for Development are other means that many Arab states have considered to protect low-income sub-populations from poverty, but more work remains to be done.

An integrated and comprehensive approach is required in order for social security mechanisms to remain intact, and become more efficient and effective. A monetary approach is not sufficient to maintain a social security system. Rather, civil society and governments need to adopt and apply principles of good governance in day-to-day decision making to ensure efficient planning and investment allocation. This move should assure the provision of social services to deprived localities and sub-populations, including women and other marginalized groups, and will ultimately lead Arab countries to make democratic reforms that will help them achieve sustainable development.

Gender equity essential for sustainable development

It is important to understand that gender equity has positive developmental outcomes. Gender equity is a comprehensive concept that requires an understanding of social, economic, and political impacts on men and women. The continuous discrimination against women and their marginalization effectively reduce their role in development. The 2005 UNDP Arab Human Development report states the need to pay special attention to the status of women in the Arab region.

Improving the status of women is central to the overall development of Arab countries. Two strategies to accomplish this are providing women with equal opportunities for education and employment. For example, evidence from several Newly Industrialized Countries (NICs), such as Korea, shows that the decision by women to have fewer children has contributed to better education and employment opportunities. This has led to a decline in population growth rates, which had positive outcomes on families, the community and on natural resource consumption and replenishment.

When women and men are empowered, the outcomes of development initiatives can be tremendously improved. Desertification and drought in Mauritania were having a negative impact on nomads as desertification was partially responsible for the loss of the rangelands that support their livelihoods. As a result, nomads left their rangelands for areas where help was available, which exerted more pressure on the already strained natural resources in the new areas.

Through the assistance of the United Nations Development Programme (UNDP) and the United Nations Sudano-Sahelian Office (UNSO), capacity building was encouraged among women to be responsible for stabilizing sand dunes. They accomplished this in part by organizing themselves into working groups to plan and establish linkages between the local community and local authorities. Within three years, these women were able to cultivate about 80 hectares of sand dunes and develop fences of shrubs and timber trees. Within these fenced areas they were able to grow needed vegetables for their families. In this traditional society, women were empowered to participate and serve their community, making everyone better off (FAO 2003).

Focusing on young people

Data for the Arab region indicates that current rates of population growth are high due to a wide range of reasons, including high fertility rates and declining mortality rate. The data also shows that the majority of the Arab population are young, at 18 years of age or less. Young inhabitants require social services such as education and health services, investments in the employment sector to create job opportunities, adequate housing and shelter, and environmental and social amenities.

As the majority of the Arab population are young, they have the potential to make large contributions to society. They can be seen as a human resource that can be developed through investments that promote and enhance their skills and capacity to improve development efforts. Arab countries can substitute human capital, modern management and production technologies for the capital stock that is scarce by investing in young populations through state-of-the art education and health services, as well as creating proper infrastructure.

Curbing urban migration

Urban primacy, which exists when a major city overshadows the remaining cities, is evident in many Arab countries. One of the reasons for this phenomenon is rural-urban migration. The phenomenon negatively affects the primate city and other human settlements within the nationally defined boundaries. Urban primacy reflects regional disparities which are associated with environmental degradation and congestion. In many cases the primate city deprives other urban and rural settlements of an equitable share of resources and investments. This in turn pushes rural settlers to move towards the primate city in search of better opportunities. Without understanding urban-rural connection and impacts, there is little hope of improving conditions in both the primate city and other human settlements. The carrying capacities of both secondary cities and rural areas make investing in these settlements more efficient from a financial point of view. In fact, the rate of return from investing in the secondary cities and villages is higher than that of investing in the primate city (El-Kholei 1993). The business-as-usual scenario of pouring investments into the primate city often disproportionately serves the interests of the urban elite who reside there, as well as their linkages with other industrial societies. Instead, there is a need to serve deprived areas with sufficient infrastructure and social services

A drawing by one of the blind children that demonstrates their understanding that a better environment means a better life.

by more equally distributing resources between these areas and primate cities (El-Kholei 2005, 2006).

Establishing a regional economic block

In 1964, the Council of the Arab Economic Unity (CAEU) was established as an affiliate of the League of Arab States (LAS). Egypt, Syria, Jordan and Iraq signed the agreement that established the Council. In August of 1964, CAEU issued decree number 17 to establish an Arab Common Area (ACA). The decree aimed to abolish all trade barriers among the signatory countries (CAEU undated). Recently, the CAEU prepared a plan consisting of three phases to establish an Arab Common Market. This plan was presented at the Arab economic summit in January of 2009 in Kuwait, and if successful will be completed in 2019.

Phase one of the plan, from 2009 to 2013, is to form the statute of the Arab Customs Union and an Arab Free Trade Area that will be operational from 2010 to 2013. Phase two, from 2014 to 2016, will link financial and labour markets within the region. Lastly, phase three, from 2017 to 2019, will promote inter-Arab trade and prepare for the establishment of the Arab Common Market. The Council will also present to the summit several proposals to liberalize trade, set up food projects and develop transportation and communication networks in the Arab world. In addition to the attempts to develop an Arab Common Market, CAEU also prepared a strategy for Arab economic integration from 2000 to 2020. This strategy is meant to serve as an investment map for Arab countries as it includes a mechanism for developing investments in the Arab region as well as a mechanism for developing greater intra-Arab region trade.

There are a number of sub-regional councils, such as the Gulf Cooperation Council (GCC), which consists of all countries of the Arabian Peninsula except Yemen, and the Maghreb Cooperation Council (MCC), which includes Libya, Tunisia, Algeria and Morocco. These sub-regional councils have emerged as trade blocs within the Arab region. However, there is not yet a regional Arab trade bloc. A number of necessary interventions are required to create a regional bloc that is effective in global markets. One of these interventions is the need to address the differences between countries and sub-regional blocs. It is also essential to direct wealth from oil and natural gas sales towards industrialization and the development of other non-oil producing Arab countries. This will require specific interventions that address structural, monetary and financial reforms. Labour and land markets will need major judicial reforms that ensure perfect competition, thus preventing market failure.

Transfer, integration and ownership of modern technologies

Not all Arab countries can afford to import the technology necessary to develop their economic systems. There are a number of hurdles standing in the way of successful and proper technology transfer to the Arab region. One way to overcome these hurdles is for Arab countries to invest in capacity building by enhancing educational systems and investing in research and development of adaptive technologies that are suitable to their climatic conditions, social contexts and economic realities. Improving the quality of human resources is an essential step towards proper technological development. This requires meeting market demands and needs by making necessary adjustments and interventions in the educational system, as well as adopting mechanisms for continuous training to build skills and competencies among adults.

Private sector companies should engage in more Corporate Social Responsibility (CSR) to improve development locally and nationally. The

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private sector should also make the shift from a multinational and transnational presence to become an active partner in the global economy. It is also important that these private sector companies support research and development for new technologies that will improve the development of the Arab region and protect its natural assets as well. By the same token, academic research needs to address linkages between the requirements for sustainable development and those issues that affect production and consumption in the Arab region. Applying principles of cleaner production, for example, need to be examined in the Arab context.

Additionally, research in Arab institutes should investigate the possibilities of reviving and promoting indigenous knowledge and technology, as well as local adaptive, appropriate technologies. Research should also harness information and communication technologies

Cultural heritage is the memory of societies. Preserving cultural heritage and social values is of vital importance for the protection of the Arab culture and identity.

conducive to the sustainable development of the Arab region. International organizations, donor agencies, regional cooperation institutions and common Arab action organizations, in the form of economic and trade blocs, will be required to play a pivotal role in transferring technology and disseminating information in the form of best practices and lessons learned, as well as helping Arab countries in their endeavours to build their own capacities.

Priority issues should be the first to be addressed by research and development and technology transfer. Among these priority issues is access to clean water, which can be enhanced through improved water harvesting and desalination techniques. Another priority issue is the use of biotechnology in improving food production and medicine. Equally important is the development and use of alternative energy sources, particularly solar energy.

Maintaining cultural heritage and social values

Cultural heritage is the memory of societies. It includes but is not limited to historic areas and monumental buildings. It also comprises language and idioms, stories and vernacular arts, traditional music and other sorts of folk performance arts. Arab countries have a rich cultural history, and the region's heritage and values should be at the centre of sustainable development plans for the region. Reviving, retaining, developing and managing natural and cultural heritage, including indigenous knowledge, are the most important elements of development and growth. Furthermore, maintaining cultural heritage and social values is of utmost importance to preserving Arab culture and identity. Sustainable human development cannot materialize without a strong sense of self and dignity, which safeguard the identity of both the individual and the society.

Cultural and natural heritage are also assets to the region's tourism industry. Sustainable tourism efforts require the sensible use of these two fragile assets. This necessitates capacity building among local authorities, national governments, Arab, regional and international organizations to maintain these assets by securing financial, human and technological resources. These resources can then conserve, repair and regenerate cultural and natural heritage to its original status, and protect it from decay.

Strengthening local communities

Strengthening local governance and administration is central to environmental sustainability. Strengthening the capacity of local governance will help ensure that environmental issues and priorities are properly addressed. It will also build trust between central and local authorities on one hand, and the government and civil society on the other. Additionally, it will promote the concept of citizenship which will contribute to the overall goal, which is to enable sustainable development of Arab communities at the local level.

Decentralization is another option that can be used to strengthen local communities. Building the capacities of both local authorities and their civil society partners can provide the basis for dialogue on sustainable development, which could lead to a community that is more resilient to the impacts of global economic, political, and environmental transformations. Strengthening the local community entails transforming the institutional framework within which the current environmental problems evolved. When accomplished, it can lead to the successful management of natural resources. In fact, clean air is a resource that is neither a commodity nor a service. Thus, using conventional centralized management tools to control air quality might not prove effective without a community watchdog to pressure polluters to abide by laws and regulations. A community watchdog cannot operate successfully if the community itself is not strong enough to manage and maintain watchdog efforts.

Today there is a number of CSOs involved in strengthening local communities throughout the region. In the OPT, the Civic Forum Institute (CFI) is a network of about 370 organizations that initiates activities to strengthen members' roles in representing and advocating on behalf of the interests of their constituents (CFI undated). Members also liaise with local leadership and encourage participatory democracy. Another OPT NGO, the General Union of Cultural Centres (GUCC), is active in the Gaza Strip and has 34 member organizations that organize and sponsor cultural and educational activities for the community.

So far, GUCC has organized twenty, one-day training sessions to address institutional development for 60 representatives of its Gaza-based member organizations. These training sessions were designed to strengthen the ability of NGOs to better serve the community, support the local elected officials on behalf of the communities, and enhance civil society participation and democracy at the local level. In Morocco, the NGO Citizenship Forum (CF) implemented a project to train a cadre of twenty civic education trainers to disseminate concepts of democracy, pluralism, tolerance, transparency, accountability, and active civil society participation. The Lebanese Foundation for Permanent Civil Peace (LFPCP), a Lebanese NGO, (LFPCP undated) aims to promote theoretical, applied, and multidisciplinary research with a view toward consolidating civil peace in Lebanon. The LFPCP seeks to build coalitions of citizens, NGOs, elected and appointed officials, and representatives from the private sector (World Movement for Democracy 2002).

Building capacity for implementation

The Arab region needs to build its capacity to implement NEAPs, NSSD, and other action plans that abide by international protocols and agreements. Once Arab countries successfully assess their national capacities, they will have to update their policy and strategy documents on environmental issues, including agriculture and environmental resources, with particular emphasis on capacity constraints and needs.

Capacity constraints include the ability to transform financial, human and institutional systems and processes, where institutional transformation is the most difficult and long-term process.

Environmental challenges, such as adaptation to the impacts of climate change, disaster risk reduction and management, scientific research, issues of youth, motherhood and childhood, and management of natural resources are multidisciplinary by nature and require massive coordination efforts. Building capacities to improve implementation means transforming ad-hoc inter-agency coordination systems into permanent systems once they have proven to be effective and efficient.

Executive agencies, such as line ministries, need to include staff training and establish specialized units to facilitate effective and efficient environmental management both at the central and local levels. Both governmental and non-governmental institutions need to build their capacities in economic analysis to better understand and comprehend market mechanisms, so that they can improve their decisions and produce positive environmental impacts. This is because, in many cases, environmental degradation is not just the outcome of market failures, but also policy failures, such as subsidizing chemicals in agricultural production, and institutional failures, such as a lack of transparency and accountability. Public bodies and their development partners need to recruit and retain cadres capable of conducting rigorous economic cost-benefit and cost-effectiveness analyses. The results of these analyses can then be used to communicate the need to invest in, integrate and mainstream environmental concerns into development plans to relevant policy and decision- makers.

At the crux of building capacities for implementation there is a need to build capacities in monitoring and evaluation. This means building the capacities of NGOs to lead during various stages of the project as well as ex post evaluations. It also entails building the capacities of executive agencies to devise a system for self- monitoring, tracking and record keeping.

CONCLUSION

The challenges that face the Arab region result from internal limitations and external threats. The heterogeneity of the region, its extended history and cultural and natural wealth, are all bases for economic growth and social development if natural resources are properly managed, maintained, regenerated and conserved.

Population growth is both a challenge and an opportunity. The majority of the Arab population is young, 18 years of age or less, and require certain services such as advanced education to give them the necessary technical, communicative and critical knowledge to be competitive in a global economy. These young people also need special healthcare services, as well as infrastructure and environmental amenities. If wealthy Arab states start to invest in their sub-regions and the Arab region at large, they will be able to provide the needed resources for the growing population. For example, Sudan has a vast area of land that could be cultivated to produce crops to feed the Arab world, but does not have the necessary funds, human resources or technology.

Poverty is another challenge and results from modest economic performance, inequitable distribution of wealth and power, and the inadequate quality of human resources. The key to successful poverty alleviation is to invest in human resources and promote liberty and democracy to transform human resources into the human capital necessary for economic growth, social development, and healthy ecological systems.

Many Arab countries have experienced improvements in health and education, yet there is still a need for additional improvements. Comparing funds allocated to both education and health with military spending demonstrates a large disparity between resource allocations. It also shows the need to secure peace and order within the region so that oil and natural gas revenues can be used for development rather than purchasing arms and other weapons. Peace and security are essential for the sustainable development of the Arab region.

As disasters are a recurrent phenomenon in many Arab countries, resulting in human, economic, developmental and environmental damages, it is necessary to include disaster risk reduction in development and planning policies and integrate risk reduction mechanisms into climate change adaptation programmes and sustainable development policies. This is accomplished through adopting the Hyogo Framework for Action (HFA), which offers the framework for developing policies and implementing programmes to reduce disaster risk through multidisciplinary and integrated approaches. These approaches take into account the institutional, political, social, economic and environmental dimensions.

The translation of such linkages into effective policies and actions is not yet de-facto. Environmental management and disaster risk reduction need to become joint national priorities. They need to be promoted and advanced through holistic problem-solving strategies justifying the protection and restoration of our environment and natural resources, as an investment in building resilience to disasters and risk reduction.

A comprehensive approach to risk reduction – that ensures its integration into sustainable development policies – will also contribute to increasing resource efficiency and cost-effectiveness. Investing in risk reduction will help ensure that critical infrastructure such as dams, bridges, schools and hospitals are built earthquake-safe, and that environmental assets which reduce storm surges – such as mangrove forests – are maintained, and that housing is properly built away from flood plains and landslides.

Taking into consideration that environmental management and ecosystem services are crucial elements to reduce disaster risks and adapt to climate change, as well as the strong linkages among environmental degradation, vulnerabilities and the aforementioned disaster risks, policy-makers have several options and actions to pursue in this regard. Some of these policy options offer opportunities for the environment and disaster risk reduction.

The Arab region needs to pay more attention to capacity building and development to improve implementation efforts. Fields in which capacity should be built include managing environmental resources, social service provision, economic analysis, monitoring and evaluation. Ultimately, countries of the region need to embark on a process of institutional transformation that is conducive to environmental sustainability at both the national and local levels.

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Chapter 10

EMERGING ENVIRONMENTAL ISSUES

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Main messages

New emerging environmental issues represent either a significant escalation of, or a change in well-known trends and conditions. Emerging issues may also include those environmental phenomena that are ongoing but not fully recognised or accepted, or are generally misunderstood. They also entail new research, scientific discoveries and technological innovations that reflect human beings in their endeavour to live sustainably with and within their environment. They represent the endless developments, information, surprises and ideas that reflect humanity's efforts to understand the environment and improve the quality of life. Emerging issues might have various meanings in different countries or parts of the world. However, much of these issues might be very effective in supporting sustainability in the Arab region if institutional attention and concern mount in this respect. Emerging issues such as the increasing pressures on natural resources that pose a considerable threat to the sustainability of natural resources and the environment have a significant bearing on Arab countries. Management of external, newly emerging environmental issues is vital for sound environmental decision making, which would also depend on actions taken in view of available technical information. The following are the main messages of this chapter:

- The production of bio-fuel is a renewable energy option currently capturing global interest. Nevertheless, rushing to bio-fuel crops at the expense of food crops is a risky business. Bio-fuel crop expansion is a matter of concern in Arab countries because of its impact on food and water security, along with its impact on ecological ecosystem equilibrium and sustainable development. This is true in many Arab countries particularly the oil-producing ones. The official Arab stance warns against the consequences of this action while it supports the production of bio-fuel from agriculture waste.

- Special emphasis should be given to environmental indicators due to their significant role in the decision making process. Some of these indicators were designed to reflect the sustainability of natural resources in individual countries and economic communities. These indicators include environmental performance indicators, environmental sustainability indicators, ecological footprint, and carbon footprint. Interest in environmental sustainability indicators emerges as a significant issue that should be studied and made use of in order to monitor environmental conditions and trends in Arab countries. This in turn would require the provision of necessary information through monitoring, validation and archiving processes that constitute the right prelude to a sustainable environmental management of natural resources.

- With the alarming increase in human consumption and natural resource exploitation, sustainable consumption is emerging as a necessity for future sustainable development to succeed. The League of Arab States has adopted a comprehensive regional approach that aims to develop a regional programme for sustainable development, with sustainable consumption and production as one of its main approaches. The initiative covers various areas including sustainable consumption and production. To foster sustainable consumption in Arab countries, it is imperative that fora be established to promote awareness, capacity building, and stimulate information exchange as well as the development of cooperative programmes among key stakeholders.

- Biotechnology, particularly the development of genetically modified organisms (GMOs), offers the potential to increase agricultural productivity and improve the nutritional content of the foods produced, contributing directly to enhanced human health and development. However, there are potential risks in this technique that should be thoroughly considered for their impacts on human health, biodiversity and the environment. In many Arab countries, especially those with large populations, food security is a daunting challenge that governments face. Estimates predict that by 2020, the food deficit in Arab countries will be between 50 and 90 million tonnes per year. Although the deficit will vary by country, the whole of the Arab region will be affected. Currently, the trade and production of biotechnology products in Arab countries are very limited. Biotechnology is mostly confined to laboratories and research centres. Arab countries should set regulatory laws and mechanisms that would ensure a reasonable level of protection in handling, transporting and use of genetically modified organisms – obtained through modern biotechnology and its products.

- Green chemistry is a new hybrid of chemistry that focuses on reducing, rationalizing and eliminating the generation of hazardous chemicals. Strategic context of chemical management would provide an ample opportunity to make chemicals safer, and in this context, Arab countries are invited to develop and implement national action plans to protect their nationals from the various risks related to chemical use. Throughout time, chemistry has played a pivotal role in the human pursuit to improve quality of life. However, the toll humans have paid in those rare cases when chemistry worked against them still litters history with some agonizing memories. Arab history is tainted with bitter incidents of people who were exposed to toxic chemicals. However, through the use of sustainable chemistry, many toxic industrial processes have been converted to sustainable processes, thus reducing noxious wastes. In Arab countries, the introduction of sustainable chemistry is still in its infancy, despite the significant role sustainable chemistry can play.

Bio-fuel is seen as a potential solution to the looming energy crisis and the increasing risks of climate change

INTRODUCTION

The final report of the Millennium Ecosystem Assessment (MA 2005) underlines how human activities are inextricably linked to the deterioration of the environment. The report depicts the magnitude of damage inflicted on various ecosystems and the underlying causes. Since the late 20th century, several environmental problems have emerged, such as resource depletion, loss of biodiversity, water scarcity and many others.

There has also been an alarming increase in world population, which along with changes in lifestyles and economic development, has led to increased demand for natural resources and environmental assets. These emerging patterns are unsustainable, and the main cause of global decline in natural resources and environmental assets. Frequent natural disasters, such as hurricanes and droughts, and other unusual weather conditions have been reported in various parts of the world, including the Arab region. These occurrences exacerbate existing environmental risks and uncertainties. In response to limited or scarce resources, humans have endeavoured to increase environmental capacity for production, or to change existing natural systems to meet their growing need for resources. The production of genetically manipulated crops is one example of successfully overcoming capacity constraints by producing crops even under severe drought and other unfavourable conditions.

The diversity of emerging environmental issues reflects the human effort to adapt to their environment and maintain natural resources.

One of the main obstacles in this direction is the need to keep up economic growth, while maintaining environmental safety. Policy-makers should play a crucial role in ensuring a balance between consumption and production. Synergies to decouple economic growth and environmental degradation have already come a long way, with a variety of emerging tools and aids. Some viable scenarios have been put into practice, with the ultimate goal being the prevention of further environmental degradation and simultaneously including sustainable development as an integral component of a country's policies.

The chapter begins with a quick examination of bio-fuel, a controversial issue throughout the world in terms of its impact on food, poverty, and the environment. Arab countries are divided in their support for bio-fuel production based on their economic prosperity, population density and demand for fuel. The second part of this chapter discusses indicators of environmental capabilities – and the attention Arab countries devote thereto – such as the Environmental Sustainability Index, the Environmental Performance Index, in addition to a third indicator discussed in the context of sustainable environmental development. The third part of this chapter is dedicated to sustainable consumption and production (SCP).

Examples of national SCP initiatives are emerging in several Arab countries. Eco-labelling is another milestone of sustainability emerging in some of these countries. The fourth part of this chapter is about biotechnology and its use to bridge the gap between demand for food and current limited crop productivity. The chapter concludes with a section on sustainable management of chemicals in Arab countries. This section discusses the need to further promote green (sustainable) chemistry in order to reduce the risk of exposure to hazardous chemicals, and impacts on human and environmental well-being.

Bio-Fuel, A Mixed Blessing

The production of bio-fuel is one of the environmentally friendly energy options currently capturing global interest. It is seen as a potential solution to the looming energy crisis and the increasing risks of climate change. The use of bio-fuel as a major source of energy emerged when Brazil began producing ethanol as a substitute for oil in the 1970s. Since that time, many other countries have become interested in bio-fuel, for various reasons. For example, the United States regards bio-fuel as one method of reducing its dependence on foreign oil while the European Union envisions it as a sustainable energy source. Developing countries see bio-fuel as a potential export, and an opportunity to create jobs for their citizens.

In the Arab region, the development of bio-fuel is considered an economic advantage. This is especially so in highly populated Arab countries such as Egypt, Morocco and Sudan, which have vast areas of marginalized land potentially suitable for bio-fuel crops. In these countries, the production of bio-fuel could create local jobs throughout the value chain, as production includes everything from growing raw materials to manufacturing them as bio-fuel as well as the related transport, etc.

Why bio-fuel? The relentless demand for energy

The current global energy supply mainly utilizes fossil fuels, a major cause of CO_2 emissions which are one of the main causes of climate change. Global demand for energy has increased to unprecedented levels in recent years and is expected to increase even further. According to the United States Energy Information Administration's 2006 International Energy Outlook, global consumption of marketed energy is projected to rise by 17 per cent between 2003 and 2030, and three-quarters of the increase will come from developing countries (EIA 2006).

Oil is one of the energy sources in highest demand, despite sharp price increases during the last ten years, and is expected to maintain its high cost in the near future. For example, in 2003 the benchmark price for Brent crude oil was under US$25 per barrel. By 2005 it had risen to over US$60 per barrel and then to US$130 by 2008 (OPEC 2009) (see Figure 1). As a consequence of the high cost of fossil fuels such as oil, many countries have advanced their bio-fuel goals to the top of their agendas.

The bio-fuel market

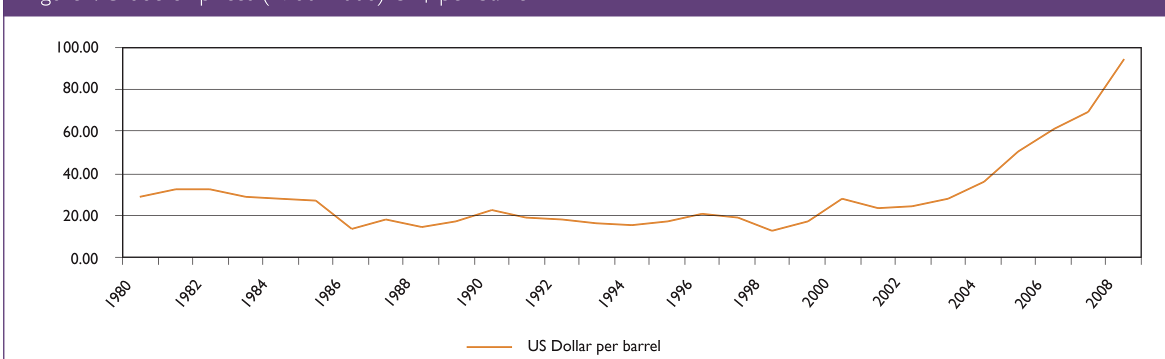
Recent figures indicate that about 14 million ha of land, or about 1 per cent of the world's arable land, is currently used for the production of bio-fuels (Greiler 2007). The global bio-fuel market mainly produces ethanol and biodiesel, and consists of approximately 85 per cent bio-ethanol and 15 per cent biodiesel. Bio-ethanol, made from corn or maize, is produced and consumed mainly in Brazil and North America. On the other hand, Europe is the global leader in the production of biodiesel made of oilseed crops and greases. Fuel produced in Europe represents about three-quarters of the European bio-fuels market (EuropaBio 2007). By 2010, it is estimated that global biodiesel production will be three times that of 2005, while global bio-fuel ethanol production in 2010 is expected to be close to double the output in 2005 (EuropaBio 2007).

It is likely that the vast majority of this increased production will depend on food crops, such as maize and sugar cane, also known as first generation bio-fuel technology. Extensive research and development is being conducted to enable the use of what is known as second generation bio-fuel technology, which would use food crop residues like rice, wheat, straw, maize husks and sugarcane bagasse to produce biogas and ethanol. This second generation technology is expected to enter mainstream commercial production after 2010 (EuropaBio 2007).

Food crops and bio-fuel crops, competition and food security

The production of bio-fuel poses a major strain on the production of other crops as bio-

Figure1. Crude oil prices (1980–2008) US$ per barrel



OPEC 2009

Jatropha curcas, one of the main crops for the production of bio-fuel, can grow on infertile soil under dry and saline conditions.

fuel crops are often grown on agricultural lands that formerly contained food crops, directly interfering with the supply of food. However, advocates of bio-fuel production argue that a number of bio-fuel producing crops are able to grow on degraded land not suitable for food crops.

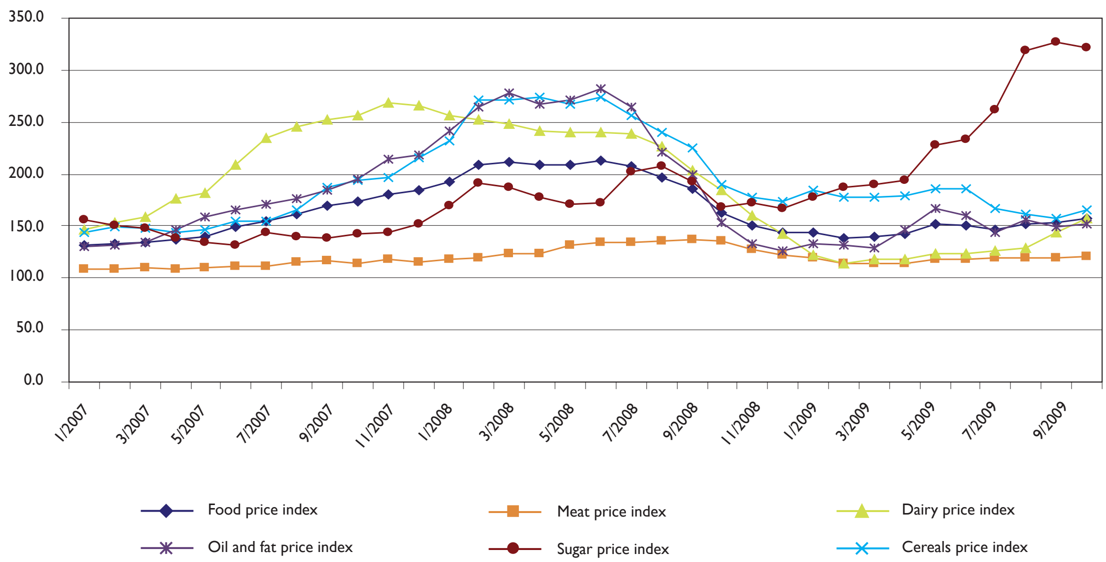
Jatropha curcas, one of the main crops for the production of bio-fuel, can grow on infertile soil under dry and saline conditions. For instance, in Egypt, wild Jatropha curcas grows in the proximity of the Red Sea, often covered by seawater with a salinity level of about 40 000 ppm (Khater 2008). Additionally, scientists have invested in a number of alternative crops that would minimize competition over land, water and other resources. Proper crop rotation may also allow a good balance between the production of bio-fuel producing crops and food producing crops in a way that does not harm food production.

Bio-fuel and rising food prices

Bio-fuel production and demand have contributed to a high record in food price levels. Specifically, the prices of those crops used both as food and for bio-fuel production have increased due to rising demand. In a recent report, the World Bank (2008) indicated that "concerns over oil prices, energy security and climate change have prompted governments to take a more proactive stance towards encouraging the production and use of bio-fuel".

This has led to increased demand for bio-fuel raw materials, such as wheat, soy, maize and palm oil, and increased competition for cropland. Almost all of the additional production of global maize from 2004 to 2007 (the period when grain prices rose sharply) was used for bio-fuel production in the United States, whereas existing stocks were depleted by an increase in global consumption for other uses than food (see Figures 2 and 3).

Figure 2. Food price indices (2007–2009)



FAO 2009

As a result of these changes in production and demand, the price of maize rose by over 60 per cent from 2005 to 2007. This was largely because of the United States ethanol programme and the resulting scarcity of maize, due to ethanol production in major exporting countries (World Bank 2007).

In 2006, the United States Department of Agriculture reported that global grain consumption increased by 20 million tonnes. Of that amount, 14 million tonnes were used to fuel cars in the US, while the remaining six million tonnes were used to meet growing food needs (Brown 2006). Similarly, Malaysia and Indonesia jointly announced that they would allocate approximately 40 per cent of their combined annual palm oil output for biodiesel production, which could increase the price of edible oil, making it expensive for both food and energy users (Asia Sentinel 2006).

Soaring Food Prices and the Arab World

Significant increases in basic food prices have sparked some unrest in the region, especially in highly populated and low-income Arab countries such as Morocco, Egypt, Jordan, and Yemen. However, most of the region's oil rich countries, especially the Gulf States, were able to sustain the hike in food prices without a problem (Johnson and Bokhari 2008). The response to food price hikes is further aggravated by the huge regional dependence on the international food market, as Arab countries buy almost one-quarter of all the cereals traded globally. Recently, several world leaders met to discuss how to control soaring food prices at an international summit on that subject organized by the Food and Agriculture Organization of the United Nations (FAO) (FAO 2008a and 2009).

Bio-fuel production and poverty

The impacts of bio-fuel production are widely feared as they have the potential to increase poverty levels and socio-economic disparity within populations, especially in developing countries. The FAO responded by warning governments of the negative effects of large-scale bio-fuel production, cautioning that rapid increases in production in developing countries could aggravate poverty, inequity and food security problems (Eide 2008).

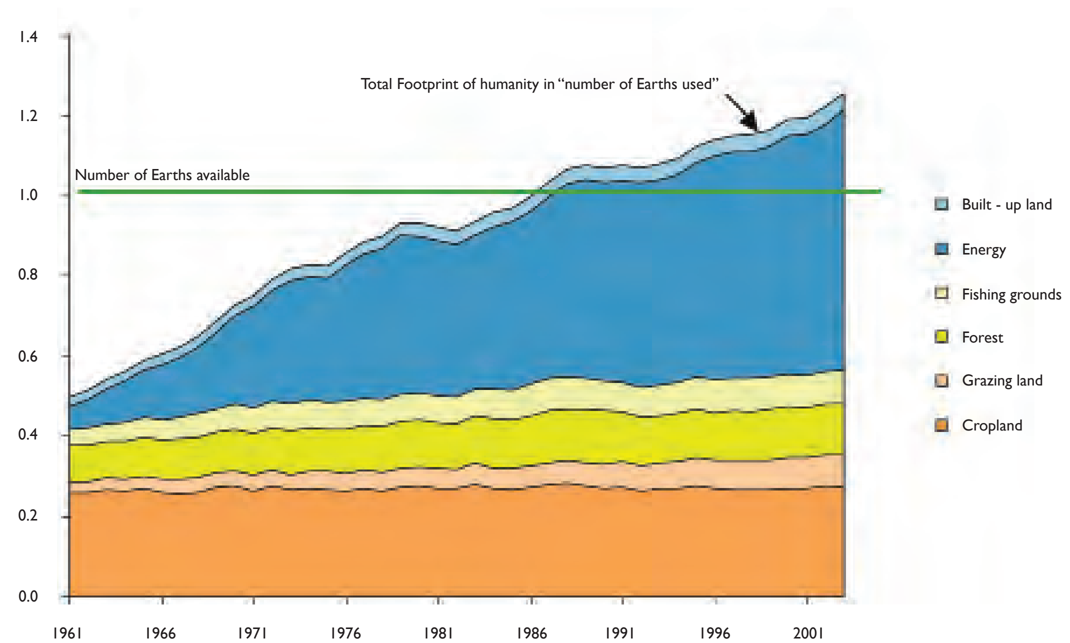
Advocates of bio-fuel production believe that growing trends in bio-fuel production will not exacerbate food insecurity. Their argument states that those people who are food insecure do not have the income to buy food regardless of supply. Rather than hurting them, bio-fuel advocates believe that the production of bio-fuel may raise incomes for small farmers, with a direct bearing on their quality of life and food security. Furthermore, the production of bio-fuel requires intensive labour, which means that job opportunities would be created, which could give rise to an improved standard of living in areas where these crops are grown.

Impact on ecosystem services

One environmental benefit of bio-fuel production is that during the photosynthesis process bio-fuel plants absorb carbon dioxide. However, a high volume of GHGs are emitted throughout the production cycle of bio-fuel, including the emissions released both down and upstream from bio-fuel plantations, processing facilities, bio-fuel extraction and during transport and use (EuropaBio 2007). Bio-fuel producing crops are also particularly water intensive and this is bound to constitute an additional water stress factor in the Arab region, already suffering from water scarcity (see Chapter 2).

Meanwhile, the extensive production of bio-fuel crops entails a substantial increase in the use of fossil fuel-based agricultural inputs such as inorganic fertilizers and pesticides. The irrational use of fertilizers and pesticides may

Figure 3. Humanity's ecological footprint by component (1961–2003)



UNEP 2007

lead to increased desertification and water pollution. The intensive production of bio-fuel crops may also lead to deforestation and the loss of biodiversity, as was the case in Brazil where the removal of forests to grow bio-fuel crops has caused an increase in carbon dioxide emissions, with impacts on climate change (Kenny and Nanninga 2008) (see Chapter 6). Furthermore, bio-fuel production would promote monocropping, with ensuing problems that include changes and flaws in the agricultural ecological system and the emergence of new pests.

Bio-fuel: current and future trends in Arab countries

The production and use of bio-fuel in Arab countries are still very limited. Saudi Arabia is one of the few Arab countries producing bio-fuel, with a production level of 170 000 m^3 in 2005 (Brown 2006). Extensive farming systems are present mostly in highly populated Arab countries and are market-driven, thereby constituting mainly food and feed crops. Therefore, production of bio-fuel crops is currently of limited importance.

With the exception of Saudi Arabia, there are currently no processing facilities for the extraction of bio-fuel in the region, meaning that the production chain is impaired, limiting the ability of and incentive for Arab countries to grow bio-fuel crops. Moreover, water scarcity limits bio-fuel production at the trade level in many Arab countries as water barely meets the requirements of basic food crops. However, Bahrain has received some offers to extract and process bio-fuel from plants grown in India and other countries, before exporting the fuel produced to the United States of America and Europe. Nevertheless, response to these offers has not yet been determined.

With the expanding use of bio-fuel in most industrialized countries, new technology has been developed to use bio-fuel, including agricultural machinery such as contractors and combines. Arab countries may choose to purchase bio-fuel operated machines, and when they do, will have to either buy or produce their own bio-fuel needs in order to operate them. Alternatively, Arab countries may continue to order fossil fuel operated machineries that are subject to higher prices and declining international demand (see Box 1).

Environmental indicators

Understanding and tackling environmental issues depend on availability of appropriate user-friendly technical information. In this concern, decision making processes have taken advantage of the recent developments in the field of information and communications technology and other advanced sciences. Accordingly, policies, particularly those concerned with environment have started to rely primarily on indicators of these technologies which depict reality and events in a brief and simple manner relayed thoroughly and promptly to decision-makers. These indicators reflect information derived from a number of data and statistics.

Indicators of environmental sustainability

The concept of sustainable development was introduced in the 1980s, creating the need for new sets of metrics to monitor whether environmental efforts were sustainable. The use of these indicators to measure sustainability, as well as its management and application, is based on the principle that only what can be measured can be managed. Sustainability indices for countries are metrics to evaluate country-specific information on the three dimensions of sustainable development: economic, environmental, and social conditions (Böhringer and Jochem 2007). In the absence of effective environmental sustainability indicators, decision-makers would be unable to perform the necessary cycle of diagnosis, target-setting, implementation, and evaluation. Consequently, the environmental decision making process may often suffer priority ambiguities and inability to evaluate performance on the basis of fixed objective criteria (Levy and Meier 2004). Environmental sustainability indices are potential metric tools to evaluate country-specific information on the basic domains of sustainable development. The United Nations Conference on Environment and Development (UNCED) in 1992 underlined the significance of developing sustainability development indicators at all levels.

Environmental Sustainability Index (ESI) and Environmental Performance Index (EPI)

Among the most renowned indicators to measure sustainability are the Environmental Sustainability Index (ESI) and the Environmental Performance Index (EPI). Both indices were developed by the collaborative efforts of the Yale Centre for Environmental Law and Policy, Columbia University's Centre for International Earth Science Information Network (CIESIN), the European Commission's Joint Research Centre, and the World Economic Forum. ESI was first used in 2000, while EPI is an outcome of a more recent effort as it was first used in 2006.

The ESI is a long-term indicator that looks at a country's efforts to effectively preserve natural resources and environmental services over a period of several decades, whereas the EPI focuses on current, on-the-ground outcomes. The latter has two objectives: the first is to reduce environmental stresses on human health and well-being, and the second is to promote ecosystem vitality and sound natural resource management.

The Environmental Sustainability Index (ESI) is a tool to measure the overall national progress towards sustainable development. It also quantifies the likelihood that a country will be able to preserve valuable environmental resources effectively over the period of several decades based on available data (Esty and others 2005).

ESI represents a composite, multifaceted profile of national environmental stewardship that is able to benchmark the capability of nations to protect the environment. The 2005 ESI is an aggregation of 21 main indicators derived from 76 underlying

Box 1. Bio-fuel, the strategic impacts on the Arab region

A number of Arab critics are adopting a sceptical view about growing bio-fuel crops in the Arab region at the expense of food crops. According to them, this will have worsening effect on food security and will widen the food gap in Arab countries. They believe that only Europe and food self-sufficient countries can afford to grow bio-fuel crops. Critics think that growing bio-fuel crops at the expense of food crops in the Arab region – where food shortage and importation are predominant – is meant to keep these countries dependant on food imports, an unfavourable option for the independence and security of Arab countries. The Arab Ministerial Declaration on Climate Change, released in Cairo in 2007, has pointed to the consequences of promoting fuel crop production, rather than food production in developing countries, a trend supported by advanced countries. The declaration has also encouraged the production of bio-fuel from organic waste.

LAS 2007

data sets. ESI gives special emphasis on the three bases of sustainable development: economy, environment and social affairs. It also reflects the institutional performance towards achieving environmental goals through a socio-economic perspective.

ESI also looks at another different set of factors that measure the ability to improve environmental performance from a more human perspective in order to measure sustainability. Therefore, issues like governance, justice and education were considered in ESI 2005. The development of ESI 2001 covered 122 countries and expanded to include 146 countries in ESI 2005.

Accurate and reliable information is essential to measure the impact of certain organizational performances on the environment. Although the economic and environmental dimensions of those corporate indicators are well defined and measurable, the social dimension which mainly deals with the impact of organizations on people and communities is not well addressed. This is mainly due to the cultural differences between communities and the absence of tools that can measure these dimensions, particularly in the Arab world, which has its own distinguished cultural and historical characteristics.

The indicators are classified in ESI 2005 under five main categories; namely, environmental systems, reducing environmental stresses, reducing human vulnerability to environmental stresses, and societal and institutional capacity to respond to environmental challenges. These indicators are combined into a single value as a total score for ESI.

Earlier versions of ESI were positively received by some countries, while garnering criticism from other countries and scientists. Concerns were raised about its conceptualization of environmental degradation and sustainability. It was suggested that the approach used to combine and present data and indicators in the ESI reflects and underlines the distinguished thoughts of the West, which differ from the concepts of third world countries concerning sustainable development. The interest in ESI components should not necessarily reflect the significance of developments that take place in the global arena.

Climate change indicators for example were not represented with a suitable weight in this indicator (Jha and Murthy 2003) (see Table 1). Esty and others (2005) have pointed out that these weights are usually determined by a number of social factors that include institutional capacity, international cooperation, and human health. Although human health aspects are essential for the well-being of a society – which is rather very important – they should not be confused with environmental sustainability. Critics also argue that these global indices focus mostly on social concerns and not on environmental sustainability (Abdelrehim 2008). They do not assign considerable weight to environmental problems that extend beyond national borders (Morse and others 2005).

Arab Countries Ranking on the ESI and EPI

Environmental degradation is a major challenge for all Arab countries and this is reflected in the ESI and EPI rankings. Most Arab countries have a higher score on the EPI than on the ESI.

Despite the view that the ESI rewards wealthy countries, because of the strong weight it gives to social and institutional capacity measures, some rich Arab countries such as Kuwait and Saudi Arabia could not have a high ranking score, showing that a nation's economic status does not always correspond to its ESI performance. The scores for some Arab countries, including Egypt, United Arab Emirates, Lebanon and Saudi Arabia, are notably higher on the EPI than the ESI. What this result suggests is that these countries face significant long-term sustainability challenges but are managing their present circumstances well.

Table 1. Relative weights for various environmental sectors

Policy realms	Percent weight
Human Health Related	34.9
Water related	18.3
Climate change related	17.3
Land related	16.6
Air pollution related	11.9
Biodiversy related	10.5
Energy related	9.8
Toxics/Waste related	4.9

Esty & Others 2005

Meanwhile, other countries, including Yemen and Mauritania, have lower scores for the EPI than the ESI. This result suggests that while these countries remain relatively unpolluted – due to lack of urbanization and overpopulation pressures – they are not facing the challenge of providing environmental infrastructure (drinking water and wastewater treatment) for their people or creating systems for pollution control and ecosystem protection. The EPI also reveals serious concerns regarding the sustainability of water resources in the region, as the water related scores of most countries are very low compared to other regions of the world (see Chapter 2).

The Arab League held a meeting in Al-Ain, UAE in 2008, to discuss these global indices, their implications on the Arab region and the plausibility of implementing them. An Arab team was formed as per the CAMRE decision in its

20th session (December 2008) to monitor and evaluate these global indices (LAS 2008). Arab countries should not underestimate the impact of these tools as they could seriously affect both national and international policy analysis.

Ecological footprint: how much of nature we use

The ecological footprint approach relates human consumption of environmental resources (demand) to the carrying capacity of ecological systems (supply). This tool was developed to measure sustainability and whether a given country or region was using resources at a rate faster than the natural regeneration rate of the resources. Since a nation consumes resources and ecological services that come from all over the world, in addition to its own resources, its footprint is the sum of the impact in all of these places, including the countries that supplied it with resources and ecological services.

The ecological footprint also measures how much biologically productive land and water area is required to produce all the resources a given population consumes and to absorb the waste that is produced (Wackernagel and Rees 1996). Countries with an ecological footprint larger than their own biological capacity, or biocapacity, are called "ecological debtors," while countries with biocapacity that exceeds their ecological footprint are "ecological creditors." Biocapacity is the amount of biologically productive space available for human use.

Ecological Footprint of Arab Countries

The use of ecological footprint to measure sustainability in Arab countries is rather new and no reported studies exist. However, the World Wildlife Federation (WWF), in partnership with the Global Footprint Network, has reported on the footprint of Arab countries for the first time in their annual report, the Living Planet Report. The report reviews the status of environment and the resources used in most Arab countries.

Ecological footprints of the Arab region vary significantly between different countries, and reflect a positive relationship between the total ecological footprint and GDP. Overall, with the exception of Sudan, Somalia and Mauritania, Arab countries place a high demand on nature to produce the food they consume, absorb the waste, and provide energy as well as space for their built environment and infrastructure (see Table 2).

Arab countries, with the exception of Sudan, Somalia and Mauritania suffer ecological deficits. Oil producing states, including Saudi Arabia, Kuwait, United Arab Emirates, and Libya, have the highest ecological deficits in the region , at -3.7, -7, -11, and - 2.4 global ha per person respectively (see Table 2).

These large footprints are caused by high consumption rates and inexpensive energy sources, accompanied by weak recycling and conservation programmes, in addition to ecological services in these countries. The United Arab Emirates was one of the first Arab countries to attempt to improve its ecological footprint. In 2008, the Global Footprint Network and the United Arab Emirates started a two-year research collaboration to improve the variables and available information on the footprint of the United Arab Emirates.

Carbon footprint

A carbon footprint is a measure of the carbon related impacts that human activities have on the environment. It is measured in terms of the area necessary to sequester the amount of greenhouse gases produced. In addition to


Jeff Kubina/Wikipedia

measuring the carbon output from fossil fuels used in daily operations, such as heating or travel, all indirect sources of carbon dioxide emissions are accounted for, including those generated in the production of the consumer goods we use.

Reducing the carbon footprint in the Gulf States

Efforts to reduce carbon footprint in Arab countries, especially in oil producing Gulf States are underway. A number of Gulf States are making rigorous efforts in order to reduce their extensive carbon footprint. For example, estimates of natural gas flaring in the area currently amount to about 30 000 million cubic metres a year, which is equivalent to the amount found in 900 000 barrels a day of crude oil. Three gulf states; namely, Kuwait, Qatar and Oman, have signed a World Bank programme that aims to reduce GHG emissions by finding alternative uses for the flared natural gas which is a by-product of oil production (Wardam 2008).

The world at a crossroads, hydrogen economy and low carbon economy

Efforts to curb CO2 emissions have triggered a number of alternatives that scientists and policy-makers are considering. Hydrogen based economy, which is relied on as a source of energy, is one of the solutions emerging as a clean and safe alternative to fossil fuels. Through its reaction with oxygen, hydrogen releases energy in fuel cells to produce water as its only by-product. Hydrogen is abundant and is well distributed throughout the world with no regard to national boundaries. However, there are some key barriers to the development of a "hydrogen economy." Most importantly, the current cost of both fuel cells and hydrogen fuel makes it uncompetitive for most applications, in addition to the current gap in hydrogen usage techniques as a source of energy which requires a great deal of effort and costly research (Crabtree and others 2007).

Low carbon economy

Low carbon economy is a toolbox that includes a set of measures meant to cut down the use of high carbon fossil fuel. It promotes using mixtures of energy-efficient renewable sources of electricity, replacing coal and oil with lower carbon fuels such as natural gas and the use of hydrogen as a fuel.

Low carbon economy should have a negligible impact on long-term GDP growth and will present tremendous opportunities for those who develop and deliver low carbon products and services. Given international engagement on climate change mitigation, the benefits of moving to a low carbon economy will more than offset the impact on the limited number of industrial sectors. Furthermore, security of supply will be increased by the lower energy demand and greater diversity of energy sources in a low carbon economy.

Carbon neutrality

Carbon neutrality is a venue to share endeavours to eliminate impacts of fossil fuel and carbon dioxide emissions. It is achieving neutrality of carbon dioxide produced by reducing that production. Emission reduction or neutrality can

Table 2. Global ecological deficit (ha/capita) in 2003

Country/ Region	Population (million)	Total biological capacity	Total Ecological Footprint	Ecological defict (ha/ person)	Change in biological capacity per person (%) 2003- 1975	Change in ecological footprint per person (%) 2003- 1975	Human development index	Change in Human development index (%) 2003- 1975	Annual water consumption per capita	water consumption (% of total resources)
WORLD	6301.5	1.78	2.23	-0.45	-25	14	0.74	-	618	10
Jordan	5.5	0.3	1.8	-1.5	14	77	0.75	-	195	115
U A E	3.0	0.8	11.9	-11	29	-24	0.74	-	783	100
Tunisia	9.8	0.8	1.5	-0.8	-36	38	0.75	47	271	57
Algeria	31.8	0.7	1.6	-0.9	-45	51	0.72	43	194	52
Saudi	24.2	1.0	4.6	-3.7	-22	203	0.77	28	736	722
Sudan	33.6	1.8	1.0	0.8	-44	-6	0.51	47	1135	58
Syria	17.8	0.8	1.7	-0.9	-36	32	0.72	34	1148	76
Somalia	9.9	0.7	0.4	0.3	-54	-38	-	-	347	22
Iraq	25.2	0.0	0.9	-0.8	-51	30	-	-	1742	57
Kuwait	2.5	0.3	7.3	-7.0	-28	44	0.84	11	180	2200
Lebanon	3.7	0.3	2.9	-2.6	-2	141	0.76	-	384	31
Libya	5.6	1.0	3.4	-2.4	-43	13	0.80	-	784	711
Egypt	71.9	0.5	1.4	-0.9	1	49	0.66	50	969	117
Morocco	30.6	0.8	0.9	-0.1	-31	4	0.03	47	419	43
Mauritania	2.9	5.8	1.3	4.5	-44	31	0.33	45	909	15
Yemen	20.0	0.4	0.8	-0.5	-00	20	0.49	-	343	162

WWF 2006

Carbon footprint is a measure of the carbon related impacts that human activities have on the environment

be accomplished by using non-carbon energy generating sources such as wind farms, solar energy or energy-efficient projects. The city of Masdar, UAE, is an example of carbon neutrality as it depends on solar energy as its main energy supplier.

Sustainable Consumption And Production

Sustainable development is typically defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987). With the alarming increase in human consumption and natural resources exploitation, sustainable consumption is emerging as an absolute necessity for sustainable development to succeed. In 1995, the United Nations Commission on Sustainable Development officially adopted the definition of sustainable development as, "The use of services and products that respond to basic needs and bring a better quality of life while minimizing the use of natural resources, minimizing toxic materials and waste emission, not to jeopardize the needs of future generations" (Norwegian Ministry of Environment 1994).

Consumption, a multi-segmented process, involves a long chain of stakeholders including suppliers of raw material, producers at the factory level, distributors, as well as many others who collect, recycle and re-use the waste. Consumption is not restricted to individuals who consume products and services. Governments, public and private organizations, and companies also consume goods and services, though at different scales and magnitudes.

Global trends in consumption and production

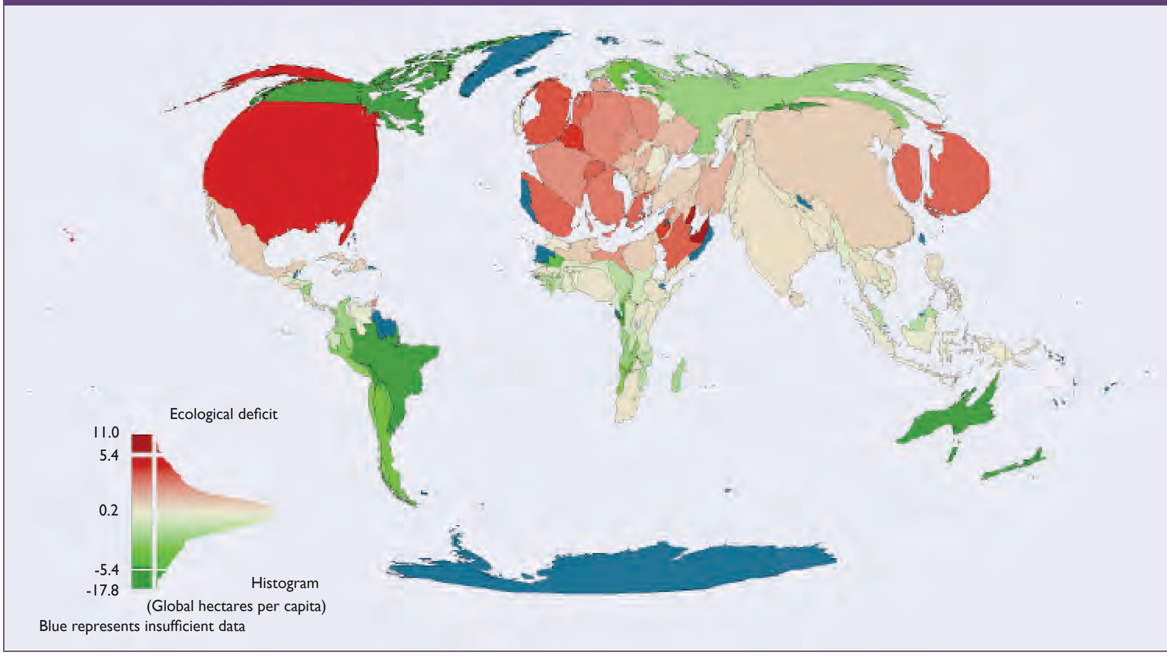
The second half of the last century witnessed unprecedented economic and human development. For example, since 1950, the world's population has doubled to 6200 million, while the gross world product has expanded sevenfold, based on large increases in the production and consumption of energy and materials. In addition, global oil consumption and paper production have both more than tripled since the early 1960s (UNEP 2002).

Production is generally recognized as the other side of consumption. In fact, factors governing production processes are usually intertwined with those of consumption. Many of the issues related to how to make consumption sustainable are actually found in production patterns. As population increases and the regional economy expands so does the supply and demand for consumer goods and industrial products. This also affects the capacity of governments and municipalities to manage increased quantities of solid waste and effluent generated.

Consumption and production in the Arab region

Consumption pressures are rather high across Arab countries, especially in wealthy oil exporting states. Moreover, as globalization continues

Figure 4. Global ecological deficit cartogram



Jerrard Pierce 2007

to expand across the region, unsustainable consumption patterns are likely to increase. There are a number of factors that contribute to the unsustainable consumption currently observed in almost all Arab countries. The inexpensive and mostly subsidized energy supply is one main reason for unsustainable consumption trends. Furthermore, the energy sector in most countries of the region has had significant adverse environmental impacts, particularly on air and water resources.

Prices set by most authorities in the region often fail to reflect the long-term environmental costs or promote sustainable consumption and production concepts (UN-ESCWA 1999). According to UN-ESCWA, some examples of incorrect concepts include:

- **Agricultural policies:** subsidized pricing of agricultural inputs such as irrigation water, reclaimed lands, agrochemicals and seeds, and subsidized markets for farm outputs.
- **Industrial policies:** allowing energy-intensive industries, lax environmental regulations, and keeping old polluting technologies.
- **Infrastructure policies:** providing access to environmentally sensitive areas involved in overexploitation of the coastal marine environment for desalination plants, land "reclamation" and establishment of human settlements on the water line, tourism infrastructure with negative impacts on the environment, and the disposal of partially treated or raw sewage in marine environments.
- **The provision of free or heavily subsidized services:** including sanitation, drinking water, electricity and gas. This often leads to the misuse and overexploitation of these services.

Sound recycling and resource management programmes are in their infancy in most Arab countries and national environment departments. Hence, common to all countries of the region is the need to strengthen institutions, particularly those concerned with integrating environmental protection and natural resource management issues into the overall development process. Stronger institutions should create successful balance between consumption and production and achieve sustainable development throughout the Arab region.

Sustainable consumption in the Arab region: an analytical perspective

It is crucial to consider the variations between states when planning for a more sustainable approach to consumption and production. Furthermore, as few countries are currently using fiscal measures, economic incentives or conventional environmental management tools to change unsustainable production and consumption, much remains to be done. Factors contributing to the minimal use of sustainable consumption in Arab countries include:

- **Lack of awareness**

  The concept of sustainable consumption is still very new in most Arab countries. As a result, the meaning and implication of the concept are not fully appreciated. This applies equally to the various stakeholders, including government and civil society actors alike.

- **How people perceive sustainable consumption**

  As a result of the poor awareness and support for the concept, sustainable consumption tends to be a low priority in the region. This is reflected on national policies and development strategies that give little regard to sustainable consumption. Moreover, most stakeholders in the Arab region regard consumption problems as a product of western cultures that, based on the traditions and customs in the region, do not necessarily apply to Arab societies.

- **Sustainable consumption is not yet on the agenda of consumer groups**

  Consumer groups are relatively new in Arab countries, and where they are present they are not yet influential enough to influence practices or policies. Currently, prices, economics and traditions tend to shape people's demand and consumption norms, away from the environmental dimension. As yet, pricing schemes based on environmental criterion are not familiar in the area, and if applied they would have a limited success, especially in non oil-producing Arab countries where poverty is still a major consideration.

Key constraints to sustainable consumption in the Arab region

The promotion of sustainable consumption in the Arab region is faced by some major constraints, which include:

- Arab countries tend to have well developed legislation and regulatory settings made to foster and promote sustainable consumption. However, with the prevailing lack of support, legislation is hardly enforced and seldom applied.
- The UN and many other regulatory bodies have come up with a recommended toolbox of mechanisms and tools to promote and apply sustainable consumption. Examples include the life cycle initiative, launched by the United Nations Environment Programme (UNEP).
- In most Arab countries, there is a lack of public bodies that focus on the issue of sustainability in general or sustainable consumption in particular. As a result, there is little action taken on issues such as green procurement and the promotion of sustainable lifestyles.
- Transport is one of the highest energy-consuming sectors in the Arab region. However, this sector does not use methods that are in

Consumption pressures are rather high across Arab countries. As globalization continues to expand in the region, unsustainable consumption patterns are likely to increase.

line with sustainable consumption. Effective solutions, based on a solid understanding of local culture, should be adopted to cut on fossil fuel-based energy consumption, especially in countries with growing urban centres.

Efforts to promote sustainable consumption and production in the Arab region

The promotion of sustainable consumption is becoming a primary objective for a number of the environmentally active agencies in the region. The first official Arab Expert Meeting on Sustainable Consumption and Production took place in Beirut, 2005, and the Arab Regional Conference on Energy for Sustainable Development was held in Cairo the same year. The United Nations Environment Programme (UNEP), in coordination with some regional and international organizations, has contributed to developing a strategy to promote sustainable consumption and production for the Arab region. Mechanisms such as capacity building, promoting the establishment of National Clean Production Centres, and initiating cleaner production pilot projects in relevant industrial sectors were developed to reach this goal.

The United Nations Environment Programme also incorporated cleaner production and sustainable consumption into environmental management systems and other relevant environmental tools in the Arab region. Additionally, a number of regional campaigns were orchestrated to raise awareness among relevant stakeholders, especially youth, through sustainable consumption surveys, workshops and youth events, as well as education curricula and the dissemination of informational materials.

The energy sector is one of the most unsustainable sectors within Arab countries. Nevertheless, while demand remains high, there has been significant diversification of energy resources in some countries. For example, remarkable increases in the use of natural gas in the electrical power and transport sectors were reported. Several countries have also been partially converted to natural gas while others have started applying wide-scale, solar and wind energy technologies.

National Cleaner Production Centres (NCPCs)

National Cleaner Production Centres (NCPCs) were established in a number of Arab countries with the primary objective of promoting cleaner production and sound environmental practices within industries and services. A group of these centres were established in Morocco, Lebanon, and Egypt, under a joint United Nations Industrial Development Organization (UNIDO) and UNEP initiative, through the support of donor agents and European countries (particularly Germany and Switzerland). Meanwhile, Tunisia and Jordan will begin establishing their National Cleaner Production Centres in the very near future. The NCPCs have also been partners in major projects sponsored by international donors such as USAID, the Swiss Government and the World Bank.

These centres have developed a global network, with a wealth of knowledge and experience that ensures expert services. The centres' mission is to help industries, with special reference to small and medium-sized enterprises, to adopt sound environmental practices and apply environmental management systems through the increased application of cleaner production methods. The centres also aim to improve economic performance, in terms of efficiency, productivity, and competitiveness. High on the agenda is their role in vocational training and their ability to provide policy advice to national and local governments.

The Lebanese Cleaner Production Centre

The Lebanon Centre of Cleaner Production (LCPC) intends to be a centre of excellence for Sustainable Consumption and Production (SCP) in the region in order to assist Lebanese Small and Medium Enterprises (SMEs) to use cleaner processes, henceforth contributing to the sustainable application of SCP in Lebanon. Since its establishment in 2002, the LCPC has undertaken three core activities: to introduce, demonstrate and train key cleaner production (CP) players in Lebanon so that they understand the concept of SCP and can use the SCP methodology (see Figure 5).

Egypt's Centre of Cleaner Production and the Chemical Leasing Experience

Egypt's Centre of Cleaner Production was one of the few centres to apply the chemical leasing (ChL) concept as a viable tool for cleaner production and pollution prevention. Chemical leasing is a service-oriented business model that aims to encourage producer companies to provide technical services in a way which ensures optimal performance while reducing adverse environmental impacts. Within chemical leasing business models, the responsibility of the producer and service provider is extended, and, in some cases, may include the management of the entire life cycle (see Table 3).

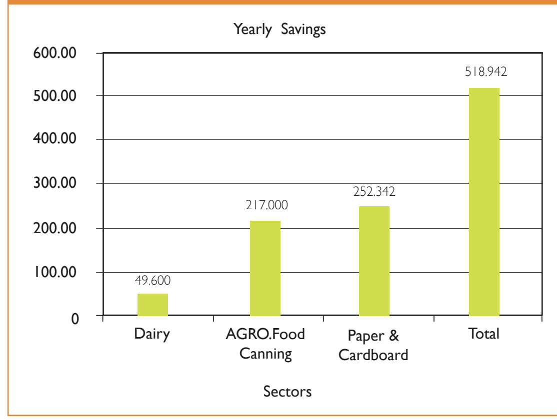
Eco-labelling

Consumers are becoming more concerned with the adverse effects of industrial pollution on the environment and their health. Mounting pressure on the chemical and manufacturing industries to adopt more eco-friendly processes has led to increased demand by consumers for eco-labels, particularly in the textile and food industry sectors. However, eco-labelling is an optional system subject to the producer.

While eco-labels do certify that their products are environmentally compatible and do not contain chemicals that might be harmful to consumers, these labels do not have uniform requirements around the world and vary within themselves as well. For example, a number of these eco-labels could assert that pesticides have not been applied to a specific product

A project implemented by the profitable Environmental Management to evaluate production losses in terms of energy, water and raw material without additional investments.

Figure 5. Lebanese Cleaner Production Centre



LCPC 2007

Total Saving From the Application of SCP in Small and Medium Sized Enterprises

while others could be evidence of different matters concerning free trade. However, with the removal of tariff barriers under the World Trade Organization Agreement on Tariff and Trade, exports may increasingly face more stringent environmental standards in the international marketplace, which could make requirements for eco-labels more universal. The practices of cleaner production and eco-labelling have been in Egypt since the 1990s, especially in the textile industry through a National Industrial Pollution Prevention Programme (NIPPP).

In 1999, a number of textile enterprises were selected to undergo eco-labelling for some of their products. The labelling process was implemented by Support for Environmental Assessment and Management (SEAM). A number of Arab countries have adopted the concept of eco-labelling, such as Jordan in the olive oil industry, and Tunisia and Morocco in the textile industry (UN-ESCWA 2005) (see Box 4).

Biotechnology

The Convention on Biological Diversity (CBD) considers biotechnology to be any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use. Biotechnology applications and products are used in many areas including agriculture and food production, the bioremediation of polluted sites, health care and therapeutic agents. Biotechnology is intensively used in fisheries, forests, agriculture, and in the sustainable development of crop production. It can also be of significant help in meeting the food needs of a growing population (FAO undated). From a health perspective, there are numerous direct and indirect benefits of biotechnology, all of which contribute to human well-being and an improved quality of life (WHO 2005).

Genetically Modified Organisms (GMOs)

The development of genetically modified organisms (GMOs) offers the potential to increase agricultural productivity and improve the nutritional content of GMO foods produced, contributing directly to enhanced human health and development. The process of creating GMO foods includes identifying those genes that directly express desired traits, and selecting these traits when breeding hybrids. Therefore, the genetic makeup of food-producing crops can be improved and made more efficient.

The introduction of genetically modified food to consumers burgeoned in the early 1990s with the introduction of the delayed-ripening tomato. Soon after, genetically altered corn, soybeans and cotton were commercially released. In addition to the improvement of the physical product, these modified crops were designed to resist pests and diseases. The spread of this first generation of GM crops continues at a steady pace. In 2004, the global area planted with GM crops grew by about 20 per cent, reaching 81.0 million ha, up from 67.6 million ha in 2003 (Paarlberg 2006). In 2005, twenty-one countries across the world planted biotech crops covering a total of 222 million acres. In addition, the food industry has made good use of genetically modified organisms, including rapid-rise yeast and enzymes used in the cheese industry, and other food industries.

Biotechnology: An Arab region perspective

In many Arab countries, especially those with high populations, food security is one of the more daunting challenges that governments face. Estimates predict that by 2020, the food deficit in Arab countries will be between 50–90 million tonnes per year, and although the deficit will vary by country, the whole of the Arab region will be affected (Paarlberg 2006). Major constraints to food security in the Arab region are identified as the limited availability of sufficient productive agricultural land, water, and biodiversity (Talhouk 2004). Land in the region is increasingly under threat from desertification, deforestation, erosion, soil degradation, and salinity (see Chapter 3). The limited availability of fresh water is due to the extremely limited and scarce water resources in the region, exacerbated by rapid urbanization and high population growth (see Chapter 2).

Box 2. Jebel Ali free zone

In the Jebel Ali free zone area in Dubai, United Arab Emirates, the application of cleaner production technologies, as well as international techniques and standards, allowed for the coexistence of industrial development, environmental protection and the prevalence of a clean, safe and healthy industrial environment.

Mallah 2006

Table 3. Chemical Leasing, A budget outline

Traditional Model	New CHL Model
Payment by bulk (1KG - 18 EGP)	Payment for services (Per m2 of coated article)
1KG powder covers 3 m2 with 180 - 250 µ	1KG powder covers 6 m2 with 80 - 100 µ (optimized process)
333 GM covers 1 m2 with 180 - 250 µ	166 GM covers 1 m2 with 80 - 100 µ (standard!!)
Costs / 1 m2 = 6 EGP	Costs / 1 m2 = 2.5 ??!!
Powder loss: 18 %	Powder loss: 6-10 %

ENCPC 2007

Biotechnology research and development in Arab countries

One of the most pressing food security concerns in the Arab region is the deficit of cereals produced, particularly in those countries that are net importers of these goods. Thus, biotechnology represents an opportunity to maximize cereal production that can bridge the gap between growing demand and limited production.

Box 3. Moroccan Cleaner Production Centre

The Moroccan Cleaner Production Centre (CMPP: Centre Marocain de Production Propre) is the national reference centre for cleaner production in Morocco. The Centre's main mission is to provide technical assistance to Moroccan industries for the implementation of environmentally sound technologies in order to improve the efficiency, productivity and competitiveness of their performance. Created in 2000, with the support of the United Nations Industrial Development Organization (UNIDO) and the United Nations Environmental Programme (UNEP), the CMPP is the 16th of 35 cleaner production centres in the world. The CMPP is the result of a Public Private Partnership between the General Confederation of Moroccan Enterprises (CGEM) and the Ministry of Industry, Commerce and Economic Upgrading, and is financed by the Swiss State Secretariat for Economic Affairs (SECO). The vision of the Moroccan Cleaner Production Centre is to position itself as a technical centre of excellence for the promotion of sustainable production tools for public authorities, the Moroccan industry, international organizations, and other actors. The application of the cleaner production concept and the transfer of environmentally sound technologies will be used to accomplish this goal. The CMPP's objectives are:

- to contribute to the improvement of the productivity and the competitiveness of the Moroccan small and medium-sized industry by respecting environmental requirements;
- to strengthen national expertise and competencies in the field of environmental engineering; and
- to create a national market of cleaner production and environmentally sound technologies.

Agricultural biotechnology research is still in its infancy in most Arab countries. Nevertheless, in the last few years, many countries have started to invest in national agricultural biotechnology institutes. Some countries have established national research centres (Egypt, Syria, Morocco, Kuwait and Jordan) to act as focal points capable of implementing and incorporating state-of-the-art biotechnology techniques into their research agendas. In many Arab countries (Algeria, Egypt, Jordan, Morocco, Oman, Syria, Saudi Arabia and Tunisia), DNA markers are being utilized for the analysis of genetic diversity in different crop plants (Baum 2004). Conventional germplasm improvement programmes in Arab countries are carried out largely by government institutions.

Biotechnology trade and production in Arab countries

The trade and production of biotechnology products in Arab countries are very limited. None of the Arab countries have produced any commercial biotechnology crops to date. Biotechnology is mostly confined to laboratories and research centres. However, Egypt is about to launch the region's first commercially grown genetically modified cotton strain, containing a gene purchased from an international company that makes the plants resistant to the main destructive insect pests. As a result, the plant is anticipated to need less pesticide application. The new plant should maintain the long stable fibres that are one of the main traits of Egyptian cotton (Mansour 2005).

Risks, acceptance and public awareness

The long-term impacts of biotechnology on humans and the environment are unknown, which has made biotechnology a very controversial issue. Genetically modified crops constitute serious environmental risks despite the BT industry's efforts to underpin their safety. Much like what can happen during the course of natural evolution and breeding over time, BT gene changes can have harmful consequences. For example, breeding to improve one trait may have a negative influence on another. Public debate on whether or not to accept biotechnology varies among countries depending on the technology's application. For example, the application of biotechnology for health issues is largely accepted in the Arab world.

On the other hand, in the agricultural and food production field, GMOs give rise to quite a number of concerns and remain controversial as a result. Some Arab countries have already responded to the Cartagena Protocol on Biosafety (CPB) by preparing to set the legislation for the movement of genetically modified organisms and their products. Some countries such as Egypt have already produced the national directive for biological safety and the National Commission for Biological Safety. A draft document titled "Establishment of a national programme for biological safety in Egypt: Directive principles and guidelines", has been prepared. It included directions and principles suitable for Egyptian conditions (Baum 2004) (see Chapter 6).

Labelling requirements for packaged food or GMO based feed

No decisions on the labelling of GMO based food products have been made in most Arab countries. However, the general policy regarding the importation of genetically modified crops is that they do not require labels. This is because Arab countries often lack laboratories that can detect whether imported goods have been genetically modified. Even if GMOs could be detected, banning large scale imports of basic foods because they are genetically modified is restricted by price changes, with possible economic and political repercussions.

Domestically, laws in most Arab countries do not require that biotech crops or products available in the local markets be labelled. However, GMO products in local markets have been reported in Egypt (El Sanhoty 2002) and the United Arab Emirates (Khan 2007). Saudi Arabia is an exception to other Arab countries as it has some of the strictest GMO labelling regulations as well as a ban on genetically engineered animal products (The Centre for Food Safety 2006).

Biosafety

Biotechnology is a very new field, and information about the interaction between Living Modified Organisms (LMO) and ecosystems is meagre. Some concerns about the new technology include its potential to have adverse effects on biological diversity and its potential risks to human health. Specific areas of concern include: unintended changes in the competitiveness of the target species; the possibility of adverse impacts on non-target species (such as beneficial insects) and ecosystems; and the stability of inserted genes after being transferred to modified organisms.

Box 4. Tunisia National Eco-label Scheme

Operating in Tunisia Since 2004 Initiated by the International Centre of Environmental Technologies of Tunisia (CITET). The Tunisia Eco-label Scheme provides:

- ISO Type I eco-label (voluntary scheme)
- Technical studies and contributions from national and international experts. The development of legal, regulatory, and institutional frameworks as well as criteria
- Promotion of the proper development of goods relevant to EU markets, in order to meet the stringent requirements of these markets
- Encouragement for manufacturers to produce goods with fewer pollutants

UNEP-DTIE/ROA 2007

The Cartagena Protocol on Biosafety (CPB) is the first international agreement to regulate the transboundary movements of genetically engineered (GE) organisms. It is a by-product of the Convention on Biological Diversity. Currently, more than 100 developing countries, including some Arab countries, are in the process of developing national biosafety frameworks (see Chapter 6).

Management Of Chemicals

We live in a universe made up of chemicals. The American Chemical Society has documented 38 million organic and inorganic substances. Nearly 25 million of these substances are commercially available. Of these, fewer than a quarter million (240 000), or less than 1 per cent of universally known chemicals, are inventoried or regulated by numerous governmental bodies worldwide (CAS 2008).

Throughout time, chemistry has played a pivotal role in the human pursuit to improve quality of life. However, the toll humans have paid in those rare cases when chemistry worked against them still litters history with some agonizing memories. Arab history is tainted with bitter incidents of people who were exposed to toxic chemicals.

For example, there was a massive poisoning in Morocco in 1959 that resulted from the contamination of edible oil with tri-ortho-cresyl phosphate (TOCP). This poisoning caused the severe illness and death of about 10 000 citizens (Bondy and others 1960). Furthermore, pesticide poisonings were reported in Saudi Arabia (Kaloyanova and El-Batawi 1991), Egypt (Mansour 2004), Iraq, Sudan and Yemen (Abdel Megid and Zedan 1996), all of which had serious implications including some reported deaths.

The trade and movement of chemicals in the Arab region

Arab countries import large volumes of chemicals, most of them pesticides, pharmaceuticals, and fine and industrial chemicals. In recent years, numerous petrochemical facilities were established in the Gulf States and North African countries, and a number of Arab countries have become major producers and exporters of petrochemical derivatives. Currently, Saudi Arabia is one of the leading petrochemical exporters among all developing countries (Al-Mady 2004). Gulf States are major exporters of ethylene and the possibility exists of doubling exports by 2010..

Apart from petrochemicals, fertilizers, textile fibres, pharmaceutical goods, cement and ceramic are the rapidly growing industries in the region. This is due to the large demand for these products in local Arab markets as well as in European markets, which are reluctant to produce some of these goods themselves due to the pollution generated through the production process.

Persistent Organic Pollutants (POPs)

Persistent organic pollutants (POPs) are emerging as one of the largest potential threats to human and environmental health. Their high affinity for binding with fat tissues, coupled with the length of time they persist in the environment, contribute to the toxic impact they can have (Fries 1995). The list of POPs includes a number of pesticides, industrial chemicals and some of their by-products, which are formed when thermal processes produce chlorine, containing organic substances such as dioxins and furans. Some POPs are believed to cause serious health problems, as they disturb endocrine chemicals, altering the normal functioning of the endocrine system in animals and humans (Preziosi 1998).

Multilateral agreements on managing chemicals

The international community has developed a number of agreements intended to manage chemicals, minimize their impacts on humans and their environment, regulate their use and promote safety. Most Arab countries are active parties in these agreements, including the Stockholm Convention on Persistent Organic Pollutants (POPs), the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, the Rotterdam Convention, the Montreal Convention on Ozone Depleting Chemicals, and the Strategic Approach to International Chemical Management (SAICM).

Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention on Persistent Organic Pollutants was formulated in 2001 to reduce or eliminate the release of twelve particularly harmful POPs and was signed by representatives of 92 countries. These countries each made a political commitment to take the next step towards ratification by developing a National Implementation Plan (NIP). The NIP lays out the priorities and action plans needed for the fulfilment of countries' obligations under the convention. In addition, each country is required to identify the use of, characterize, and address the release of the chemicals mentioned in the convention.

All Arab countries have ratified the Stockholm Convention, and are in the process of implementing the convention's components. Many of the Arab countries have already completed their national action plans, which include detailed information about emissions inventories, stocks, contaminated sites, and legislation. Furthermore, the International POPs Elimination Network (IPEN) initiated the global NGO project and the International POPs Elimination Project (IPEP), in partnership with UNIDO and UNEP. The GEF provided core funding for the project.

The Basel Convention on the control of transboundary movement of hazardous wastes and their disposal

The Basel Convention is the most comprehensive global environmental treaty on hazardous wastes and other wastes. Almost all Arab countries are signatories to this convention, which aims to protect human health and the environment against the adverse effects of the generation, management, transboundary movement and unsafe disposal of hazardous and other wastes.

Despite their support for the convention, the definition of hazardous waste in Arab countries remains controversial. Different definitions, lists of hazardous chemicals, and frameworks for legislation on hazardous waste are far from unified between Arab countries. Maghreb countries, like Morocco, Algeria, and particularly Tunisia, have taken some serious strides toward developing a legislative framework for hazardous waste management.

On the other hand, other Arab countries still lag behind without a proper legislative framework. Plans are currently underway to organize a series of meetings in which Arab legal experts will discuss how to come up with a definition of hazardous waste as well as a unified legislative framework in the Arab region

(Abdelazim 2008 and El Metwally 2008).

Stockpiling obsolete pesticides

One of the mandates of the Basel Convention is to help countries eliminate their stockpiles of obsolete pesticides. This is particularly relevant in the Arab region as a number of countries have very large quantities of pesticides. Stockpiles have accumulated largely because some products were banned for health or environmental reasons, but were never properly discarded. These pesticides contain some of the most dangerous insecticides produced – members of the persistent organic pollutants (POPs) group such as DDT. These dangerous chemicals threaten communities through the potential contamination of food, water, soil, and air. Poor communities are the most vulnerable to environmental degradation of this sort (see Chapter 5).

Tunisia and Morocco are participating in the Africa Stockpile Programme for the Prevention and Elimination of Obsolete Pesticides (Abdelazim 2008 and El Metawlly 2008). Under FAO guidance, Tunisia completed a comprehensive national inventory of obsolete pesticides and is preparing to dispose of them.

Meanwhile, a Technical Cooperation Programme (TCP) for inventorying and safeguarding obsolete pesticides has been completed in Syria, where 600 tonnes of obsolete pesticides were located. The Swiss Agency for Development and Cooperation (SDC) has offered funds for a sub-regional project on obsolete pesticide prevention and disposal in Syria, Jordan and Lebanon (FAO 2008b).

Electronic waste in the Arab region

Used electronic products are the most rapidly growing problem in the global waste stream due to their quantity and toxicity. Electronic waste (e-waste) such as televisions, computers and computer components contain toxic substances like lead, mercury, cadmium, lithium, brominated flame retardants, phosphorous coatings, and PVC plastics that create dioxins when burned.

Estimates of e-waste generated world-wide amount to 20–50 million tonnes per year (UNEP 2005). However, there is no data on the volume of e-waste and its management in Arab countries despite the large waste stream produced. One of the very few approaches for the sound disposal of e-waste was launched by Hewlett-Packard in some African countries, including Tunisia and Morocco (Donoghue 2007).

A recent report on e-waste recycling indicated that in Arab countries recycling is undertaken by unauthorized bodies, posing some potential risks to people involved. The report has emphasized the need for the establishment of programmes and projects in each Arab country to undertake the recycling and management of e-waste, which in turn would reduce risks to people and environment, provide business opportunities as well as restore and reuse a number of metals and other substances (CEDARE and UNEP 2008).

The report also referred to some activities in Arab countries in the field of e-waste disposal, most of which are partnerships between governmental entities and NGOs or private companies.

In recent years, significant international transboundary movement has evolved in used and end-of-life electronic equipment that

Box 5. Chemical Hazardous Waste

The chemical industry discharges many types of chemical waste into the environment, including hazardous waste. Examples of this type of waste include toxic metals and carcinogenic polycyclic aromatic hydrocarbons (PAH) found in smoke resulting from burning organic waste as well as exhaust. Electronic products, including personal computers, also contain toxic substances such as lead, mercury, arsenic, cadmium and selenium which are considered hazardous wastes.


Cedare

have been transported from Europe to some Asian countries for the removal of usable parts, repairs, refurbishment, and re-export to several third world countries for reuse. These electronic devices lack all safety and security standards.

Green (sustainable) chemistry

The closing decades of the last century witnessed the emergence of green chemistry (or sustainable chemistry), a new hybrid of chemistry that focuses on reducing the use and generation of hazardous chemicals for their risks to people and environment. Through the use of sustainable chemistry, many industrial processes containing noxious products or wastes such as nitrous oxide, cyanide and other environmentally hostile compounds have been converted to green (sustainable) processes that do not involve toxic compounds.

Sustainable chemistry is also responsible for significant energy savings through chemical processes, energy saving alternatives and the use of supercritical fluids, such as carbon dioxide, and other alternatives to organic solvents that are often toxic and have adverse environmental impacts.

In Arab countries, the introduction of green chemistry is still in its infancy, despite the significant role sustainable chemistry can play. Sustainable chemistry is being incorporated gradually in educational curricula and research work at university level in a number of Arab countries including Saudi Arabia, Morocco, and Egypt. Moreover, the Dubai Declaration on International Chemical Management is one example of legislation in the region that specifically emphasizes the benefits of chemistry, including sustainable chemistry, for better managing hazardous chemicals and improving living standards, public health and protecting the environment (Secretariat of SAICM 2006).

Sustainable chemistry: industrial ecology and industrial areas in Arab countries

Industrial parks are seen as a viable approach to improving the economy, and abating industrial pollution in a number of developed and developing countries. A number of industrial parks and export processing zones have been established in several Arab countries, including Bahrain, Egypt, Tunisia, and Jordan accommodating a number of diverse industries and processing facilities (ArabianBusiness.com 2008, El Madany 2008).

In the Arab region, the concept of industrial symbiosis, a type of eco-friendly industrial development that is an application of the concept of industrial ecology, a main component of sustainable chemistry, is not applied in these parks.

However, the application of industrial symbiosis would allow for the integration of waste produced in one facility into the production processes of another facility in a closed loop where the waste of the first facility is turned into a raw material for the second. Applying sustainable chemistry will provide the crucial leverage needed to promote its sale in growing environmentally-oriented markets. Assorted efforts should be directed to implement such newly emerging concepts in industrial practices in the Arab region.

Conclusion

Emerging issues reflect human endeavours to understand the environment, and to improve quality of life. This chapter has dealt with some of the issues that might have some economic, social or environmental repercussions in the Arab region. In this context, the chapter discusses issues related to the production of bio-fuel, measuring the environmental capabilities as reflected by environmental indicators that include environmental sustainability, environmental performance and ecological footprint indicators, that are an integral part of good environmental governance.

The prevailing trends of sustainable development have induced sustainable consumption and production to become a significant core issue in the cleaner production paradigm. Despite risks, biotechnology and genetic engineering have become valuable tools that may be used to overcome food scarcity and promote drug development.

Finally, green chemistry (sustainable chemistry) has emerged as a promising new hybrid that focuses on reducing the generation and use of hazardous chemicals. There is no doubt that

The first international forum for e-waste management was held in Cairo in February 2009, to present stories of success in hazardous waste management at the regional and international level, and to introduce investment opportunities in this new field.

considering these issues, and the advantages of their use and application is a matter of paramount importance, and would constitute a cornerstone in environmental decision making.

Abdalrahem AL Arjan

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Section

Four

Outlook ….Towards 2015 and Beyond

Chapter 11: The Future Today

Chapter 11

THE FUTURE TODAY

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Main messages

This chapter builds on previous chapters by exploring how current social, technological, economic, environmental and political trends may unfold along divergent development paths, and what this might mean to the environment, development and human well-being. It presents four scenarios for the year 2050 (Markets First, Policy First, Security First, and Sustainability First) using a narrative storyline to explore the potential of different policy approaches and societal choices by Arab countries. The following are the main messages of this chapter:

- The most important choices affecting the environment in the future are not necessarily environmental choices. Achieving environmental sustainability relies on a multitude of potential interventions and developments, such as changing governance approaches towards more public participation, improving and broadening the education system, implementing technological innovations, and changing the behaviour of people. The environment and environmental policies should not be compartmentalized; rather they should be integrated into national socio-economic development plans. Furthermore, sound sustainable policies should make human and environmental welfare central to planning.

- Investments in human resources development, democratic transformation, governance improvement, regional cooperation and integration of the Arab countries are key issues along the lengthy, intricate path to sustainability and the desired political and socio-economic revitalization in the region. Relying on the market alone is unlikely to achieve major environmental and human well-being goals. Investment in human resources development in the fields of education, training, and capacity building, with the ultimate objective of establishing knowledge based societies, is a key issue on the long road to sustainability.

- The emphasis on markets and economic growth stimulates needed improvements in resource efficiency and the development of new technologies. However, it results in significant increases in environmental pressures and slows down advances in achieving social targets. The trend towards less environmental legislation and regulation and seeking further self-regulation, or letting markets decide, can lead to the complication of many environmental problems that can have implications on socio-economic development. In this context, market forces should not fully control national and regional policies as reform of current polices should coincide with comprehensive socio-economic development.

- The use of resources to satisfy security needs rather than improving the standard of living, human well-being, the environment and natural resources, causes significant harm. The overall development of the region is negatively impacted by these actions, which eventually leads to the disintegration of its social and economic fabric. Fragmentation of existing states and external hegemony, domination, and subordination of the region's countries are expected.

- The improvement of governance and a sustained link among social, economic, and environmental policies provide a solution to the sustainability challenge in the region. Integration, cooperation, and dialogue at the national, regional, and inter-regional levels replace tensions and armed conflicts.

- Achieving sustainable development and long-term goals require strategic planning and wide-range vision that reflect the truth of environmental and socio-economic situations, the challenges encountered by Arab societies and available and captured opportunities, based on scientific objective analysis dependant on experiences.

- Regional integration and cooperation among Arab countries are vital for the future survival and prosperity of these countries. The main areas of cooperation and integration are in the fields of food production, research and development in desalination and water treatment technology, new and renewable energy research, and the protection of the freshwater and marine environment.


Abdalrahem AL Arjan

Introduction

As society's environmental problems grow along with its population and economic development, new methods are devised to keep track of these problems. One of these methods is "environmental assessment"; a technique that provides basic information about the state of the environment (SOE) for decision making institutions. However, SOEs can only assess the current condition of the environment, whereas many important environmental problems have to do with the future state of the environment and with what might emerge based on today's actions and policies. Therefore, environmental assessments must cover both the current state of the environment and explore its various possible future states, especially considering that these assessments require undertaking effective future policy actions to solve environmental problems.

An increasingly common approach in environmental assessments that examine future conditions is the use of scenarios, which serve as useful tools for evaluating future environmental problems and assessing policies to resolve them. Scenarios also make it easier to synthesize and communicate complex and extensive information to decision-makers and the public at large.

The value added to scenarios of the traditional SOEs is in their capability to handle and assimilate a lot of information and view points, and to provide an effective format to bring this information together. Moreover, as scenarios are written in the form of stories, the results of an assessment can be communicated to a large and diverse audience. Finally, perhaps the most important function of both scenarios and environmental assessments is that they act as a crucial bridge between environmental science and policy. Scenarios influence policy making by summarizing and synthesizing scientific knowledge in a form that can be used by policy-makers to develop policies. Specifically, they help policy-makers to visualize the different aspects and connections of an environmental problem, as well as its large time scale (Alcamo 2001).

This chapter builds on the previous chapters in this report by exploring how current Social, Technological, Economic, Environmental, and Political (STEEP) trends in the Arab region may unfold along four different development paths in the future, and what this might mean for the environment and human well-being. It explores the Arab region's future through the lens of "environment and development", and concentrates on the end results of the various choices that might be taken through the use of scenarios' thinking. Four scenarios exploring different policy approaches and societal choices are presented here using a narrative storyline. These scenarios are termed Markets First (Souq), Policy First (Islah), Security First (Inkefa'a), and Sustainability First (Nahdha). The framework of these scenarios is based mainly on the UNEP's Global Environmental Outlook process, namely GEO-3 and GEO-4 (see Box 1).

It should be noted that these developed scenarios are neither predictions, nor should they be taken as the most likely of possible futures. At most, they portray pictures of a limited number of plausible futures based upon a certain set of assumptions about driving forces, critical uncertainties, and system relationships (see Box 2). These include governance, demography, human and economic development, science and technology, culture, and regional integration. Their rationale is not to indicate what will happen, but rather what might happen if certain choices are made. Their purpose is to assist in thinking more carefully about how it might be possible to encourage or counteract particular events and trends (UNEP 2007). The fundamental assumptions defining the EOAR scenarios, based on the GEO-4 scenarios, focus on who is making the key decisions, or the dominant actors; how these decisions are made, or the dominant approaches to governance; and why certain decisions are made, or the dominant priorities. The assumptions about these in each of the scenarios are summarized in brief in Table 1.

The emphasis in "Markets First" is to ensure the smooth functioning of markets. Strong efforts are made toward the development of institutions that encourage and support the open exchange of resources, finances and products. Faith is placed in the hypothesis that the best path to the improvement of social and environmental welfare is through rapid economic growth. In "Policy First", national governments are assumed to play a greater role, and greater coordination is also expected in the evolution of governance. There is more direct effort to define economic, social and environmental goals, as well as to manage and direct society toward the achievement of these goals.

"Security First" assumes the dominance of governments and private sector players, such as large and multinational corporations in exerting authority, but there isn't always agreement among these groups. There is less emphasis on the pursuit of the greatest good for the greatest number. This is reflected in the general assumption that groups, primarily but not exclusively bound geographically, establish systems of governance that emphasize their own security and welfare.

"Sustainability First" assumes a significant shift in the attitudes and behaviour of many key players. A balance is established between the government, private and civil sectors with respect to governance. There is a strong emphasis on environmental and social progress, with economic growth seen as a means to an end, and not an end in itself. Greater emphasis is placed on accountability, transparency and legitimacy in government, as well as in the private sector and other societal institutions, including scientific ones. Strong efforts are exerted to ensure that participation in governance is widespread and goes beyond the mere dissemination of information.

Environmental scenarios for the Arab region

What lies ahead for the natural environment and human well-being in the Arab Region? What are the main driving forces that will shape the future?

Box 1. The GEO 4 scenarios at a glance

At their core, the scenarios presented here explore the implications for the environment and human well-being of alternative assumptions about who is making the key decisions, how these decisions are made, and why certain decisions are made. Elements of each scenario can be presently seen and each of the four scenarios will almost certainly contain aspects of the others. The nature and the names of the scenarios, though, are characterized by the theme that dominates the particular future envisioned, or what comes first.

Policy First:

the government sector, with active private and civil sector support, implements strong policies intended to improve the environment and human well-being for all, while still emphasizing economic development.

A view of the future? You shall…you shall not… a policy-dominated world?

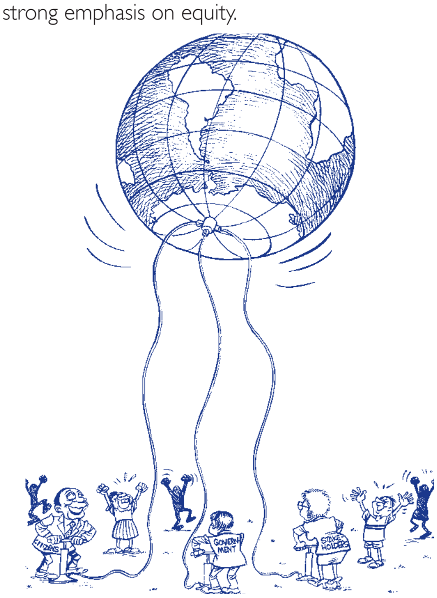
Markets First:

the private sector, with active government sector support, pursues maximum economic growth, trusting this to be the best path toward the improvement of the environment and human well-being for all.

A view of the future? A market sell-out?

Sustainability First:

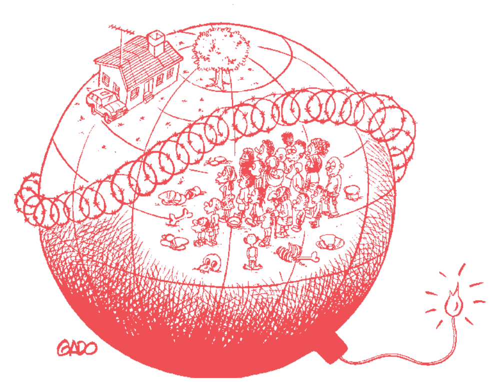
the government, civil and private sectors work collaboratively to improve the environment and human well-being for all, with a strong emphasis on equity.



A view of the future? Together we can sustain the Earth!

Security First:

the government sector and certain private sector actors compete for control in an effort to improve, or at least maintain, well-being for select groups.



A view of the future? To have… not to have… security in a divided world?

UNEP 2007

Which of the current social, economic, and environmental trends will continue and which will see a dramatic shift? What are the impacts of these changes on the environment and human well-being? What role can humans play in shaping the future?

All these questions need to be addressed if Arab countries want to have a role in determining their future. Once they answer these questions they can begin to make policies and take actions that will help them to move from their current conditions to a future that has both immediate and long-term benefits for generations to come. At the very least, addressing the necessary changes will enable countries to adapt their policies and practices to deal with future external developments and avoid or alleviate negative impacts. At best, they will be able to identify future opportunities and benefit from them in order to build a healthy environment that flourishes in the future throughout the region.

In order to achieve an environmentally healthy future, it is necessary first to identify the main driving forces in the Arab society. These may be social, technological, environmental, and political in nature and may be driven by policies which can be internal (made by the countries themselves) or external (imposed on countries from outside).

When countries are aware of their past trends and the various impacts on human beings and the environment (see Annex A), they are more capable of forecasting what might happen if these driving forces continue or not in the long-term. They will also be able to examine whether current or future policies are capable of achieving long-term social, economic, and environmental goals.

Box 2. Scenarios vs. predictions

A scenario is not a prediction of what the future will be. Rather, it is a description of how the future might unfold. Scenarios explore the possible, not just the probable, and challenge users to think beyond conventional wisdom. They support informed action by providing insights into the scope of what's possible. They can also illustrate the role of human activities in shaping the future, and the links among issues, such as consumption patterns, environmental change and human impacts.

Jäger and others 2007

Scenarios key questions

The scenarios presented here are used to try to answer the main question: Over the next 50 years, can the Arab region achieve sustainable development in which socio-economic development and environmental protection are balanced? If the answer to the main question is yes, then how will they do this? If the answer is no, why is it?

Other key questions that these scenarios address and explore are: Under the current socio-economic development policies, what are the impacts on human well-being and what are the environmental consequences? Under these conditions, is it possible to avoid negative environmental impacts or mitigate them? What are the compromises/trade-offs involved? Can environmental and natural resources (coastal, marine, groundwater, biodiversity, land, etc.) continue to be exploited in order to promote economic development and human welfare without degrading these resources and compromising their sustainability? Finally, what are the environmental, economic, and social costs that would result from this exploitation in the long-term?

versus investment in socio-economic and human resources development represents a key driving force in the region.

The scenarios narrative

The following four narrative storylines attempt to explore the impacts of the possible policy approaches and choices to be made by Arab countries relative to the current and future environmental challenges they face. While these choices show the impacts of the various STEEP drivers on the future paths of these countries, they also show how acting reactively or proactively would affect and determine these paths. The quantitative social, economic and environmental indicators (see figures 1–10) according to International Futures – IFs, support these scenarios quantitatively – (Hughes 2008). These indicators aim to clarify and support the story narrative and compare between scenarios, but the figures indicated should not be relied on absolutely.

Arab countries key environmental challenges and focal issues

The key challenges and focal environmental issues in Arab countries are water scarcity and quality, land degradation and desertification, degradation of coastal and marine environments, management of the urban environment, and the impact of violence and conflict on the environment (UNEP 2007, UNEP 2006, and UNEP 2002). Although various Arab sub-regions have different socio-economic and geopolitical characteristics, exploitation of natural resources, sustained growth of population and urbanization constitute major driving forces for all the Arab countries' economies.

The issues of governance at the national level, and cooperation and integration at the regional level, represent two of the overarching driving forces that will have a major impact in shaping the future of the region. Furthermore, a protracted history of wars and political tensions in the region, as well as within countries, has placed peace and security at the centre of human well-being and environmental concerns. Thus, security and military spending

Markets First (Souq)

Under this scenario, development in Arab countries is dominated by market forces and market mechanisms (demand and supply of goods and services); the slogan of "economic growth/development at any cost" dominates. Exploitation of natural resources, provision of inexpensive labour, mass production and manufacturing efficiency are seen as the formula for lowering prices and enhancing competition in the regional and global markets. Economic development through better technology and management is prioritized, while social problems and environmental stresses are left to the self-correcting logic of competitive markets. Under this scenario, in the field of human development, the assumption that economic growth will naturally lead to improvement in social conditions prevails, meaning that investment in education and health must compete against other possibilities that might offer more immediate returns. Arab society largely adopts and gradually converges to values and expectations prevailing today in capitalistic industrialized societies including materialism, individualism, and consumerism that can run counter to collaborative efforts for societal change. Private sector investment and marketing initiatives play the main role in moving the wheel of the economy, while government officials and legislators are increasingly put under pressure to minimize their interventions in the free market mechanisms, thus facilitating self-regulation. For example, the oil and gas sectors and other industries might become self-regulating. While Arab countries witness some positive socio-economic trends, natural and environmental resources depletion, environmental degradation, and health risks increase (see Box 3).

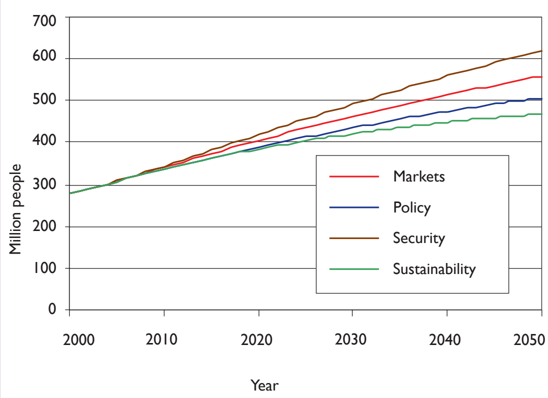
Most Arab countries undergo economic policy reforms and restructuring processes that feature a rapid transformation of their roles from service provider to service enabler and regulator. Privatization is perceived as the main way to decrease governmental costs, increase the efficiency of services and enhance cost recovery. Democratic systems are not fully established and so inherited social and tribal structures continue to dominate decision-making.

One side effect of this climate is that environmental legislation and regulations are relaxed in order to attract foreign industrial investments. State support of training and education is very weak

Box 3. "Markets First" scenario

"Markets First" is an environmentally depressing scenario for Arab Countries. Under this scenario, countries face considerable environmental problems, and the environment continues to deteriorate. The environment has the lowest priority and is overridden by economic investments and policies that maximize economic development.

Figure 1. Population



and left mostly to private industry. Under this scenario, market forces lead to greater technical and economic efficiency (such as the increase in oil extraction efficiency) and better performance of services. Nevertheless, social disparity and environmental problems increase. By 2015 only a limited number of Arab countries will achieve the Millennium Development Goals (MDGs), with the main deficiencies being persistent, namely poverty, illiteracy, gender inequality, deteriorating health and education, in addition to continuous environmental deterioration.

Population continues to increase due to the failure of population policies (see Figure 1). Rapid population growth rates in the absence of a human development strategy constitute a core development problem, leading to increased levels of unemployment and poverty especially among poorer social groups. This has an overall negative impact on the environment, natural resources, and the economy. Social disparity, resulting from increased levels of poverty and unemployment, leads to frequent social unrest and increased crime rates, endangering the stability and security of many Arab countries.

This in turn discourages foreign investments, and leads to the impediment of economic growth targets in these countries. Under these conditions, authoritarian solutions and responses become common and more frequent in Arab countries, which only serve to fuel this vicious cycle. Peace and security are absent, and instability and tension continue to plague the region as a result. Regional and national political conflicts, though contained, continue to interrupt development programmes and exacerbate social and environmental problems.

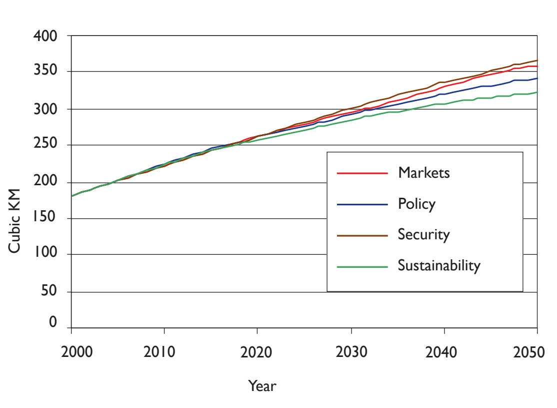
Meanwhile, water stress increases due to rapid population growth rates, swift expansion of economic activities and limited renewable water resources. As a result, the number of people living in river basins with severe water stress increases over time. The situation is further exacerbated by climate change impacts which lead to a gradual decrease in rainfall and an increase in evaporation rates in the region, resulting in even fewer available water resources. Higher per capita water consumption in the domestic sector also increases along with water used for crops, further contributing to the pressure on available water sources.

Thus, water demands continue to escalate (see Figure 2) and exceed available water resources, leading to further increases in the overexploitation rates of groundwater and surface water resources and the degradation of these resources. Water competition increases among various sectors, including the agricultural, municipal and industrial sectors, further exacerbating the situation. An increase of wastewater discharges from municipalities and industry and continuing agricultural run-off cause additional deterioration of the quality of both groundwater and surface water supplies, leading to escalated land degradation, reduced food production and increased water-related health problems.

As water scarcity worsens, water becomes more expensive, resulting in increased usage of desalination and the re-use of treated wastewater to meet escalating demands. In the case of the latter, re-use occurs without strict adherence to wastewater re-use standards or guidelines due to the large volume of wastewater generated in comparison to the limited treatment capacity and high agricultural water demands. As a result of using this wastewater, frequent outbreaks of water-related diseases occur in Arab countries. Furthermore, Arab countries import desalination and treatment technologies because of relatively low regional investments in research and development (R&D). In addition, desalination facilities continue to be powered almost exclusively by fossil fuels, thereby increasing the emissions of greenhouse gases (GHGs) and other air pollutants. The use of clean renewable energies, such as solar and wind, both of which are abundant in the region, continues to make up only a marginal share of the region's energy sector. Additionally, a large volume of wastewater is regularly discharged from desalination facilities into the marine environment, disturbing its ecosystems and biodiversity.

While privatization of the water sector, along with other sectors, has increased, leading to an increase in the efficiency of water use, it is also accompanied by the layoff of a large number of workers and removal of water subsidies. Fewer subsidies translate into less access to water resources by the poor. In general, water resource management authorities ignore these issues of social equity and environmental sustainability. Furthermore, the problem of shared water resources remains unresolved, threatening regional stability.

Figure 2. Water use



Planned and unplanned urbanization escalates under this scenario, resulting in increased employment opportunities and easier access to educational and health services, particularly for marginalized rural populations. However, it also leads to increased local air pollution, concentrated waste production, rising numbers of slums and shanty towns, loss of limited agricultural lands and insufficient basic health care and sanitation services for large numbers of people (see Chapter 5). Organized, planned urbanization continues to lag behind the needs of rapidly increasing populations.

As a result, infrastructure and resources remain over-stretched to satisfy increasing demands. Existing infrastructure deteriorates rapidly as most resources are directed towards extending and constructing new infrastructure and not sustaining existing structures. Furthermore, as large cities continue to expand, both horizontally and vertically, to accommodate new dwellers, more people are forced to travel long distances to go to work. The transportation problem in some large cities becomes very acute with consequences including increasing air pollution, higher energy consumption rates, and losses to the economy. Environmental and health problems become particularly bad in some countries, especially among Palestinians, Iraqis, Somalis and other refugee groups. Future conflict is also expected to escalate between Palestinians and Israelis, within Iraq and in other parts of the region.

Figure 3. Food demand

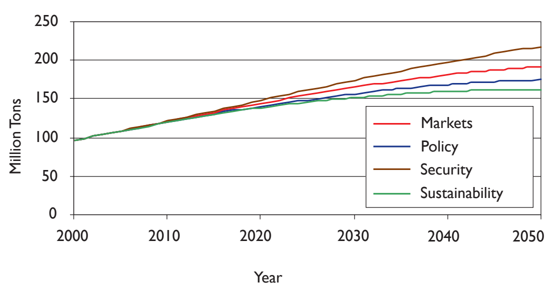
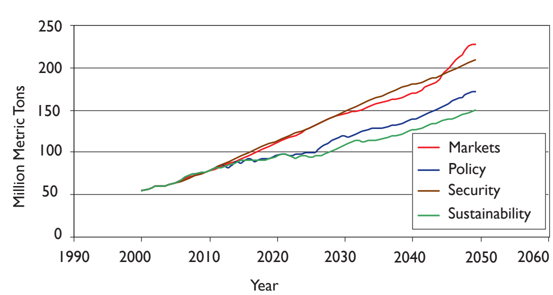


Figure 4. Agricultural imports



Moreover, arable land is lost due to the expansion of cities and other industrial and service activities. Growing food demand (see Figure 3) leads to the expansion of irrigated agriculture, water resources over-exploitation and salinity. Over-cultivation under the conditions of deteriorating irrigation water quality and soil salinity causes additional land degradation and loss, eventually leading to even more desertification and land degradation. Soil salinity, water logging, soil erosion, and land pollution are some of the types of land degradation that emerge (see Chapter 3).

These deteriorating conditions spur market forces to expand non-traditional agriculture through advances in biotechnology and genetic engineering research. Once developed, this technology is used to improve agricultural productivity. However, the "industrialization" of agriculture leads to various unintended side effects in the form of health problems, including allergies, autoimmune diseases, toxic exposure, and nutritional problems, as well as genetic pollution (see Chapter 6 and 10).

Furthermore, as food demand increases, and as many countries continue to exploit most of their arable land, many farmers resort to excessive use of chemical fertilizers and pesticides. As a result, some key agricultural commodities fail to meet the high standards of global markets and remain bound to local markets. This puts even more pressure on many countries that already struggle to sustain their export of agricultural commodities, which reduces their hard currency income generation. Thus, the sustainability of agriculture in many Arab countries becomes highly questionable due to the serious degradation of land and water resources. This degradation, in part, triggers food security issues in the region, impacting economies as well as stability. All of these factors make the Arab region more vulnerable to global food crises that lead to an increase in food import costs (see Figure 4).

The deterioration of habitats and ecosystems continues, as a direct result of increased pressures exerted on biological and natural resources. Biodiversity in the Arab region continues to be threatened by population growth, urbanization, industrialization and uncontrolled hunting and fishing (see Chapter 4). The concentration of new developments along coastal areas has adverse impacts on fauna and flora. The region has witnessed a general decline in species population; an increase in the number of species threatened and a continuous loss of biodiversity (see Chapter 6). Furthermore, due to weak law enforcement, illegal trading in rare birds and animal species continues. Conflicts and wars in some countries are another threat to biodiversity.

Despite their limited area, forests continue to be used as a source of wood fuel and charcoal due to increasing oil prices. As population increases and the demand for these resources increases as well, forests are depleted beyond their natural replenishment capacity. Natural disasters, such as fires and severe drought, also take their toll on forests. Despite the acknowledgement of the deforestation problem by governments, economic and climatic pressures outweigh forestation and reforestation efforts. Although the area and number of protected land increase over time, land protection is not part of a broader strategy to protect and develop genetic resources. Moreover, the introduction of foreign and genetically modified species continues to be unregulated, further threatening indigenous species (see Chapter 6).

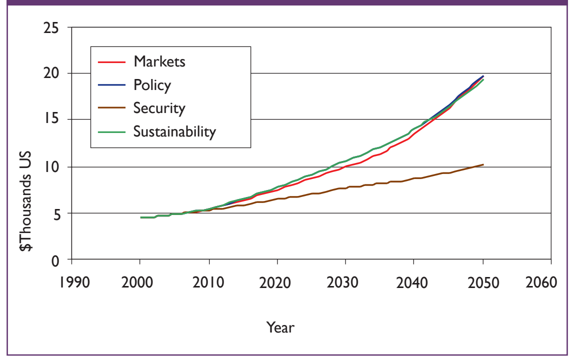
Coastal and marine environments are also degraded under this scenario. The growth in population number and density along the region's coastal areas increases marine pollution, primarily through untreated wastewater. Intensified development of coastal and marine areas, along with poor resource management and regulation, exacerbates the degradation of marine ecosystems and habitats as well as biodiversity loss. Other risks to the coastal zone and marine life stem from marine tourism and the large increase in the number of ships visiting ports as a result of more open trade policies with the global market (See chapter 4).

Overfishing is another threat to environmental sustainability in the Arab region. Increasing food demand for fish-protein and the lack of cooperation among riparian countries cause the over-exploitation of marine resources and fish stocks. Furthermore, a continuing increase in the number of oil exports from the region intensifies the risk of oil spills and the spread of invasive alien species (IAS). The fishing sector continues to be disturbed by expanding industrialization in the coastal zones, which leads to an overall increase in habitat disturbance and contamination of the marine environment from land-based activities.

This causes additional habitat and biodiversity loss and higher fish mortality, leading to an overall decrease in marine food production and economic losses in the fishery industry. Aquaculture and mariculture, driven by the private sector, thrive in an attempt to meet escalating food demands. However, this takes place with minimum concern for environmental consequences and, thus, environmental damage results from these industries, such as the destruction of "Al Qarm" trees and waste concentration, spread of epidemics and threats to local species.

Planned economic reforms in Arab countries are designed to diversify sources of income and bring in investment so as to prevent the negative effects of a single-sector economy. This improves overall economic development and encourages improved budget planning at the national level (see Figure 5). In addition, the tourism industry continues to significantly contribute to the GDP of many countries. However, Arab countries are

Figure 5. GDP Per Capita at PPP



unable to reap the full benefits of tourism due to high levels of pollution, poor basic services, and occasional internal conflicts.

Furthermore, when environmental legislation and regulations are relaxed to attract outside investments, the environment often pays the price. Industries decide to increase profits or lower the prices of their products at the expense of reducing the amount of waste they treat. These actions maintain, rather than diminish, the environmental hazards they produce. Not surprisingly, industrial areas become even more heavily polluted. Pollution, coupled with unenforced health standards in workplaces, causes more workers to fall ill.

It is envisaged under this scenario that international environmental policies exert enough pressure on the private sector in the Arab region to abide by international environmental regulations. Industries and manufacturers begin to consider environmental actions such as the use of the ISO14000 environmental management standard and desulphurized diesel in order to ensure their access to the international market. Although this allows for better management and control of various emissions, with less stress on natural resources, it does not lead to rapid rehabilitation of the deteriorated environment and the restoration of damaged ecosystems and habitats.

In general, under the Markets First scenario, pollution loads increase significantly and have negative impacts on human health and the environment. Adverse effects also include the persistence of high inequality that limits the number and quality of improvements that can be achieved through economic growth, causing continuous environmental degradation that can have severe health consequences, and diminishes natural capital. All of these consequences are mainly due to the prevailing focus on economic development, with little attention paid to environmental repercussions. Hence, in this scenario, investment policies override environmental policies, leading to weak environmental governance and institutions and a particularly weak enabling environment.

Policy First (reforms)

Under this scenario, strong actions are undertaken by Arab governments in an attempt to reach specific social and environmental goals, such as social and economic equity, women's empowerment, environmental protection and natural resource capital maintenance. Arab governments place strong policy constraints on market forces in order to minimize their undesirable effects on human beings and environment.

Environmental and social costs are factored into policy measures, regulatory frameworks and planning processes. Required laws and legislations for the protection of human health and the environment, and the enhancement of resource sustainability, are formulated and implemented. The private sector is brought on board to contribute to investment and economic development by Public Private Partnership (PPP) schemes with incentives and strong regulatory body and regulations (see Box 4).

Box 4. "Policy First" scenario


Mariam Yehia

The environment has a higher priority than in the market forces scenario, but pressures from investment policies continue to be high. However, there is a general improvement in human well-being and a decrease in the rate of environmental degradation.

This scenario envisages that constitutional democracies – which include public representation and voting, as well as accountability and transparency – are gradually institutionalized in the Arab region. Civil society is empowered to participate in public processes that impact major decision making. Issues related to environment and health gradually become a main concern among civil society members, strengthening the alliances and decision making power of national environmental authorities and institutions.

At the regional level, there is greater cooperation within ministerial forums and regional and international environmental organizations. Furthermore, Arab economies and the various infrastructures that underlie them are gradually integrated into one economic Arab bloc under the Arab Free Trade Association (AFTA). Although this integration initially remains incomplete and sub-regionally oriented, it eventually leads to the emergence of a diversified bloc that considers the comparative advantages of different member nations.

Governments decide to integrate social and environmental issues into economic and fiscal policies in order to mitigate the rising environmental, social, and cultural costs of free market economies. More attention is given to environmental policy and this leads to a decrease in the rate of environmental degradation. As a result of these policies, population growth slows down in the 21stcentury due to: effective national population policies, significant investment in training and education, improvement in the quality of education, increased education levels among population and the entry of more women into the workforce. Women have greater access to education and the employment market and people are generally more aware of the current

Integration and cooperation are vital for the future and prosperity of Arab countries. The main fields of such cooperation and integration are food production, investment in water desalination technologies and treatment, new and renewable energy research, in addition to protection of fresh water and marine environment.

and future implications of population growth on human development, the environment, and the economy. Democratization continues to spread.

These policies allow many, though not all, Arab countries to achieve the MDGs by 2015, with major improvements in the areas of poverty reduction, literacy, gender inequality, public health, environmental sustainability, and global partnerships for development. The spread of integrated water resources management (IWRM), as well as increasing public awareness about water problems, takes place as a result of extensive public awareness campaigns. These campaigns include water and environment education in primary and secondary schools and lead to incremental improvements in water use efficiency and changes in water use behaviour over time. Most countries that reform their water management systems do so while following a major policy shift from supply augmentation towards demand management, conservation, and protection. However, demand for water continues to exceed available water resources and the number of people living in river basins with severe water stress continues to increase.

During this period of water policy reform, the treatment of wastewater becomes common, leading to a significant decrease in the total volume of untreated wastewater. The need for non-conventional water resources continues to increase, however. The production of desalinated water and the re-use of treated wastewater increase significantly as there is more regional cooperation to develop these technologies. By the year 2050 this research makes a major breakthrough – allowing the unit costs of desalination and treatment to decrease substantially, and with increased added-value to the economies of Arab countries from these technologies.

The use of clean renewable energies, particularly solar, continues to gradually increase in the region and in many sectors. However, the share for Arab countries continues to be marginal in the energy and water sector. Therefore, concerns remain about environmental problems such as air and marine pollution, particularly with the continued use of fossil fuels as a major source of energy.

The impacts of climate change on water resources and food production, as well as sectors such as health and biodiversity, are a major concern for governments in the region. Comprehensive vulnerability and adaptation assessments are made to identify areas and sectors critically vulnerable to the potential impacts of climate change. Strategies are developed based on these assessments to strengthen national capacities to respond to likely challenges.

Under this scenario, governments encourage private sector participation in water services and production to increase efficiency and decrease economic burdens, while keeping certain environmental regulations and subsidies in place that ensure that the poor continue to have access to water resources. Bilateral and multilateral agreements for the equitable use of shared water resources are achieved in some of the region's basins as a result of regional cooperation and integration. In other basins, Arab riparian countries integrate their development projects and become closely involved with other riparian countries when formulating their water policies. The problem of shared water resources is therefore reduced, enhancing regional stability and providing opportunities for long-term planning. Furthermore, economic integration and regional cooperation help to modify agricultural policies in the region and reduce agricultural water consumption.

The main fields of cooperation and integration are food production, investment in water desalination technologies and treatment, new and renewable energy research, in addition to protection of fresh water and marine environment.

Urbanization continues to increase but not at an accelerating pace. Effective urban planning, which includes well-planned, integrated development of rural areas, as well as decentralization policies, bridges the rural-urban divide and reduces environmental and health problems associated with rapid urbanization. The expansion of slum areas and shanty towns stabilizes, and even decreases in some countries. Environment, transportation, and integrated waste management policies are implemented. With these policies in place, the urban environment improves and features safe drinking water, sanitation, transportation and a reliable power supply. In addition, as public transport systems improve, more people use them in place of private vehicles, thus improving air quality.

Lower licensing fees are imposed on vehicles that are run by natural gas, while solar energy, which starts to be manufactured locally at a more affordable cost, is used in touristic and residential housing developments. Moreover, industries located within urban areas, either move out of urban areas as a result of proper land-use zoning, or are forced to control their gas emissions and waste to minimize environmental impacts. The number of refugees and displaced people decreases because of policies that strengthen the internal political fabric and decrease conflicts in the region. However, the region remains vulnerable, as central conflicts, such as the Arab-Israeli conflict, remain unresolved.

The emission of greenhouse gases from industry, power generation and some agricultural activities is controlled through government regulations

(see Figure 6). The cooling and air conditioning industries are banned from using CFCs and other environmentally harmful products. The overall improvement in air quality has a positive effect on public health.

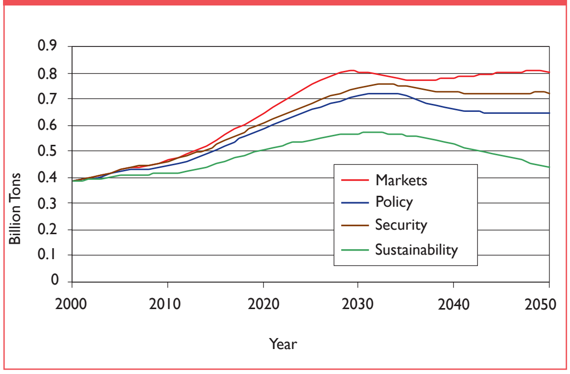
Under this scenario, the implementation of land-use planning to protect land resources, as well as livelihood-centred policies, slows down the loss of arable lands and enhances their conservation. This is strengthened by slowing population growth rates and urban expansion. Sufficient attention is given to the loss of good agricultural land due to soil salinity, erosion, and degradation. As a result, soil rehabilitation schemes are established and include banning the use of chemicals, which are replaced by organic fertilizers. A switch to cash crops for export assists with the shift to organic fertilizers.

Food demand increases more slowly due to the reduction in the population growth rate. Some countries adopt strategic food management plans to reduce agricultural water demands. Large regional research and development investments by both the governmental and private sector, aimed at improving farming practices and soil management, eventually lead to the stabilization of environmental degradation and a reduction in the region's food deficit. As a result, the region becomes less vulnerable to global food crises. Biotechnology research continues to develop new crop varieties that are more droughts and salt tolerant, have shorter life cycles and require less water, while assessing the negative impacts of the technology. All of these efforts lead to the generation of less agricultural drainage water and, subsequently, the reduction of land-based pollution to the sea and other water bodies.

The destruction rate of habitats and ecosystems is greatly reduced by the implementation of appropriate land-use management plans, the adoption of effective laws to protect biodiversity and species population, and the regulation of foreign and genetically modified species. Biodiversity is protected in part by the successful enforcement of environmental laws requiring industries that produce harmful waste products, which seriously harm biodiversity, to comply with these laws. Furthermore, Arab countries increase the extent of protected areas in order to reach international targets and requirements, thus significantly reducing the depletion rate of biological resources. Moreover, the wetland areas, where a wide variety of fauna and flora live, are all declared protected areas.

Governments realize that despite the fact that forests only occupy a very small part of the region, their environmental and economic

Figure 6. Annual Carbon Emission



values are much greater than their total area. Thus, existing forest legislation is reviewed, strengthened and strictly enforced in order to achieve national goals and policy requirements. Forest protection and restoration efforts take some time to produce results but will be apparent by 2050. In addition, gene and seed banks are effectively used in the region to reforest and maintain forest resources. Regional cooperation and transboundary reserves are also established. Nevertheless, climate change, intensification of agriculture, and other factors lead to a steady overall decline of biodiversity in the region.

Urban development of coastal zones and marine areas is slowed down by coastal and marine resource protection plans. These plans have indirect and gradual benefits on coastal areas through the redistribution of large coastal populations. Furthermore, Arab countries take the necessary measures to reduce marine pollution by developing wastewater treatment infrastructure to reduce discharge into water bodies. Laws and regulations are issued in order to protect the coastal areas and water bodies from unplanned development and its associated environmental impacts. Many coastal areas and inland water bodies are turned into protectorates, with special emphasis on the defence of their ecosystems. Degradation of marine ecosystems and biodiversity is thereby reduced and fish stocks maintained.

There is also strong cooperation among the riparian states, accompanied by the ratification and implementation of relevant Multilateral Environmental Agreements (MEAs). Aquaculture and mariculture continue to increase to meet increasing food demands in the region. Nevertheless, potential environmental consequences and damages of these industries are identified through research and mitigated through precautionary planning. Some countries impose stringent regulations to protect the marine environment from oil spills, invasive species and land-based contamination, slowing down the degradation of marine resources and, in some cases, achieving rehabilitation.

Plans for economic diversification, including industrial, manufacturing and service sectors, continue in the region with more integration among Arab countries under AFTA. The private sector in Arab countries is encouraged and stimulated to take part in economic diversification through policies that include economic incentives like reduced taxes and easier trading procedures. This process is facilitated by AFTA. Diversification is implemented alongside environmental legislation and regulations that mitigate the negative impacts on the environment and natural resources. Governments set and enforce the implementation of environmental impact assessment (EIA) procedures to minimize risks to human beings and the environment. The tourism industry continues to be the main source of income in many Arab countries. In addition to international tourism, inter-Arab eco-tourism is emphasized and promoted to maintain the social fabric of the Arab region and increase economic integration. This is accomplished

The adoption of "Security First" scenario leads to deep socio-economic disparities and political turmoil, mainly military coups, imposition of emergency laws and creation of dictatorships. Consequently, this results in severe degradation of the environment and natural resources.

through a set of policies and incentives that facilitate border crossing, real-estate ownership, and development of family-oriented touristic attractions.

This scenario envisions great improvements to human well-being and a decrease in environmental degradation that results from assigning higher priority to human resources development, health and environment protection, compared to that in the market first scenario. However, mounting pressure is exerted on the environment by investment and economic development policies. Furthermore, the governance approach in this scenario, in addition to its top-down approach that involves minimal stakeholder participation, suffers from being reactive rather than proactive and, is thus, slow to respond to change.

Security First (devolution/decadence)

This scenario assumes that the current instability in the region intensifies in the future and that global and Arab security continues to deteriorate as well. Foreign pressure and interests in the Arab region's strategic resources have the potential to bring about further destabilization, rising tension or even war. The conflicts that exist in the Occupied Palestinian Territories (OPT), Iraq, Somalia and Darfur continue to play a major role in regional instability, with effects that negatively impact the region and beyond. Under this scenario, the region experiences deep socio-economic disparities and political turmoil that lead to authoritarian "solutions" by the elite, such as military coups, imposition of emergency laws, and creation of dictatorships. As a result, the region experiences intensified environmental and natural resources degradation, which eventually leads to even greater social and economic disparity and extremism, and finally intra- and inter-country conflicts. These conflicts facilitate additional environmental depletion as governments decide to allocate large amounts of their budgets to purchase armaments at the expense of socio-economic development and environmental protection. Political and armed conflicts among Arab countries, and the lack of economic reforms within these countries, cripple the potential for regional economic integration and the creation of an Arab economic bloc (see Box 5).

At the national level, governments form alliances with the private sector. This negatively affects the decision making process by allowing government and corporate elite interests to dominate and corruption to become widespread. This causes Arab society to split into two groups: a small group of elite and public officials who live in relatively prosperous conditions in highly protected enclaves, and a poor majority who live outside of these enclaves and are deprived of basic services and rights, and have few options and resources. This social division may lead to the complete breakdown of society. Under these conditions, achieving the Millennium Development Goals (MDGs) by 2015 or later becomes impossible for the majority of Arab countries. Poverty, illiteracy, public health, and environmental degradation become even more acute with time, and global and regional conflicts replace partnerships and cooperation.

Human and economic development stall due to political conflicts and tensions, occupation, superpower interventions, sanctions, lack of economic and political reforms, social inequity, and increasing sub-regional and regional disparity (see Figure 7). These developments hinder any progress towards regional economic integration. Although there is an increase in average regional income, the rate is very slow compared to what is desirable to meet human development goals. Regional and national tensions, coupled with an increased frequency of armed conflicts, lead to further fragmentation of existing states along ethnic and religious lines.

This prompts the fragmented and weak economies in the region to merge with global superpowers, creating major economic blocs and

Box 5. "The Security First" scenario

The environment and natural resources are sacrificed as further pressure is placed on these resources to meet security demands. This leads to the disintegration of the social and economic fabric of the region.

Investment in human resources development, democratic transformation, governance improvement and regional cooperation of Arab countries are key issues along the lengthy, intricate path to sustainability and political and socio-economic revitalization in the region.

The "Security First" scenario will divide society into two groups: a small group of the elite who live in prosperous conditions and a poor majority who are deprived of basic services and rights, and have few options and resources.

global superpower domains, instead of an Arab economic bloc. As a result, external hegemony, domination, and subordination occur in the region, leading to a decrease in economic opportunities and competitiveness for Arabs. The share of military expenditures continues to increase tremendously, accompanied by high population growth rates, both of which contribute to economic stagnation and diminished living standards. At this stage, the dream of peaceful Arab integration and unification is no longer possible under this scenario.

The level of water stress becomes severe due to high population growth rates and the lack of proactive strategic water resources planning and management. Climate change impacts significantly aggravate the already deteriorated environmental conditions in the region. The number of people living in areas with severe water stress increases significantly. In most of the Arab region, water scarcity reaches its highest level and renders many groundwater resources entirely depleted and unfit for direct use. At the same time, the volume of untreated wastewater grows enormously and its discharge continues to pollute surface water, groundwater, and the coastal and marine environment.

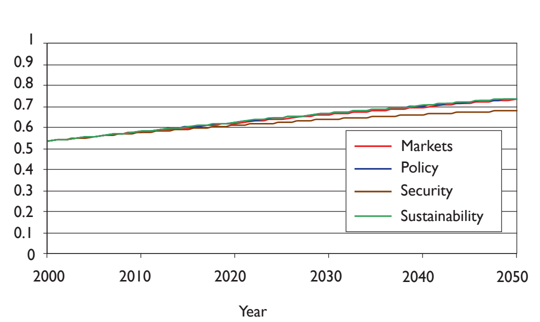
Competition and conflicts over water continue to increase between economic sectors nationally and regionally. More water is directed towards wealthy areas like the elite enclaves and their associated businesses, such as the industrial and tourism sectors, leaving marginal water resources for the poor majority and their major employment sector, agriculture. Thus, overall side effects of the deteriorating quality of irrigation water grow, land deterioration and desertification accelerate leading to reductions in local crop yields, and water-related health problems increase.

Wastewater re-use is stepped up to compensate for agricultural water demands. However, this takes place without adherence to treatment standards, leading to major outbreaks of water-related diseases. Yet research and development for non-conventional water resources remain negligible as available financial resources continue to be used for security purposes. Desalination capacity is expanded to meet domestic water demands and continues to be powered by fossil fuels that degrade the environment. The management of water resources and services is auctioned off to multinational companies, particularly those having trade business ties with executive establishments and the ruling elite.

As higher taxation is required to finance government budget deficits and security/military needs, water subsidies are removed, leading to even greater inequitable access to water resources and basic services for a major proportion of the population. Political instability in the region further exacerbates the problem of shared water resources, which are used more and more frequently as a political tool. The continued degradation of water resources and increased water scarcity continue to add to the tensions within the region, as well as with countries outside the region, triggering additional armed conflicts.

Unplanned urbanization, with concentrated urban centres surrounded by slums and shanty towns demonstrating decreasing living standards, contributes to the uneven distribution of public services and the increase in poverty levels. Unplanned urbanization also has negative

Figure 7. Human Development Index



environmental and health consequences in the form of: increasing air pollution, large concentrated waste production, loss of limited agricultural and recreational lands, insufficient basic health care and sanitation, deteriorating infrastructure facilities as well as increasing unemployment pressures and crime rates. Refugee centres mushroom in many Arab countries as a result of regional and internal conflicts, and in the Mashriq, environmental and health problems worsen particularly in Palestinian refugee centres.

Disparities between environments of the elite and the poor continue to widen. The elite, being much fewer in number, wealthier and better educated, protect their resources through the continual fortification of their properties. Unlike the poor, they have access to reliable basic services. The environment within their fortified living areas remains rich and sustained by environmental protection measures. Careful planning of their surroundings ensures that air quality remains high because of low population densities and sufficient green areas. No significant industrial waste is produced inside these locales as industries are concentrated well outside of their vicinity. Nevertheless, sewage water is not treated before disposal; because it is disposed of in areas where poorer populations live, thereby having no effect on the elite. The picture in poor communities is starkly different from that in elite areas, with high levels of air pollution, unsafe drinking water, poor sanitation and solid waste accumulation.

As a result of their limited resources, the poor continue to overexploit land resources available to them, further degrading these areas. With the exception of relatively small areas that are well preserved by and for the elite, most of the land resources in the region become degraded due to unsustainable agricultural practices. At this point,

Large disparities between environments of the elite and the poor continue to widen. The elite, being fewer in number, wealthier, and better educated, protect their resources through the continual fortification of their property. Unlike the poor, they have access to reliable basic services.

land-use planning is almost non-existent, and further development continues on a largely ad hoc basis. Allocation and access to land become even more grossly inequitable.

Food self-sufficiency and security remain high on the political agenda. Subsidies offered to encourage local agricultural production add to the immense stress on water resources and arable lands. Intensive agricultural production during periods of deteriorating irrigation water quality and soil salinity eventually leads to additional land impoverishment and loss. After a peak in agricultural production, food self-sufficiency begins to decline as land and water resources are depleted beyond their sustainable or replenishable limits (see Figure 4). The region becomes increasingly vulnerable to starvation and drought.

Under this scenario, the continued destruction of habitats and ecosystems results in continuous decline in species population, increase in the number of threatened species, and an incessant loss of biodiversity. However, efforts to stop these trends are ineffective due to declining economic and environmental conditions and the increasing need for food. Preserving the natural environment remains very low on the list of priorities among policy-makers and the private sector. Additionally, without efforts to curb rapid urbanization among the poor majority of society, biodiversity experiences even greater damage. Biodiversity loss increases further as a result of some individuals who choose to make a quick profit by illegally selling rare species.

Moreover, forests continue to be overexploited by the poor majority as they provide a cheap source of wood fuel, charcoal and timber. Unfortunately, the poor are forced to satisfy their basic needs before they are able to give sufficient concern to environmental degradation. In some cases, they do not realize the environmental value of the forests they are depleting. In other cases, they are simply unable to put environmental interests before theirs and those of their families.

In addition to the intensified random development and exploitation of coastal zones and marine areas, pressures stem from the military development of these areas for weapon and missile testing, manoeuvres as well as actual combat. The marine environment is victim to large amounts of military hazardous wastes in addition to increased pollution from oil spills that result from the sabotage of oil facilities and tankers. Growing food demand, lack of cooperation among riparian countries, and lack of environmental regulations and/or enforcement also lead to increased overexploitation of marine resources and fish stocks. Efforts exerted to expand aquaculture and mariculture do not take into account the potential environmental and health consequences. Thus, they result in even more rapid degradation of the marine ecosystem, irreversible loss of habitats and biodiversity, and accelerated trends of species extinction. Many rare marine species become threatened or extinct.

The "Security First" scenario, which can also be viewed as an extreme case of the "Markets First" scenario, leads to the growth of, and ultimately the complete decadence of the elite classes, while poverty and deprivation among the poor increase. The result is a complete breakdown of society, where human beings and environmental conditions suffer greatly in order to meet security needs. However, after breakdown and complete collapse, countries eventually bounce back. A new young and motivated generation of civil society members emerge to lead these societies and rebuild them.

Sustainability First (renaissance)

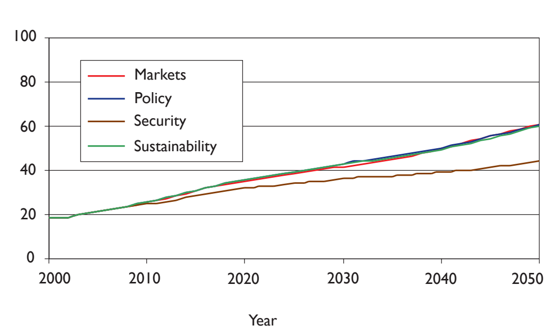
This scenario envisions the emergence of a new development paradigm in response to the challenges of sustainability, which is supported by new and more equitable values and institutions. The notion of human development and investment in human capital, rather than material acquisition, is advanced as a form of cultural and social evolution. A more visionary state of affairs prevails; where proactive solutions to the challenges of sustainability are provided that support a sustained link among social, economic and environmental policies. This is achieved through the creation of long-term integrated strategic planning that has as its objective the achievement of a superior quality of life and a healthy environment. This is to be accomplished in the long-term by a strong emphasis on heavy investment in human development through education, training and other capacity building programmes (see Box 6).

The aim is to create a productive knowledge-based society that fulfils the economic development needs in Arab countries. Environmental sustainability is pursued through changing the education system and human attitudes and behaviours towards the surrounding environment for long-term viability and success. Furthermore, scientific research and development to solve social, economic and environmental problems is encouraged and paid for by significant funding from national budgets, drawn from both private sector funding and government revenues of Arab countries. Universities and research institutes in the region are capable of carrying out competitive research projects in the key fields of communications, information technology, development of new energy sources in addition to water desalination and treatment. In fact, the Arab society is gradually transformed into a scientific, information and knowledge-based society (see Figure 8). In this scenario, environmental policies aimed at protecting the environment and the sustainable use of resources decide investment policies, ultimately leading to the massive use of clean technologies. Eco-taxes and polluter pay charges proliferate.

This scenario begins with Arab society adopting the positive features of cultural globalization and industrial societies. Arab countries reject materialism and consumerism in favour of professionalism, productivity, awareness, public participation and commitment to the environment (environmental citizenship). This shift will gradually permeate society and replace non-compliance with laws, the petition system, corruption, indifference and waste. Furthermore, national and regional identities; positive Arab societal values, such as the emphasis on family and societal unity; and regional spiritual and moral values will be maintained and enhanced. By 2015, most Arab countries will have achieved their MDGs, while others would surpass these goals.

Where policies of centralization and limited civil society participation once dominated Arab countries in the past, they are gradually reversed, with positive impacts on the decision making process, development, and public involvement and participation. Arab society becomes completely democratic and the balance of power among governments, the private sector, and civil society is equal. Civil society empowerment reaches its highest levels, leading to active public participation in decision making processes at the national level. Human well-being, health and environmental issues become civil society's main concern. As a result, government environmental authorities have a strong influence on decision-making processes

Figure 8. Knowledge society index



at the national and regional levels, leading to the prioritization of environmental policies over economic policies in cases where there is a conflict of interest.

This process begins at the regional level, where integration among Arab countries reaches its highest level. Arab countries become fully integrated economically and politically creating one economic Arab bloc, AFTA. The region then integrates into the global economy as a strong regional economic bloc, marking the emergence of diversified economic blocs in the world. This development eventually leads to the emergence of the Arab Union; a major accomplishment for the region. The Union has all the required elements to succeed despite external challenges and threats. The Arab regional ministerial forums and organizations are enhanced and strengthened by this development. Regional environmental policies are formulated and implemented nationally by these organizations with the full cooperation of Arab member states. In addition to its political and economic influence, the region becomes an active partner in setting global environmental policies and agendas (see Box 7).

Arab countries witness significant improvements in governance accompanied by sustainable environmental policies. Human development and environmental protection are central to planning, resulting in a healthier environment, superior quality of life, and longer life expectancy (see Figures 9 and 10). Civil society involvement reaches its highest levels, including active public participation in decision making at the national and regional levels.

Regional conflict ends due to the equitable and just solutions achieved through improved policies and ongoing dialogue. As a result, Box 6. "Sustainability First" scenario

Governance improves and sustainable policies are created that make human and environmental concerns central to planning. This results in superior quality of life and healthy environment throughout the Arab world.

military spending is considerably reduced and these expenditures are redirected towards education and health, capacity development and environmental protection. The implementation of effective population policies leads to a slowdown of population growth. At this point, a high standard of environmental awareness is present at all levels of society.

The region continues to face shortages of some natural resources, water being the most vital among them. In response, governments in the region create institutional, policy and legislative reforms that allow water scarcity issues to take centre stage on national and regional policy agendas. This permits governments to create measures to sufficiently address the problem. The implementation of IWRM strategies, with a strong emphasis on demand management and conservation, aided by slowing population growth rates and environmental awareness, significantly reduces water stress. Nevertheless, population growth and climate change impacts still produce additional stress for those people living in river basins. However, actions are taken to make these people less vulnerable to water shortages.

Major regional investments in the development and use of non-conventional water technologies, coupled with the development of cleaner renewable energy, lead to major breakthroughs in desalination and treatment technology without major environmental problems. This has the added benefit of reducing overall GHG emissions. Furthermore, the reduced costs of non-conventional water resources make these technologies affordable to many countries

Figure 9. Quality of Life Index

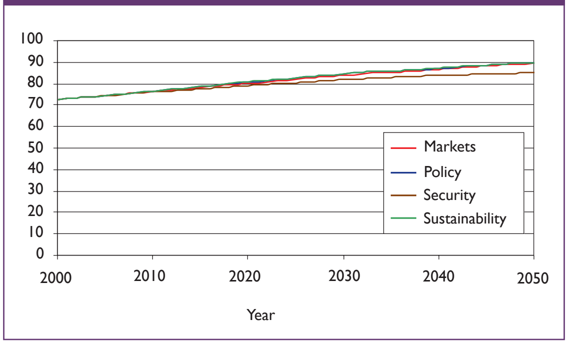
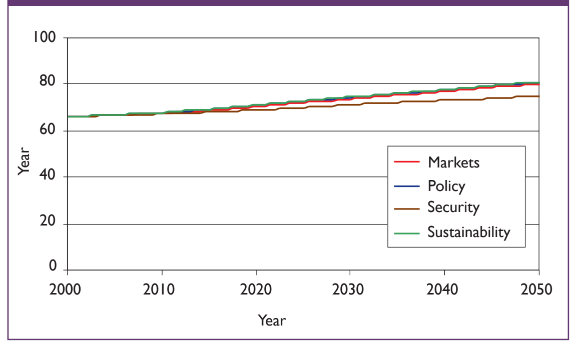


Figure 10. Life Expectancy



and sectors. The problem of shared water resources is addressed through cooperation and dialogue, leading to the more equitable sharing of surface and groundwater resources among riparian countries. This helps to significantly minimize regional tensions and enhance overall development, increase agricultural production, and reduce uncertainty in planning.

Effective and concerted urban planning, along with well-planned, integrated development of rural areas and decentralization policies, has many positive benefits. Among them, quality of life improves in rural areas and there is a slowdown in the expansion of both urban and slum areas. Urbanization continues at a steady but controllable pace. Reduced regional tensions and conflicts allow for refugee issues to be resolved. Net rural-urban migration decreases and even reverses in some countries. Population redistribution takes place between urban and rural areas, alleviating congestion and its associated air pollution.

Air quality, particularly in large urban areas, significantly improves due to the large-scale replacement of fossil fuels with natural gas and solar energy. Furthermore, the implementation of strict environmental laws reduces environmental depletion and improves air quality. Polluting industries are moved out of urban areas to new, specially developed areas, where planning takes environmental issues into consideration. This planning emphasizes increasing green areas and maintaining forests as well as other measures intended to improve air quality.

The expansion of cities is well planned, minimizing encroachment on arable lands. Negative environmental and health impacts associated with urbanization are also mitigated as a result of proper urban planning. Integrated land management strategies that take MEAs into consideration are implemented, resulting

USAF/Wikipedia

in reduced and well planned transfers of arable land to other sectors, conservation of land resources, and the rehabilitation of degraded lands through better land-use practices. Sustainable agricultural production becomes the norm. The adoption of modern irrigation and agricultural techniques reduces chemical fertilizers and pesticides and increases organic substitutes.

Economizing on water use in this way and using higher quality water both help to maintain the sustainability of agricultural land. National food security problems are solved through large investments in non-traditional hi-tech agriculture.

Moreover, it becomes clear that in the majority of Arab countries, individual food security is neither achievable nor feasible. As a result, high levels of Arab food security are achieved through regional agricultural integration among Arab countries. Countries with comparative advantages in land and water resources and competent human as well as financial resources join together in major agricultural projects aimed at achieving food security for the Arab region. This is accomplished by using advanced and state-of-the-art agricultural methods supported by active research and development in agricultural production.

Furthermore, there is wide and rational application of biotechnology in the field of food production, including the safe handling and movement of GMOs. As a result, the region's vulnerability to global food crises is significantly reduced.

Biodiversity in the region benefits from the overall improvements in environmental conditions. Under this scenario, the quality of wastewater greatly improves and the same applies to biodiversity. The whole ecosystem shows symptoms of recovery following its long period of deterioration. Programmes to promote public awareness and improved environmental education help governments to preserve biodiversity, as citizens take an active role in the process.

Moreover, the destruction of habitats and ecosystems is curbed through proper land-use management plans, which reduce human pressures on natural ecosystems, as well as strict legislation that protects biodiversity. Deforestation is greatly reduced while forestation is widely increased as governments strengthen and enforce legislation governing the exploitation of forests.

These efforts are aided by education and public awareness programmes that emphasize the importance of forest resources. Later, drought and other natural water resource shortages are the greatest hindrances to forestation and reforestation efforts, rather than direct human actions. Protected areas reach and go beyond acceptable international levels, significantly enhancing the conservation of biological resources. Regional cooperation, transboundary reserves, and eco-space parks are also established across countries. These actions result in a slowdown of biodiversity loss in the region as a whole.

Furthermore, coastal and marine environments are very valuable resources to the countries of the region, and remain well protected and managed under this scenario. Unplanned random development of coastal and marine areas ceases as a result of coastal and marine resources protection strategies and the wide implementation of Integrated Coastal Zone

Management. Laws regulating coastal areas are issued and strictly enforced. New development in sensitive areas is totally banned, and tight control is imposed on developments in other areas. Extensive efforts are exerted to restore degraded marine and coastal ecosystems. For example, marine resources are rationally managed and preserved with strict regulations on fishing and development, and the region's planned marine bio-reserves and protected areas reach international standards.

All riparian states ratify and jointly implement relevant MEAs as well as establish oil wastes reception facilities, resulting in a significant reduction of marine oil pollution. The global programme of action for the protection of the marine environment from land-based activities is strictly implemented to control wastewater, significantly reducing sewage releases into the marine environment.

Economic diversification continues throughout this scenario under the AFTA, which takes advantage of and integrates the region's diverse strengths and resources while simultaneously enforcing strict environmental legislation and regulations. The region as a whole is successfully promoted as one large tourist attraction, which increases the tourism industry's contribution to regional economies. Eco-tourism thrives and becomes widespread throughout the region, making the utmost benefit of environmental and natural resources.

Under this scenario, a balance is achieved between the management of natural and human ecosystems in the long-term. New policies and practices lead to conservation through the efficient use of natural resources and sound management of the environment, providing ideal conditions for human well-being. Although economic growth is moderate compared to the market forces and policy reform scenarios, there is a considerable improvement in health and environmental welfare, and the cost of environmental degradation and pollution reflected in the GDP of Arab countries is considerably reduced.

Conclusion

This chapter has explored future divergent development paths and their reflection on the environment and human well-being, based on the development of current social, technological, economic, environmental and political trends in the Arab region. It presented four scenarios exploring different policy approaches and societal choices by using a narrative storyline. Box 7:

These scenarios are termed "Markets First" (Souq), "Policy First" (Islah)," Security First" (Inkefa'a) and "Sustainability First" (Nahdha). The messages deduced from these scenarios are as follows:

In the "Markets First" scenario, although the market stimulates needed improvements in resource efficiency and the development of some new technologies, the region faces considerable problems on various levels due to the almost exclusive emphasis on economic growth. Problems of social and environmental stress are left to the self-correcting logic of competitive markets, which only partially solves these problems and in some cases exacerbates them, possibly leading to stalled economic growth. This is best manifested in the current financial crisis.

In the "Policy First" scenario, strong and coordinated government interventions and actions are exerted to achieve greater social equity.

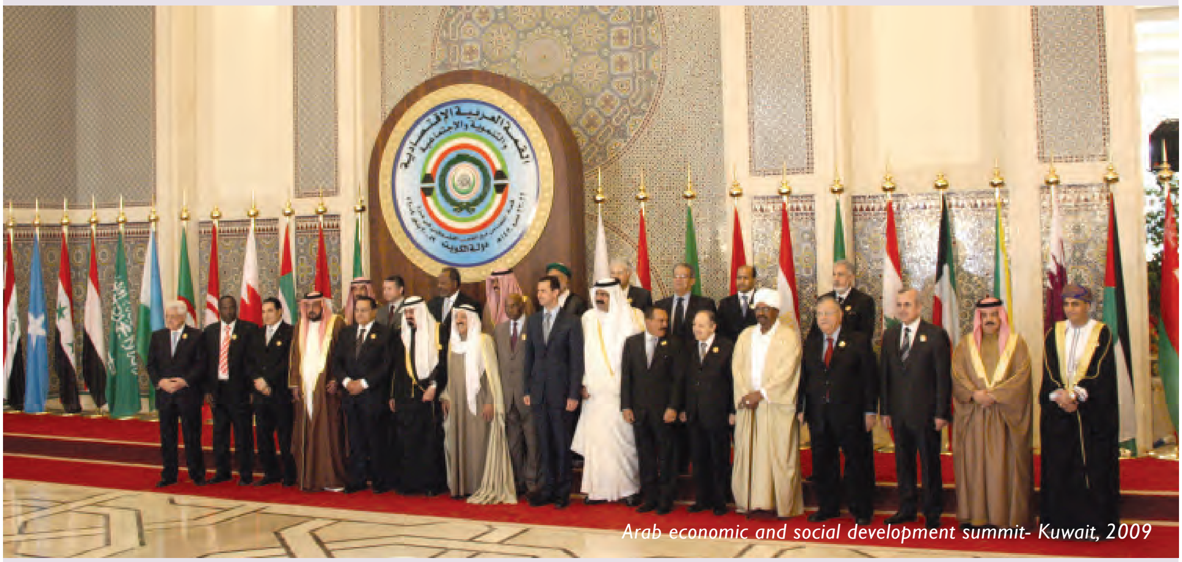
Environmental protection leads to a decrease in environmental degradation and improvement in human well-being. However, environmental pressures stemming from investment policies continue to be high.

In the "Security First" scenario, considered by many in the Arab region as an extreme case of "Markets First", national and regional political tensions and conflicts remain unresolved in the long-term and continue to be a major driving force that negatively impacts the region's overall development. This eventually leads to further disintegration of the social and economic fabric of the region and greater disparity between the rich and the poor. Human well-being, the environment, and natural resources are sacrificed to meet security demands.

In the "Sustainability First" scenario, both the improvement of governance and a sustained link among social, economic, and environmental policies provide a solution to the environmental sustainability challenges in the region. Integration, cooperation, and dialogue at the national, regional, and inter-regional levels replace tensions and armed conflicts. Economic gains are modest compared to "Markets First" and "Policy First" scenarios but overall quality of life and environment improve. Perhaps the most important policy lesson that these scenarios offer, in addition to the above, is that investment in human resources development, improvements in governance, and the cooperation and integration of Arab countries are key issues along the lengthy and intricate path to sustainability and the desired political and socio-economic revitalization in the region.

Box 7. the Kuwait Summit 2009......Moving away from decadence and heading towards renaissance

The Arab Socio-economic Development Summit was held in the state of Kuwait on 20 January 2009, under the theme "Solidarity Summit with the Palestinian people in Gaza." The summit issued the Kuwait Declaration entitled "Upgrading the Standard of Living of Arab Citizens", and an annexed action programme that included executive steps and a future road map for Arab countries, in order to attain the goals and objectives adopted by Arab leaders at this summit.



Arab economic and social development summit- Kuwait, 2009

According to the Kuwait Declaration:

"……..The necessary resolutions have been adopted to ensure uplifting the standard of living of Arab citizens, giving priority to joint Arab investments, paving the way for the private sector and civil society to participate in the process of growth and socio-economic development, as well as consolidating infrastructure projects. Resolutions also aimed at developing production, trade and services sectors, social projects and environmental rehabilitation, in addition to promoting electric linkage projects, the Arab land connection plan, and food and water security programmes with the purpose of achieving Arab integration….."

The declaration identified the challenges encountered by the "Arab world" as:

"...... Local and international challenges affecting security, cohesion and independence of Arab states, among which at the local level are poverty, unemployment, modest standard of living, decline of trade and environmental investments, migration of Arab funds and talents, poor infrastructure and education, as well as failure to keep pace with educational outputs to development requirements and global competition. In addition, the Arab world faces water and food security problems, climate change, energy issues and non-optimal use of resources. On the international arena, Arab states suffer from the consequences of the global financial crisis and its ramifications, disruptions of global financial markets, the risk of economic recession and downturn and their negative impacts on the development process ..."

The summit declaration referred to agreements by Arab leaders on various significant issues and their persistence to implement them through the declaration executive Action Programme. The most important of these issues were those related to the driving forces of the proposed scenarios: to exert tremendous efforts to achieve socio-economic integration, promote human development and capacities of the Arab citizen, develop education and scientific research in addition to promoting the role of civil society in socio-economic development.

Box 7. the Kuwait Summit 2009......Moving away from decadence and heading towards renaissance

In relation to the topics of direct relevance to the environment, the declaration stressed the preservation of the environment and natural resources and their optimal use for achieving sustainable development. This has been considered a cornerstone in all socio-economic development fields to improve the livelihoods of citizens and reduce the impact of climate change on communities, along with the implementation of the Agricultural Development Strategy (the Riyadh Summit 2007). This contributes to achieving food security and self-sufficiency as a priority to Arab national security, improving energy efficiency and rationalizing its use, as well as the expansion in the use of renewable energy technologies, and developing an Arab strategy for achieving water security.

Undoubtedly, these directives, as well as others stated in the Kuwait Declaration, represent a quantum leap in Arab thought and action. If they are implemented by Arab states, they are expected to contribute to uplifting the people of the Arab region to high levels of progress and socio-economic welfare.

LAS 2009

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Table no. 1 Overview of driving forces, uncertainties, and assumptions across the four scenarios				
Driving and sub-driving forces	**Market Forces**	**Policy**	**Security**	**Sustainability**
GOVERNANCE				
Dominant actor and power balance	Private sector with strong government support; more power goes to the private sector	Government with civil society support; more power goes to the government	Government and private sector, civil society marginalized	Balanced relationships between civil society, government, and private sector;
Governance approach	Top-down (with emphasis on hierarchical structures)	Top-down (with stakeholders consultation)	Authoritarian	Balanced bottom-up and top-down approaches
Level of public participation	Low public participation	Medium public participation	Zero public participation	High public participation
Priority	Maximum economic growth, with presumption that social and environmental concerns will be reconciled with market forces	Social development, environmental management and economic development	Security and maintaining privileges of the elite	Social and environmental welfare with economic self-sufficiency
Mainstreaming of social & environmental policies	Low	Medium	Low to none	High
ECONOMIC DEVELOPMENT				
Economic growth	Highest	High	Lowest	Medium
Diversification	High, favouring services	High, favouring services	Military oriented	High, favouring services
Privatization	Highest, no control	High, with control	Highest, no control	Medium, with control (if government agencies are allowed to operate and work like corporations, they can achieve the same efficiency as the private sector)
DEMOGRAPHY				
Population growth rate	Highest	High	High	Medium to low
Urbanization	High due to population growth rate; random	Medium; more controlled but still exerting pressures on environment	High and random; Slums and shanty towns expand rapidly	Low; well planned and stabilized in proportion to resources
HUMAN DEVELOPMENT				
Level of investment in education and health	Medium	High	Lowest, only in the elite and military circles	Highest
Capacity building and training programs	Medium, left to market demand	High, governments lead the efforts	Lowest, only in the elite and military circles	Highest, well planned by leading government efforts

Table no. 1 Overview of driving forces, uncertainties, and assumptions across the four scenarios				
Traditional government support system	**Medium, decreasing trends**	**Medium**	**Low**	**Low, population is highly educated and entrepreneurial, do not need help from government**
Environmental awareness	Medium	High	Lowest	Highest
SCIENCE AND TECHNOLOGY				
Level and type of investment	High, but market driven by the private sector, based on its own needs, emphasis on profit	High, government and private sector solve societal needs and problems and also focus on making profits	High, though only in the military field	High, government and private sector solve mainly societal needs and problems (like the development of desalination technology)
General level of technological progress and Science infiltration into society	Low	High	Lowest	Highest
CULTURE				
Global culture homogenisation	Highest	High	Low	High but wise, diverse and accommodating
Individualism v. community focus	Individual	More community	More individual	Community
Indigenous culture and heritage retention	Eroded by conflicts	Retained due to less conflict	Eroded, Resentment by young population	Retained with the least conflict
REGIONAL INTEGRATION & COOPERATION				
Type, level, and rate	Medium to slow rate, market driven with a focus on trade,	High to medium rate, policy driven,	Lowest level of integration, disintegration of state along religious and ethnic lines	Highest, policy driven integration at a fast rate
HEALTH & ENVIRONMENT				
General Status	Medium	High	Low	Highest

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Demography	**Population growth rate and total number of population**			
	• Population will continue to increase but at a slower growth rate than at present due to many factors (education, awareness, and economic factors). However, the growth rate will continue to constitute a core development problem as it will continue to exceed the rate of development • The total population will continue to negatively impact the environment, the economy, natural resources development and capacity (particularly water and arable land) in addition to food self-sufficiency. • Government population policies and programs will not be effective in controlling national population growth due to dominant cultural and religious beliefs. However, they will be relatively effective in controlling and reducing foreign migration to the region and substitution programs for national labour.	• Effective population policy will include the planned substitution of foreign labour, family planning, and will be designed to be on pace with the development rate for different economic and service sectors. • In the short-term, the total population will continue to negatively impact the environment, the economy, natural resources development and capacity. In the long-term, however, population growth will be rationalized to meet the available resources and the policy's socio-economic objectives. • Government population policies and programs will not be effective. Challenges to controlling national population growth will emerge due to both cultural and religious factors. However, they will be effective in controlling and reducing foreign migration and substitution programs.	• Highest fertility rates due to ignorance and poverty as well as government policy to promote population growth to feed wars and disputes, and the absence of measures to control such growth. • High adult mortality due to wars • High child mortality due to impoverishment and lack of proper health facilities • Migration outside the region due to conflict resulting in population internal displacement and an increase in refugee pressure and number. • Migration of Arab brains and depletion of such human resources • Increase morbidity and epidemics • emergence of enclaves and tribalism	• Population growth is slowed and size of population is proportional to resource availability and socio-economic development • Foreign labour force will be regulated in GCC • Integrated population policies implemented
	Population age group distribution			
	• The young will continue to dominate the population structure with tendency towards population aging (due to a slowdown in population growth), which will continue to stress natural resources, environment and economic development and will increase the poverty level, and social unrest due to unemployment problems.	• Population will continue to be young with a growing tendency towards population aging • More job opportunities for the young in labour-intensive fields (services, tourism, IT, knowledge-based industries)	• Unbalanced population structure, mostly of young and elderly generations, due to migration and adult mortality • Increased female/male ratio • Uneven geographic distribution of population due to ethnic conflicts • Increased stress on natural resources and the destruction of native habitats due to poverty and displacement pressures	• Balanced age pyramid
	Urbanization and population distribution			
	• Rapid, unplanned/planned urbanization as a natural consequence of economic growth which will continue to	• Continued urbanization, but with better planning, control and management (better services and development of	• Increased urbanization pressures due to uneven distribution of public services	• Better management of geographic population distribution • Best managed urbanization

Annex A: Arab region driving forces				
	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Demography	increase. Despite its positive social benefits in terms of employment and easier access to educational and health services, it will continue to have negative environmental and health consequences in terms of air pollution, increase in locally-concentrated waste production (liquid and solid), encroachment on limited agricultural and recreational lands, insufficient basic health care, sanitation, and infrastructure facilities • High population concentration (in rapidly growing cities) will continue to increase and generate larger amounts of waste causing health and environmental problems and economic losses	rural areas and urbanization of non-capital centres). • More and effectively planned urbanization and zoning. • Protection of limited agricultural lands. • Decentralization policies dominate. • Better management of waste (integrated waste management). • Vertical expansion	• Shantytowns and low living standards create pressures on limited urban service systems with negative environmental impacts • Unemployment pressures among urban population (migration away from urban centres in situations of conflict)	• Planned expansion of cities in the region • Improving quality of life in rural areas resulting in slowing down of migration to cities and possible reversal of the trend
Economic Development	Economic development			
	• Economic growth will continue to grow in most of the economic sectors without or with limited strategic sustainable planning that takes into account the environment and resource capacity • Negative impacts on the environment and natural resources continue. • GDP increases and the average per capita rises but many are not equal to PPP.	• Growth will continue but with a more even distribution of wealth • Overall GDP as well as PPP increase • Strategic sustainable planning that takes into account the environment and resource capacity	• Decline of economic growth due to disruption of economic activities by conflicts and wars • Low standard of living and high poverty and unemployment rates • Increased income inequalities • Low social and health spending because of resources diversion to war and security • Increased exploitation of natural resources to meet the requirements of war and security, leading to adverse impacts on the environment • There may be a temporary surge in economic development with focus on military related investment spending	• Achievement of substantial economic development • Economic growth continues at a slower rate than under Market First, with better distribution of wealth, and with minimum impacts on the environment
	Single-sector dependent economies			
	• Plans to diversify the economic sector – including sources of income – and the move to other sectors, such as industrialization,	• Environmental and health risk assessment, regulations, and enforcement minimize negative environmental impacts	• Symptoms of conflict-shattered economies spread like rationing of goods, black market, underground economies, smuggling, monopolies, shutdowns	• Rational economic diversification that affects population composition • Wise/optimal utilization of resources • Control of resource utilization

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Economic Development	manufacturing, services and tourism, will continue to limit the negative impacts of fluctuation of the international market prices that accompany a single sector economy. This will improve overall development through improved national budget planning. This will/could negatively affect the environment in terms of natural resources stress and pollution as economic activities expand.	• Economic integration (see globalization vs. regionalization below) of the countries in the region to maximize productivity, better use of resources and rational investment	• Lack of diversification leads to depletion of exhaustive resources and overexploitation of relatively abundant ones with critical impacts on the environment • Lack of incentives to encourage private investment and the flight of national capital • Decline of export oriented industries and growth of import substitution manufacturing	
	Debt burden, foreign trade and investment			
	• Debt burden will continue in most countries while in some countries it will stagnate and decrease, (debts will continue to negatively impact investment and the overall economy and environment). • International economic aid and loan flow will continue to be based on political interests and regional conflicts instead of real needs, leading to limiting the overall development and adversely affecting the environment	• Debt burden will decrease in the long term. • International aid and cooperation will be facilitated as a result of the economic reform policies adopted by the countries.	• Acute balance of payment • Problems due to sluggish exports and increased imports of military equipment. • Increased national and foreign public debt to finance security related expenses, negatively impacting socio-economic development. • Decline of foreign investments due to domestic instability and corruption. • Foreign exchange problems • Increased political debt	• Debt burden is minimized through economic integration of the countries in the region.
	Economic policy reforms (Structural adjustment and foreign and national investment, etc.)			
	• Structural adjustments, privatization and financial investment will continue to expand. This will have a positive impact on the economy (employment, quality and productivity, influx of national and foreign investments, tax revenues and national budget) and the environment in terms of giving governments an opportunity to control and regulate environmental pollution by the private sector in addition to creating laws to make resource use more efficient.	• Structural adjustment in line with social priorities • Policy reforms include equity sharing among stakeholders • Effective, enforced policy and guidelines to minimize negative environmental impacts and alleviate resource stress • Economic policies have regulations to facilitate investment and at the same time to increase job opportunities for nationals. • Improve labour movement within and amongst the regions.	• Extractive government policies favouring military spending at the expense of social and development spending. Priority is given to security at the expense of economic and environmental policies • Restrictive economic policies lead to inflation and recession • High tax rates to finance government budget deficit directed to security and military spending • Control of economic activity by the public sector, leading to inefficiencies, corruption, and rent seeking activities	• Efficient economic policy reforms will lead to equality among social groups • Environmental policies override other policies in the decision making process, leading to better environmental conservation

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Economic Development	• However, this will also have negative social impacts in terms of job loss and on available natural resources in terms of stress due to expanded investment. • In this scenario it is envisaged that investment policies will over-ride environmental policies aimed at protecting the environment and sustainable use of resources. • Subsidies for services will continue to be abolished gradually, which will have a positive impact on government revenues, and will also improve the environment in terms of waste reduction and conservation of natural resources, which will enhance sustainable development. However, this could be accompanied by social unrest at certain stages.	• Subsidies on services will continue impacting the environment negatively. The challenge to the government is to incorporate an awareness policy to bring public cooperation/ awareness.	• Weak incentives discourage the participation of the private sector in economic development • Ad-hoc planning and crisis management-like policies within governments; corrupted officials driving the economic scene • Colonial economic policies geared towards short-term exploitation of natural resources • Protectionist type of trade policies and foreign exchange controls	
	Globalization versus Regionalization			
	• Arab countries integrate into the global economy; however, it will be slow and will happen under a regional and inter-regional economic bloc (GCC countries for example) or partnership (Mediterranean basin countries). This will impose greater need for capacity building, and will increase economic opportunities. • Culturally, "westernization" will continue to dominate the area eroding the national and regional identity, increasing consumerism, materialism, waste production, etc.., while at the same time impacting positively on productivity, awareness, public participation and environmental commitment.	• Stronger regional integration among Arab countries and their integration as economic blocs in global economy • Increased access to global information while at the same time enhancing national values	• Disintegration into tribal, religious or ethnic structures • Citizens congregate around tribes, not around state, forming fragmented societies • Regional conflicts increase over shared resources • State of siege and isolated economies (like Iraq and Libya) and increased economic pressures as a result of international sanctions. • Non respect for international agreements and non implementation of ratified treaties. • Minimum integration in global markets due to conflicts and tensions	• Full economic integration among the countries in the region with greater economic participation in global economy (build regionally and trade globally) • Preserving local culture while accepting global culture • Countries of the region are members of WTO

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Economic Development	**Industrialization**			
	• Industrialization will continue to expand and will continue to impact air, marine, freshwater resources, land quality, human health, and fish stock, with limited capacity to alleviate the negative impacts of such industrialization.	• Strict industrial waste management and planning. • Cleaner production. • More consideration for environmental health impacts.	• Under security pressures industrialization is not geared towards society needs but to security needs • Self-sufficiency drives industries to focus on import substitution • Emergence of dirty industries with negative impacts on environment	• Well planned expansion in industrialization taking into account health and environmental impacts, land use zoning, etc. • Indigenization of the appropriate high • added value technology with low negative impacts.
Human Development	**General human development**			
	• Human development will continue with health and education programmes and economic development and will have a positive impact on the standard of living, poverty alleviation, and awareness, resulting in increasing stress on resources and the environment. • Though human development has generally improved, there are still great disparities within Arab states and in the Arab society in general.	• Health, education and other public services improved • More concentration on reducing the impact of human development on resources and the environment	• Human development indices rankings will decline, with negative impacts on poverty and economic well-being	• Better health, education, and other vital public services to human well-being (provision of clean water, safe food, sanitary services and the control of chemical hazards) while reducing human development impacts on the environment and resources.
	Gender inequality			
	• Gender inequality will decrease with time, but not to the point where equity is achieved in the field of employment. However, this will have a positive impact on human development and population growth in general (decrease in fertility rate). Overall environmental awareness will also increase.	• Gender inequality will continue to decrease and it will have a positive impact on human development and on population growth in general (decrease in fertility rate), leading to an overall increase in environmental awareness.	• Due to conflicts, society becomes male-dominant, which leads to greater gender inequalities and discrimination against the female population	• Eradication of illiteracy among females and provision of full employment opportunities • Eradication of extreme poverty and hunger • Gender equality is achieved
	Brain drain			
	• It is increasing with time as a result of existing social inequality (job opportunities), low income, and lack of effective human resources planning. Brain drain will continue to have negative impacts on the development process and environment.	• Social equality reforms, eradication of ethnic discrimination and improving human resources planning slows down migration.	• Increased brain drain due to instability • Barriers to emigration depending on status and relation to the ruling institution. • Frustration over closed doors, leading to more instability.	• Brain drain is reversed, as better conditions are available at home and in the region • Economic integration of the region will create better job opportunities for professionals and scientists.

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Human Development	**Education level and quality**			
	• Illiteracy will decrease substantially by the year 2050 which will have a positive impact on the population growth rate, awareness, environment and resources. • Quality of education will continue to improve and will be market-oriented, but will not satisfy the required needs of the market.	• Illiteracy to be eradicated by the year 2050; MDG goal #2 will be achieved (universal access to primary education is to be met by 2015 by all countries in the region). • Education quality is improved to meet the needs of the market.	• Illiteracy rates increase • State control over education • Low quality of public education • High dropout rates • Security and army related type of education and training.	• Quality of education is enhanced through new paradigm • Equal education opportunity is realized.
	Environmental awareness			
	• On the whole, concern about the environment gradually increases, coupled with gradual improved appreciation of the nature of linkages between environment and development. • Social and financial constraints limit the extent of effectiveness of these trends. • Strengthened status of environmental management in governmental departments.	• Strengthened status of environmental management in governmental departments. • Environmental education will be included in most of the curricula at all levels. • Widespread legal rights of citizens to sue for environmental damage. • Media programmes will be utilized to increase public environmental awareness. • Promoting environmental citizenship. • Empowering the role of NGOs	• Loss of environmental awareness because environment is not a priority • Overlooked linkages between environment and development • Weak environmental governance	• High level of environmental awareness will be achieved at all levels of society • Environmental education will be realized and strengthened • NGOs play an effective role in the decision making process on environment
	Traditional government support system			
	• In general, traditional government support system is breaking down gradually. While this will have a positive impact on efficiency, it will cause social instability, unless it is accompanied by programmes for alternative job opportunities (job rehabilitation) and subsidies for the poorest sectors of society.	• Socio-economic reform policies include effective programmes offering alternative job opportunities, taking into consideration the poorest sectors of society.	• Governmental socio-economic support gradually decreases in society. • Support will be available only through political and security apparatus	• Balanced socio-economic programmes and better corporate social responsibility (green private sector)
Science and Technology	**Expenditure in R&D**			
	• Currently negligible and likely to remain so • Research will be driven by the private sector and focus on activities that can be commercialized	• Integrated environmental protection is considered • Research and development geared towards efficient use and conservation of resources (especially water)	• Low research and development spending • Spending is geared towards military and security research (warfare research and development)	• Increase research funding to 2 per cent of the budget of the Arab states • Environment will benefit from clean technology development

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Science and Technology	(rather than environmental and socio-economic priorities) – likely to result in a worse environment		• Research and development will not abide by ethical standards • Less investment in improving natural resources systems • Weak institutions and lack of security standards , thus leading to unsafe disposal of hazardous industrial waste	• increase spending on research and development of environmentally sound technologies • Greater role of universities and research centres (science-based communities)
	Information and Communication Technology, (ICT)			
	• Use of IT will continue to increase and play a major role in society, which will have a positive impact on overall human and economic development. This will increase innovation and general awareness in environmental fields. However, this might also have a negative impact on the environment, in terms of waste (especially when highly poisonous waste is produced like e-waste), as well as a negative social impact.	• The language barrier will be surmounted • Higher awareness of the likely environmental and social negative impacts.	• These technologies are mainly applied in security and military institutions.	• Complete integration of ICT throughout society and activities with controlled social and environmentally negative impacts • Major breakthrough in research resulting in high productivity with low resources use • National and regional capacities in the field of environmental information are enhanced resulting in better communication and dissemination of information
	Biotechnology and genetic engineering			
	• Research and application of biotechnology will increase with time, due to resource overexploitation and the need for food increase, which will gradually reduce water use in agriculture, increase productivity, improve health and life expectancy (medical application of biotechnology) as well as increase and affect population age distribution. • Little concern for possible negative environmental impacts – a situation that is likely to change with time.	• Better consideration for possible negative environmental impacts resulting from biotechnology applications.	• Interest is not geared towards application of biotechnology. • GMOs are largely imported regardless of their negative impacts.	• Wide and rational application of beneficial uses of biotechnology in food production, health, and the environment. A major breakthrough is achieved in research resulting in high productivity with low resources use. • Safe handling and movement of GMOs will be achieved (full implementation of Cartagena Protocol on Bio-safety) • Socio-environmental consequences of GMOs use will be controlled
	Advances in water desalination and treatment technology			
	• Research in desalination and water treatment will advance with time, as water resource scarcity increases (taking place outside Arab countries),	• Alternative technologies and enhancing measures are undertaken to reduce impact on air and marine environment.	• Interest is not geared towards application of this technology or its negative impacts.	• Major breakthrough in desalination technology leads to cost efficiency with minimum environmental impacts

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Science and Technology	which will cause a gradual reduction in the unit cost of desalination and treatment, and make it affordable to all countries in the region. However, while this will increase available usable freshwater resources, desalination will have a negative impact on marine and air environment.	The decreased demand on water as a result of reduced population Growth – compared to the Markets scenario – alleviates these impacts.		• Major improvement in water treatment technology leading to increased use of recycled water without major environmental problems.
	Advances in clean renewable energies			
	• Research and use of alternative cleaner renewable energies, such as solar energy (which is abundant in the region), will not advance as long as fuel energy is abundant. Environmental pollution will continue in the region.	• Investment in alternative energies (solar, wind, marine etc.) to replace fuel energy. This will lead to a greater share of clean renewable energies (particularly solar), reducing environmental pollution and decreasing global warming, as well as prolonging the life of fuel reserves in the region.	• Entire reliance on fossil fuels and lack of interest in clean renewable energies.	• Investment in alternative cleaner renewable energies will result in gradual replacement of fuel energy by the year 2050, having a positive impact on the environment and resources
	Technology implementation and environmental management standards in industry			
	• Technology implementation and environmental management standards in industry will continue to expand in the area, which will increase productivity and competitiveness at the global and regional levels. This will increase the national income and produce cleaner industries.	• Regional enforcement of cleaner technology use and the application of environmental management standards	• Negligence of environmental management standards	• Integrated environmental management
Governance and Institutions	**Public involvement and participation**			
	• Public participation will continue to increase with time, which will lead to sound and sustainable decision making and stakeholder involvement and awareness. However, it is not anticipated that this participation will be enough to impact major decision making.	• Greater consultation and participation of the public in the decision making process	• Authoritarian system, with very limited public participation • Absence of rule of law • Prevalence of customary laws • More centralization of the decision making process • Clientele and corruption • Minimal accountability and transparency	• Full participation of the public in the process of decision making with increased transparency and accountability • Capacity building is adequate

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Governance and Institutions	**Centralization**			
	• Decentralization will move slowly, impacting the decision making process, and public participation. • Civil society participation will still be ineffective	• Decentralization to take effect at the local level for better and more sound decisions and local participation	• Centralization • Least public and civil society participation of the scenarios; authoritarian system	• Appropriate decentralization
	Accountability and transparency			
	• Will not increase at a very slow pace	• Accountability and transparency will increase	• Minimal accountability and transparency	• Most accountability and transparency of the four scenarios
	Implementation of multilateral environmental agreements (MEAs)			
	• Very limited implementation	• Implementation of multilateral agreements (MLAs)	• Non respect of MLAs, particularly environmental agreements negatively impacting environment.	• Integration of MEAs in national policies and the decision making process
Culture	**Traditional customs and life style**			
	• western culture is spreading within the region	• Western culture is spreading and attempts are made to preserve local culture	• Isolation • Enclave cultures • Follow traditions by default not by choice • Adoption of western lifestyles as a protest against status quo	• Western culture is spreading and attempts are made to preserve local culture
	Tribes and social heritage			
	• There are some indications that show that these inherited structures are dissolving with time. However, these are not conclusive. Culture will continue to be a major driving force controlling the development of the society	• Gradual democratization and dissolution of existing tribal/social structures	• System encourages social and tribal inherited life styles	• Democratization and complete dissolution of existing tribal/social structures
Environment	**Water availability, demand, and quality**			
	• Water stress will continue to increase with time as water demands will continue to exceed available limited water resources (due to population growth and expansion of different development sectors). This will lead to deterioration of water resources quality,	• Strategic water resources management to increase water use efficiency by different instruments in addition to water resources augmentation	Same as with the Markets First scenario but even worse as shown below: • Severe stress on water quality and quantity due to displacement pressures and conflicts • Loss of biodiversity due to conflicts and overexploitation of natural resources and main environmental habitats	• Stabilizing water resources per capita by controlled population growth and efficient water resources management and allocation • Water sources protected from pollution

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Environment	• competition increase among sectors/users, land deterioration, reduction in food production, and aggravation of water-related health problems.		• Food demand surges due to shortage and self-sufficiency policies along with isolation from the international markets • Conflicts over shared water resources • Increased vulnerabilities to starvation and droughts	
	Biodiversity			
	• Although the area and number of protected lands are increasing, the destruction of habitats and ecosystems as well as overexploitation of resources will continue as a result of human pressures and activities.	• Increased protected areas to reflect habitat variation and reach the international requirements • Initiation of botanical gardens and zoos • Effective use of gene and seed banks • Utilization of biochemistry to conserve genetic resources • Use of aqua-culture as a solution to solve ever-increasing fish demand • Well studied programmes of ecosystem rehabilitation • Policies for conservation outside the protected areas.		• Similar to the Policy First scenario • Biodiversity conservation and sustainable use of its components as well as equitable sharing of benefits arising from biodiversity technology
	Shared water resources			
	• Equitable sharing of water resources among riparian countries will remain unresolved, increasing tension and instability in the region.	• Bilateral and multilateral agreements for shared water resources are achieved, enhancing the stability of the countries and providing opportunity for long-term planning.		• Shared management of surface and groundwater among riparian countries.
	Food demand and food security policies			
	• Food demand will increase and food security will decrease with time as population growth continues while water, land, and marine resources remain limited. Imports of basic food items will increase causing a trade deficit, and environmental deterioration. • Improved farming practices	• Strategic food demand management • Increased pace of the introduction of improved farming practices and improved technologies through research and development • Better regulation for food safety. • Agricultural production will be rationalized to meet the limited national resources.	• Subsidies are offered to encourage local agricultural production as self-sufficiency is high on political agenda. This leads to intensifying agriculture, land degradation in addition to depletion and loss of water resources used in land irrigation.	• Investment in non-traditional hi-tech agriculture to overcome the problem of water and land scarcity • Regional cooperation and integration among Arab countries and other areas based on comparative advantage in agriculture solve the problem of food security

Annex A: Arab region driving forces				
	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Environment	(including new non-traditional agricultural methods, such as soil-less agriculture) to optimize water and land use will emerge due to scarcity of water and limited arable land. However, it will mitigate the problem of food shortage, but not solve it. • Agricultural production geared towards export to increase foreign currency, which will increase the use of agricultural inputs, water stress, and export of (virtual) water.			• Good balance between local production and production for export, making use of comparative advantages. The theory is that natural resources enhance agricultural production. • Sustainable production and consumption patterns are achieved
	Land Use			
	• Arable land will continue to be lost due to expanding urbanization (accompanying population growth) and soil salinity (accompanying irrigation water quality deterioration). • Land transfer will continue to dominate as urbanization and growth of economic sectors increase. • Continued encroachment of services on land around population centres • Allocation of land for waste management, etc.	• Land-use planning to protect arable land resources, the slowing down of land transfer		• Land-use planning in strict effect • Rehabilitation of degraded lands • The spread of green cities • Implementation of the integrated land management strategies taking into consideration MEAs
	Climate change and climate extremes (drought incidents)			
	• The Arab region is greatly affected by climate change due to lack of interest in vulnerability studies and development of adaptation policies and programmes. • Recurrent drought incidents will exacerbate water scarcity and food production problems, and will expand desertification. • Sea-level rise will have negative socio-economic impacts on the coastal areas in the region.	• Better prediction, monitoring, and management to mitigate drought impacts and undertake precautionary measures. However, as the impacts of climate change are global, policies to mitigate climate change shall incorporate regional and international concerns.		• Adoption of proper adaptation policies to alleviate vulnerability to climate change. • Application of a clean development mechanism yielding cleaner and more efficient utilization of oil and natural gas. • Full implementation of UNFCCC (Kyoto Protocol) provided developed countries do the same. • Carbon sinks are developed.

Annex A: Arab region driving forces

	Scenario 1 Markets First	Scenario 2 Policy First	Scenario 3 Security First	Scenario 4 Sustainability First
Regional Conflicts and Political tensions	**Political conflicts, tensions and armed conflicts**			
	• They will continue in the region, and will negatively affect the economy, the environment and overall development.	• Adequate policies will tend to strengthen the internal political fabric of the Arab region, contributing to a decrease in internal conflicts. However, the region will remain vulnerable to external influences, mainly caused by continued occupation.	• Internal and external conflicts will continue to exert pressures on economic resources and environment.	• Ending conflicts in the region based on equitable and just solutions, including the termination of occupation and elimination of threats of aggression and intervention in the internal affairs of countries. • Reduction of military spending and directing it towards sustainable development and building the Arab citizen
	Instability			
	• Instability will continue to occur as democratic systems are not fully established and inherited tribal structures continue to dominate leading to the dissatisfaction of deprived or politically competitive groups. This will impact development and the environment	• Implementation of democratic systems will reduce instability		• Implementation of full democratic systems

In these scenarios, a distinction is held between economic growth and economic development. The term "economic growth" refers to the rise or growth of a number of indicators such as real national income, Gross National Product (GNP) or the per capita income. When the GNP increases, it is referred to as "economic growth". On the other hand, the term "economic development" means much more than this. It often refers to an improvement of a number of indicators like illiteracy rates, life expectancy and poverty rates. There are several definitions for "economic development", among the most common is: "It is a process that ensures the achievement of a high growth rate for the average per capita income during an extended period of time (three decades for example) provided that it is not accompanied by deterioration in income distribution or an increase in poverty level in society." The GNP is one of the specific measures for economic welfare. However, it does not take into consideration important aspects such as spare and leisure time, quality of environment, liberty or social justice. Hence, "economic growth" is an inadequate definition for "economic development".

Section Five

Environment for Development: Our Common Future

Chapter 12: Policy Options

Chapter 12

POLICY OPTIONS

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Main messages

- Rapid population growth and unbalanced economic development in the Arab region are among the main pressures to which environmental resources are exposed. Both have become burdens on the environment, due to the shortcomings of population policies and natural resource management policies in many Arab countries. The ensuing chronic environmental problems and their far reaching impacts on the economy and human health surpass the present generation.

- The Arab region is characterized by weak environmental institutions despite the variation in economic conditions, resources and infrastructure among Arab countries. These institutions need to be empowered, upgraded and their capacities built. In addition, a comprehensive, integrated, clear and effective legislation should be introduced and environmental issues incorporated into the overall development process. Building strong institutions is a pre-condition to shifting successfully from sectorial work and policies to cross-sectorial policies which could limit degradation of resources and achieve balanced and sustainable development.

- There is slow progress toward environmental reform which does not match the socio-economic development process. This is due to the shortcomings in environmental policies, institutional weakness, lack of public awareness, weak environmental knowledge base as well as market defects including government subsidies and interference in prices. Despite some improvements in environmental issues in the Arab region and a marked increase of environmental compliance during the past ten years, the region is still facing developmental and environmental challenges such as continuous depletion of natural resources, weak institutional capacities, and malfunctioning of legislative frameworks, particularly in dealing with issues equally important as security and peace. Environmental degradation will cause harm to the interests of this generation and will have extensive impacts on future generations unless bold and effective reform steps are taken to surmount these challenges.

- It is imperative to adopt a strategic approach aimed at improving the quality of life of the Arab citizen and warding off the threats of environmental problems. This can be accomplished by implementing strategies that aim at improving Arab environmental performance by taking measures that radically deal with environmental problems, change patterns of production and consumption and stop the depletion and degradation of natural resources. Strategies should also embrace the participatory approach as a code and consolidate better environmental practices. It is essential to adopt and widen the scope of successfully proven environmental policies and customize their implementation tools (such as those related to management of renewable resources) as a model that can be replicated and used to design future programmes. Moreover, it is important to adopt policies capable of changing environmental management structure to ensure incorporation of environmental policies in the decision making process. It is also necessary to look for new funding sources by building partnerships and encouraging the private sector to play a pivotal role in the social development process. This is to be accomplished by creating more job opportunities, adopting the social responsibility concept and environmental responsibility perception through financing environmental action and taking initiatives to integrate environmental considerations into its operations.

- Shifting to a green economy has become a strategic option from the economic and environmental perspective. The environment is the basis for development; therefore, there is a need for a comprehensive Arab development programme to restructure institutional infrastructure and environmental legislation, and adopt strategic structural solutions. This should be done in a way that ensures investment in the Arab citizen to achieve the aspired transformation toward development and environment. Opportunities should also be taken to benefit from renewable environmental energy sources such as solar and wind energies as well as compete to develop them. This in turn demands generous expenditure on applied research in this field. In this context, Arab initiatives for sustainable development and decisions released by the Arab Economic Summit in addition to the Arab national and local initiatives form the basic elements of the policy framework and a recipe for sustainable development across the Arab region.

- The government plays a pivotal role in the legislative and legal systems and in the enforcement of laws. This alone is not sufficient; other instruments are needed to complement the regulatory tools in order to encourage protection of the environment, such as the use of financial incentives, economic tools, increased awareness, training and education. It is also important to provide an environment which allows the creation of sound environmental opportunities by encouraging competition and specialization, improving chances to obtain environmentally safe technology and including modern tools, such as environmental expenditures, in .calculation costs.

Introduction

The previous chapters have referred to the environmental issues and challenges facing the Arab world and the continuous efforts of many Arab countries to achieve sustainable development based on sound socio-economic and environmental foundations. Some Arab countries suffer from water scarcity; as per capita water is decreasing and many Arab countries are complaining of water shortage. Degradation of land resources is rising sharply as seen in the decrease of land area, weak productivity, soil erosion, desertification, and degradation of rangelands. Signs of desertification are evident in different parts and ecosystems of the Arab region. Desert sand dunes are encroaching on oases and inhabited areas. Biodiversity has declined due to degradation and shrinkage of habitats to the extent that in many cases they have become districts or industrial, commercial or agricultural complexes. Biodiversity also lost ground in many of its natural widespread areas and was replaced by other alien species causing economic and environmental losses. Degradation has often affected the type and quality of resources. Data may show no change in rangeland area and an increase in forests, but in reality the quality of these resources has become so low that they are unable to provide good quality products or services.

Throughout the past 30 years uncontrolled population growth, coupled with unbalanced economic growth, has led to great discrepancies between urban and rural settlements and migration of rural populations to the big cities and industrial areas in search of job opportunities. These populations have settled within belts or informal areas, which has led to the erection of random or shanty housing, weighing hard on municipal services. Additionally, ruralizing of cities is a phenomenon that has added to the already existing problems of cities. Pollution has affected many Arab cities such as Cairo, Damascus, and Beirut, polluting the air and contributing to a large percentage of pollution at the national level.

Climate change is high on the global agenda and is casting shadows on the economic and environmental situation in the Arab region, which is the region most affected by climate change and its implications.

While Arab socio-economic development initiatives topped national efforts, many environmental considerations were overlooked, allowing environmental problems to create serious challenges to the people of the region. This has necessitated taking swift measures to minimize and mitigate their negative impacts in a bid to improve the Arab citizen's standard of living and provide promising opportunities for future generations.

Although current policies do not contribute largely to the protection and sustainability of resources, sustainable development is not an improbable target and can be realized at all levels through the adoption of good governance policies which include curbing population growth and adopting economic policies that can be integrated into environmental situations.

This chapter reviews existing environmental policies in Arab countries described in previous chapters and tries to link the current environmental situations with the ensuing success or failure of such policies through reviewing aspects of success and failure and determining their inherent causes. This is accomplished by means of reviewing and linking environmental policies with the pressures which led to the current state of environmental problems. This chapter also tries to anticipate future environmental action, its potential tools and conditions for success.

Environmental policy responses

Policy background

The Arab region is facing many challenges and pressures which threaten the sustainability of its natural resources and consequently undermine the potential for socio-economic development. This puts the whole region at risk for socio-economic and environmental degradation. The adjusted net savings index (as a percentage of the gross national income) registered negative figures in many Arab countries compared to the gross savings index (as a percentage of the gross national income). This indicates a regression of opportunities and wealth available in these countries as a result of the ineffective management of natural resources and unbalanced development (UNDP 2009).

While management of the environment at the national level has improved throughout the region, local initiatives fell short of fulfilling their goals as limited decentralization of the legislative and financial authorities posed a key obstacle to the formulation, financing, and implementation of local agenda 21 for sustainable development .

Today, countries are still suffering from limited capacities to achieve integration among social, economic, and environmental dimensions, and prioritize key issues for presentation to national forums in order to gain legitimacy. Participatory approaches are often discouraged by cumbersome bureaucratic procedures and political and security constraints. This means that national sustainable development policies do not necessarily represent local priorities. Consequently, there is a disconnection between the local and national sustainable development efforts that is echoed in national, regional and global linkages and should be better organized so as to reinforce one another.

In Arab countries, economic development is prioritized at the expense of environmental conservation. This has led to failure of environmental policies, taking into consideration that environmental organizations are weak bodies that are seen as special interest groups that often lose out in battles related to environmental policies. Another complicating factor is the non-enforcement of environmental legislation due to many constraints, including insufficient administrative cadres, limited competencies, domination of executives over administrative bodies as well as weak government protection of its organizations.

Despite the increased interest in providing necessary information to support sustainable development in the region, insufficient environmental data has limited the capacity of decision-makers to make sound decisions based on criteria and indicators of environmental situations. This has undermined the efforts exerted to improve environmental situations. The shortcomings of environmental policies have led to the aggravation of simple environmental problems, while others were exacerbated. However, some policies did meet their targets, especially those dealing with specific environmental issues, such as city waste and safe potable water, but fell short of resolving more complicated environmental problems such as biodiversity loss, desertification, and air pollution of cities. This is due to the interlinkage of these issues starting from the directives and pressures they cause to failure of response measures to tackle such directives and pressures since they are confined to procedures which mitigate impacts and alleviate sufferings. There is a need to change environmental management methods including policy drawing, decision making and integrating environmental policies and strategies into the national development strategies.

There are several obstacles still hampering Arab environmental policies, foremost among which is the inability of these policies to provide the needed support to the community partnership-based approach and to consolidate achievements of the sustainable development process. Moreover, the institutional structure is still unable to guarantee integration among all parties concerned with socio-economic development policies and programmes in most countries of the region. There is also a need for an executive body to formulate policies and oversee their implementation in a participatory manner.

In most Arab countries environmental policies do not tackle problems related to institutional capacities, and linkage between national strategies and environmental policies are not clear. Moreover, absence of priorities has prompted governments to distribute their limited resources on a wide range of environmental initiatives without clearly considering cost effectiveness and urgent priorities. In addition, environmental policies depended basically on laws and regulations, giving less attention to the use of economic tools to protect the environment or to adopt effective approaches to measure the environmental impact of different policies and decisions. As a whole, a big share of environmental problems facing the region is due to mismanagement, insufficient capacities and minimal public expenditure on environmental problems (ESCWA and the League of Arab States 2007).

Policy gaps and constraints

Environmental policies have institutional, legislative, organizational, educational and cultural tools. Environmental policy frameworks in the Arab region suffer from weakness related to policy formulation and objectives. This has led to the aggravation and exacerbation of some existing problems. The following will examine the main problems these policies experience.

Institutions

During the past thirty years environmental institutions in the Arab world have evolved from environmental units, departments in ministries, agencies or cross-sectorial councils concerned with pollution, human health and other specific issues to independent institutional entities often with executive competencies backed by national legislations. This transformation from a "municipality to a state" was a considerable achievement which was assisted by the growth of global environmental concern, particularly following the UN conference on human environment in 1972. The conference called for the setting up of appropriate national institutions at state level to organize and manage environmental resources to improve the quality of the environment. This paved the way for the establishment of national environmental frameworks around the world, including Arab countries.

However, the structure of these institutions could not match the challenges of environmental management and sustainable development in the region. Environmental institutional arrangements in the Arab region (including several sectors of different ministries) remained incapable of dealing with various issues, particularly when it came to sustainable development matters as these institutions lacked adequate planning capabilities. They continued with the same arrangements as a legacy of sectorial planning and implementation, which did not lead to effective governance of sustainable development issues (UN-ESCWA 2005).

The period of the 1990s and the convening of the conference on Environment and Development (1992) witnessed the restructuring of environmental departments to catch up with the new global environmental thought and its new governance. Several international environmental conventions appeared at the same time such as conventions on biodiversity, climate change, and desertification. Environmental management expanded to encompass environmental impacts resulting from development and hence the responsibilities and tasks of environmental institutions also expanded to tackle problems which were under the jurisdiction of other ministries. However, despite these transformations, the new environmental frameworks remained unqualified to deal with the expansion of the scope of environmental issues from a multisectorial perspective.

Within the framework of tackling sustainable development issues, national consultation committees for sustainable development were established in order to encourage institutional coordination between ministries and government agencies. Restructuring of institutions was consolidated following the Johannesburg Summit in 2002, yet the structuring is still changing. Syria for instance was one of the first Arab countries to set up a state ministry for environmental affairs in the 1980s, but after ten years the ministry was dissolved and the general authority for environmental affairs, the technical arm of the ministry, was placed under the guardianship of the ministry of local administration and environmental affairs. Last year, the ministry was restored under the same title.

During the past three decades, environment ministries and authorities were consolidated and improvements were introduced to the environmental management field. Achievements of these environmental institutions included: developing laws and regulations, setting criteria and improving the capability of formulating environmental strategies and action plans, strengthening self capacity in collecting and monitoring data, improving environmental awareness programmes, and providing better understanding of global environmental issues such as climate change and biodiversity loss. However, much of their work was insufficient in the field of sustainable development in many Arab countries. Environmental institutions faced many challenges and obstacles, being fledgling institutions with big responsibilities to shoulder in comparison with other ministries of a specialized nature. Moreover, the continuous restructuring process of these institutions limited the stability of their working conditions besides their already limited authorities and budgets. In addition, these institutions are often considered second degree ministries or institutional frameworks whose role in solely conserving the environment is acknowledged by the national political institution while issues of sustainability and management of natural resources are considered the concern of other ministries.

The modest budgets also limit the capacity of environmental institutions to implement programmes, monitor environmental compliance and promote technical capacities. This resulted in the total or partial dependence on foreign financed projects. The inter-linkage between institutional competencies led to friction between environment agencies and ministries as well as duplication of work between them.

At the regional level, new institutions appeared during the past three decades which reflected changes in the conceptual framework concerning environment and development. Socio-economic regional organizations were set up in the 1960s and 1970s which reflected development in environmental thought that led to the establishment of several specialized regional centres and institutions. The first of these was the Council of Arab Ministers Responsible for the Environment (CAMRE) established in 1987, thus becoming the first official Pan Arab political framework for tackling environmental issues in the region. This was followed by the establishment of other organizations and centres for environment and development in different countries of the region during the 1990s, such as the Centre for Environment and Development for the Arab Region and Europe (CEDARE) and the Joint Committee for Environment and Development within the framework of The Council of Arab Ministers Responsible for the Environment (CAMRE) (see Box 1).

Legislation and compliance:

During the past three decades several decisions and laws dealing with conservation of the environment were issued. This legislation included several topics that addressed land degradation, scarcity of water, pollution, waste management and biodiversity conservation (El-Fadl and El-Fadel 2004, El-Gundy 2008). Arab countries depended more on legislative mechanisms than on market forces. However, with the development of environmental thinking, governments started to adopt economic tools as possible options. Most countries are currently applying tax and fee systems classified under many systems such as property rights, tax systems, environmental performance bonds and environmental responsibility, re-insurance and guarantee systems, and the setting up of markets. Moreover, economic and financial tools to control and mitigate pollution were used through giving incentives or placing obstacles.

In practice, environmental laws suffer division and do not take into consideration modern methods of resource management. This is due to centralization and restrictions imposed on local and regional legislative practices. Despite the slow and gradual transformation towards decentralization in some countries, this transformation has facilitated the

Box 1. The Council of Arab Ministers Responsible for the Environment

The Council of Arab Ministers Responsible for the Environment (CAMRE) is the regional mechanism which was formed to carry out coordination and cooperation among Arab countries regarding issues relevant to the environment and sustainable development. The establishment of this council by the League of Arab States in 1987 is considered a turning point in joint Arab action because the council acted as the first political forum to deal with environmental issues at the Arab countries' level. The council convenes periodically to discuss key environmental issues in the Arab region and focuses on sectorial issues such as water quality, industrial pollution, soil degradation, desertification, etc. The council now tends to discuss cross-sectorial issues, which is more appropriate to the process of heading toward sustainable development such as trade and development, public awareness, and compliance with environmental conventions. The council scored success in several domains especially concerning environmental issues at the global level, foremost of which was the Arab Ministerial Declaration on Climate Change in 2007, which defined preemptively Arab positions and policies.

The League of Arab States 1987

process of updating and enforcing new laws and regulations (El-Gundy 2008). This is because, in many cases, environmental laws are both inclusive and ambiguous, and are therefore controversial and debatable, which impedes sound environmental performance (see Box 2).

Technology initiatives

Arab countries have adopted several initiatives to introduce and accommodate environment friendly technology. Most of these initiatives focused on mitigating pollution, depending on waste reduction and recycling to ensure combating pollution rather than transferring it to other parts of the environment (Abu-Zeid 1998, World Bank 1995). They also introduced measures to conserve energy and increase its efficiency in industrial and commercial sectors as well as other technological approaches to improve water use efficiency and reduce its loss (Abu-Zeid 1998, World Bank 1995). Technologies for mitigating pollution in industrial complexes, especially the modern ones, were also introduced. However, the depreciation and obsoleteness of industries and their dependence on government's direct and indirect subsidy led to limitations in adopting cleaner and more effective industrial technology.

At present, new initiatives, accompanied by privatization and structural adjustment programmes, are being prepared to encourage environmentally friendly activities. These have been introduced through the "cleaner and more resource-efficient production" approach which aims at the continuous improvement of industrial products and processes through reducing the consumption of raw materials and energy, thus reducing pollution. Some countries have introduced pollution prevention programmes through preparing processes for industrial and municipal inspections, while applying cleaner production approaches in the newly established industrial complexes. Energy conservation and efficiency measures have also been introduced in the industrial and commercial sectors in many countries. However, there is a need to adopt clean processes and renewable energy technologies on a larger scale. In general, the cleaner production approach was not widely adopted in many Arab countries due to lack of financial resources,

Reem Borhan

Box 2. Environmental legislations in the Arab region

Reasons for the ineffectiveness of key environmental legislations in the Arab region are as follows:


Maged Mahmoud

- Inflexibility of legislations to match rapid developments in different aspects of life led to large scale and diversified impact on environmental activities, hence the need for appropriate legal tackling of the issue.
- Duplication of tasks related to environment, resulting in lack of clarity in approving the text that has to be adopted.
- Duplication of the work of institutions dealing with environmental affairs resulting in interference and dispute of competencies, in both monitoring and implementation.
- Insufficiency of sanctions included in the legislation texts due to lack of deterring power parallel to the volume of environmental violations.
- Inefficiency of legal texts and failure to tackle many of the new environment-related developments.
- Lack of autonomy in the work of environmental institutions as they do not deal with the environment dimension only, but with other government activities which consume much of these environmental institutions' effort and time.
- Lack of specialized cadres in institutions concerned with environmental management which results in the loss of administrative and scientific references.
- Environmental affairs organizations often lack a monitoring authority over their work, whether public, private, or NGOs, to follow up the application and enforcement of legislative texts concerning the environment.

restrictions on obtaining such new technology as well as weak application of rules and standards regarding pollutants.

There is an absence of integrated Arab policies in the field of technology transfer and customization as initiatives are confined to limited and separate programmes and lack interlinkage at the national and regional levels. Among such initiatives is the introduction of hybrid vehicles in some Arab countries like Jordan and the expansion programmes to replace old vehicles in Egypt. Other countries started diversifying and implementing initiatives for generating solar and wind energy as in Jordan, Egypt, Tunisia, Syria and Morocco. The initiative of "Masdar" city in the UAE is one of the most important national Arab initiatives for developing renewable energy technologies.

In Arab countries, weakness in the field of technology, particularly environmental technology can be attributed to factors related to the political, social, economic, administrative, academic and organizational systems surrounding the scientific research process and technology development. The traditional structures and frameworks which are the basis for building national technological capacities such as universities and research centres are not equipped to implement science and technology policies effectively and build a national renovating system. Technology production requires updated structures that include all factors that encourage scientific research and creativity. Despite the existence of many traditional structures in Arab countries, their roles are confined to meeting basic requirements and are generally exhausted with administrative and institutional burdens as well as shortages of highly qualified national cadres.

Important issues required for success of technological initiatives and adoption of environment-friendly technology: human resources development; institutional strengthening; administrative systems upgrading; development of legislations and systems; generous expenditure on scientific research; support of research initiatives; development of the educational process; and implementation of alliances between the concerned national, regional and international agencies. There have been some promising initiatives in some Arab countries which have aimed at narrowing the differences between producers and investors of scientific knowledge and technology such as the Mubarak City for Scientific Research and Applied Technology, the Technological Incubators Programme in Egypt, the Technological Incubators Project in Kuwait, Information Technology Garden in Jordan, the National Project of Incubators and the Communication Technology City in Tunisia (ESCWA 2003).

Awareness and public participation

Policies which deal with environmental issues require public participation to ensure cooperation, communication and sustainability. Although environmental policies and plans in the region lack sound strategic vision, governments were the first to pay attention to environmental problems. However, public participation is still very low (CEDARE 1998).

With few exceptions, NGOs play a weak role in environmental conservation due to the fact that they are funded by the government and are thus subjected to the bureaucratic governmental system. Independent NGOs face the risk of losing their funding unless income generating mechanisms are adopted that are not controlled by the government or donor agencies. Moreover, some of the constraints and limitations which face NGOs in the region are the enormity of environmental problems and the fragmented structure of national environmental management systems (Djoundourian 2007).

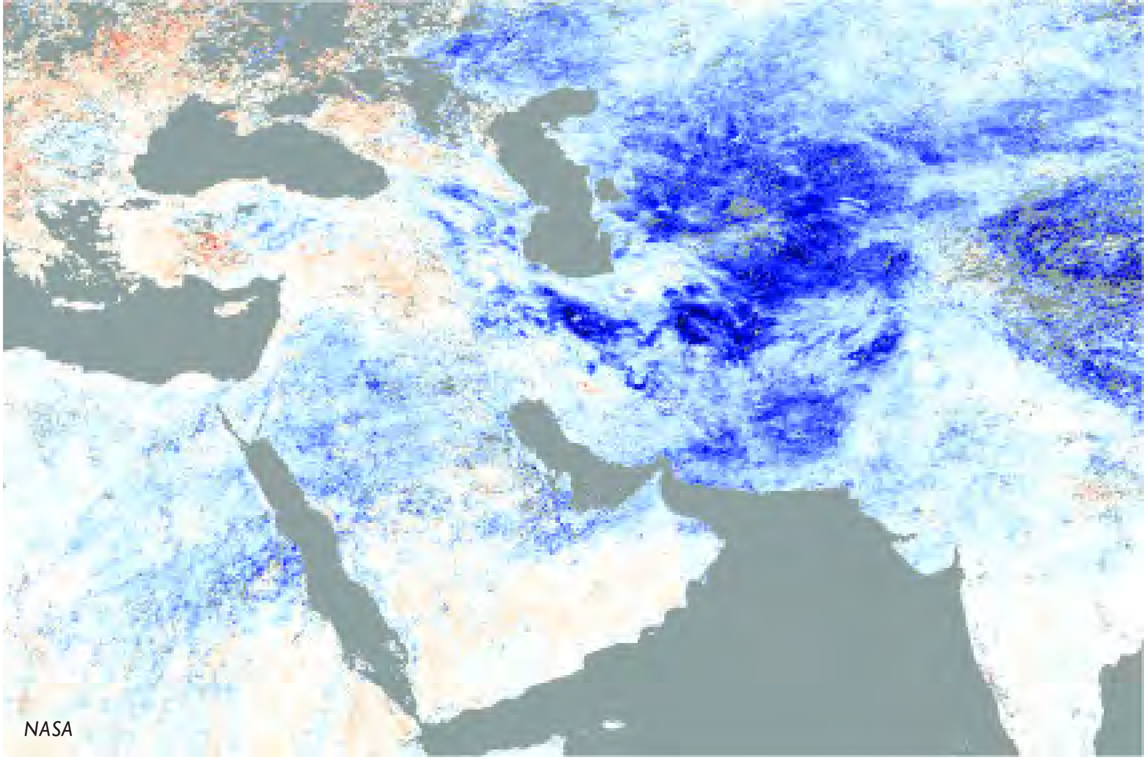
NGOs and other civil society organizations in the Arab world have grown and developed during the past years and have started to assume a very significant role that can be influential in development and environmental protection. Accordingly, it has become imperative to engage them in all phases of environmental policy formation, management and decision making by involving their representatives in environment committees and board of directors. It is highly important to make use of these organizations to raise environmental awareness and disseminate environmental culture among all categories of society.

Environmental culture/environmental education

Most Arab countries launched environmental culture and education activities in the 1970s and 1980s. The majority of these countries included environmental issues in the school curricula and officially declared their adoption of these activities (CEDARE 1998). The environmental culture curriculum was included as a co-subject in many courses at the primary and secondary school levels. However, the environmental culture approach witnessed variation between the countries of the region. Their informal activities included different mass media programmes designed to help people become aware of the value of natural resources and the ecological processes which protect them, in addition to the possible threats to the environment such as degradation of these scarce resources. These programmes also underlined the mismanagement of resources which caused significant socio-economic losses and encouraged the masses to do whatever they can to improve environmental management.

Environmental information

The Arab region's interest in environmentally sustainable development created an increasing interest in integrating environmental information into the decision making process. However, this was faced by lack of consistent environmental information and methods of presentation, hence appeared the need for collecting, processing, analysing, producing and disseminating environmental information in a systematic way. The biggest challenge lies in the issues of information and data availability, accessibility, effective coordination and standards, and the networking mechanism to facilitate exchange of information.



The cold wave that affected south east Asia and extended to the Arabian Peninsula in January 2008. Temperatures in blue begin from -20

The lack of an organized framework to supply the required data limits the value of the environmental information, hence appears the need to put in place a framework for organizing the collection, analysis, and presentation of environmental information, and to link this information to decision making needs, taking into consideration the geographic dimension. This approach should specify data gaps and duplications and help prepare new data to fill these gaps. There is also a need for a unified framework for sub-areas for the development of an environmental information system.

Another major problem which hampers the use of environmental information is the institutional aspect. Most institutions have not institutionalized the information management process and the use of clear frameworks which define the roles of beneficiaries and the flow of information within the one institution and across other agencies, even in those institutions which have built a strong technological infrastructure. Hence, top priority should be given to the issue of improving the management, accessibility and use of information.

Indeed, there are gaps, shortcomings and differences in the environmental indicators between one group and another, and one environmental issue and another. For example, we find more data regarding status, causes and environmental trend indicators than those dealing with environmental responses. Moreover, some environmental issues have greater data availability than others.

Policy implementation and tools

National context

The key challenge facing most decision-makers in the Arab region is achieving integration among policies; such as, how to realize effective drafting, integration and implementation of sustainable development policies in different sectors, taking into consideration that this matter requires coordination

Box 3. Ensuring environmental concurrency – trends and good practices

The following trends may consolidate efforts aimed at ensuring compliance with environmental laws:

- Focusing on strategic planning and performance assessment depending on indicators derived from outputs.
- Integrating systems of permission and compliance such as control and inspection systems in all sectors.
- Increasing attention to encourage compliance, especially of small and medium enterprises.
- Giving priority to monitoring compliance of enterprises which have harmful environmental impact and those whose compliance is uncertain.
- Transferring the monitoring responsibility from the authorities concerned to the organizational authorities and encouraging internal auditing within the companies to monitor compliance.
- Allowing enforcement to be proportionate to non-compliance while resorting whenever possible to administrative and organizational measures rather than imposing sanctions.
- Strengthening cooperation, transparency, disclosure of information by stakeholders to ensure accessibility of data by the masses.
- Capitalizing on opportunities provided by information technology to improve organizational efficiency, reduce administrative burdens to facilitate obtaining licenses, self-monitoring, preparation of reports and setting up data bases.
- Analysing reasons for non-environmental compliance in order to improve policy designs and regulations with the aim of

and consultation between government institutions. It also requires taking supportive measures and consistent policy tools currently applied by different ministries. Centralization and division of the environmental management system in different countries led to aggravation of problems. For instance, the national environment agencies in the region in general assume the responsibility of drafting and implementing the sustainable development policy which leads to intensive sectorial bias regarding sustainable development and less involvement and commitment of the economic and social ministries to articulated sustainable development targets. This practice by dual responsibility institutions underplays the importance of the problem since the environmental institutions in the region do not generally represent a focal point in the governments' decision making process and are also unable to influence the ministries concerned. Moreover, there is limited communication between stakeholders and authorities responsible for implementing and overseeing enacted legislations and those related to sustainable development. This explains the reason for the ineffective application of environmental policies.

It is worth underlining that the region has depended entirely on legislative mechanisms (control and command) rather than economic tools and voluntary arrangements. It has also used the environmental impact assessment as an effective and precautionary tool to assess impacts of projects. However, this measure often remained nominal and in many other cases was complementary to the process of obtaining environmental licenses for projects (see Box 3).

Box 4. The multi lateral international conventions - support and financial mechanisms

While implementing the multilateral environmental conventions is the responsibility of the state, in practice not much blame is laid on the governments as to the degree of their application of these conventions. It is also worth mentioning that there are so many complications in the mechanisms of these conventions that it is difficult to benefit from one specific mechanism. The clean development mechanism can be cited as the most obvious example to demonstrate the bureaucracy and complexity of these mechanisms. Out of 1 946 projects supported by the clean development mechanism, the Arab countries got only 19 projects, which is less than 1 per cent of the total projects registered at the mechanism compared to 16 projects for Israel, 680 for China and 474 for India. In this context, changing the donor agencies pattern of work, simplifying their bureaucratic requirements, offering additional training and programmes for strengthening local capacities and local government may lead to far reaching tangible results.. It is important to provide financial and technical support to different countries and remove obstacles that hinder technology transfer as stipulated in these conventions so as to encourage the countries' compliance.

(Bankobeza undated, UNFCCC Secretariat 2010)

During the past two decades, most countries of the region have applied environmental policy tools such as direct saving by the government. Some Arab countries applied tools to realize public-private partnership such as the public partnership initiative, and partnership between the public and private sectors. However, other instruments such as using the markets and creating new markets are not completely used by Arab countries and need more in-depth exploration.

The international and regional context

Arab countries have shared the international community's environmental concerns through their participation in international debates regarding environmental problems and multilateral and regional environmental conventions. The number of conventions joined by Arab countries indicates a positive trend toward commitment to the requirements of MEAs. However, the level of commitment is modest due to the insufficiency of qualified human resources and limited financial resources both of which often hamper drawing implementation strategies (Al-Yusuf undated).

Most countries focus their efforts on classifying the state of the environment, preparing institutional frameworks and extending the tasks of existing institutions to implement MEA commitments. The countries continue to focus on priority studies, implementation of individual pilot projects, preparation of strategies, and development of national action plans and programmes. But very little of these are implemented in practice as is the case with the Convention on Biodiversity and the UN Convention to Combat Desertification. On the other hand, the implementation level for the ozone convention was higher due to international attention, and is reflected in the provision of financing and capacity building as well as the provision of a system for monitoring and publishing reports.

The "command and control" approach was the most favored approach in implementing the different MEAs. This is evident in the environmental laws and ministerial decisions that have been issued or are still being issued, taking into consideration that the economic tools or other political instruments which rely on the market were not given sufficient attention. So far, the economic tools used to facilitate effective implementation of MEAs are still not well developed in the region. However, there are some countries, like Egypt, which are currently designing economic tools to combat industrial pollution. Sudan follows the same approach based on control and command together with planning to raise fines and taxes imposed for non-compliance with environmental laws. There are other tools such as strategies to offer incentives, taxes and fines, pricing and other indirect measures which are only applied on a few MEAs like the ozone convention, and the UN Framework Convention on Climate Change (see Box 4).

The implementation of regional or bilateral agreements by Arab states does not differ much from international ones because the roots of the problem which hinder implementation are the same. Added to that is the instability of relations among states and with neighbouring countries, especially regarding shared resources where the issue of sovereignty poses a major problem in all parts of the region. However, there are success stories which cannot be ignored. The Arab Initiative for Sustainable Development and the Arab Ministerial Declaration on Climate Change represent two cases of joint political responses by Arab countries toward global environmental issues of local roots. In these cases, interlinkages and support between global MEAs and regional organizations were taken into account to improve enforcement mechanisms.

The Arab initiative gave priority to three fields, namely: integrated management of water resources, land degradation and desertification prevention programmes, and marine resources and coastal zones integrated management programmes. The projects are currently being determined in cooperation with relevant Arab and regional organizations. The Council of Arab Ministers Responsible for the Environment (CAMRE) adopted the Declaration on Climate Change in December 2007 in recognition of present and future interlinkages between climate change, the Arab citizen's welfare and sustainable development. This was also an attempt to accommodate MEAs at the regional, national and local levels. However, it has to be acknowledged that any arrangements or regional initiatives fail to achieve their objectives unless their roots strike deep down in the national institutional fabric.

Future policy framework and options for action

A Strategic approach

It could be generally said that interlinkages between the institutional system in the Arab world and governance is weak. Developing and institutionalizing these relationships may improve chances of developing comprehensive policies, building stronger and more sustainable partnerships and increasing regional and national cooperation, in addition to realizing the Millennium Development Goals (MDGs). The first step lies in institutionalizing the decision making process which leads to positive results while engaging civil society organizations, the private sector, and citizens in the policy making process, environmental management and decision making. Environmental policies have succeeded in solving many conventional problems, especially where technical solutions have been available. However, relatively speaking, they did not tackle multi-level environmental problems or problems of several sources and impacts such as the high concentration of greenhouse gases, biodiversity loss, accumulative pollution of the soil and groundwater, and increased impact of hazardous chemicals on human health. These problems were not subjected to large scale improvement and in some cases the resulting impact was irreversible (UNEP 2007).

Failure to effectively address these problems has hindered efforts seeking to resolve conventional environmental problems. Many Arab states have laid several strategies and plans for environmental action, but they were rarely incorporated into the context of general strategies for socio-economic development. The reason is that general strategies are materialized on a sectorial basis without consideration to natural resources. It therefore becomes necessary to change the pattern of work and shift to an alternative approach which primarily depends on natural resources, and calculate the cost of an alternative opportunity when planning the use of these resources. In that sense, the planning process would focus on the optimum use of resources. It is impossible to start planning on sectorial basis and expect to get a sustainable development plan. In this context, Arab countries should double the use of economic instruments in addition to legal tools, while providing necessary conditions and chances for everybody before applying "command and control" tools.

It is imperative to adopt a strategic approach to upgrade the quality of life of the Arab citizen and ward off the risks of aggravated environmental problems by developing a strategy aimed at improving Arab environmental performance. This can be achieved by undertaking measures which treat the roots of environmental problems, change patterns of production and consumption, stop depletion and degradation of natural resources, embrace the participatory approach as a code and consolidate best environmental practices. To achieve all this, there should be a shift from an economy that depends on export of raw materials or import of polluted, energy consuming industries to a creative economy. This requires radical measures in the field of finance, insurance, scientific research, and technical and higher education to match international levels, in addition to building cadres and setting up high-level logistics and mechanisms. Measures should also include managing and making known knowledge-building processes through investing in information and communication technology to link national and international economies.

Arab countries should therefore adopt a more advanced and wider planning approach which allows for participation and ensures the representation of all stakeholders when studying or examining an issue, drawing a plan or taking a decision to guarantee some sort of consensus on the issue, objective, or purpose as well as alternative implementation mechanisms. They have to benefit from the participatory mechanisms in building partnerships to ensure successful programmes and

Box 5. project for developing El-Darb El-Ahmer District—Pioneer experience and proven solutions

The project for developing El-Darb El-Ahmer district, which is situated in the heart of Old Cairo, represents an example of an optimum tested solution aimed at protecting cultural heritage and benefiting from it in the architectural design of urban areas, taking into account the use and sustainability of resources and environmental protection. The project was implemented by an initiative from the Agha Khan Foundation, Egyptian-Swiss Development Fund, the German Reconstruction Bank, Ford Foundation, and Cairo Governorate. The priorities of the project were set with the citizens' participation. The project's components included training, environment conservation, primary health care, maintenance and rehabilitation of houses, restoration of Islamic antiquities such as Cairo's historical wall, restoration of houses, and waste recycling. The project's environmental rehabilitation work included digging, leveling and soil treatment, as a garden has been established on the ruins of tonnes of waste accumulated over hundreds of years in this location. The garden today has become a distinguished landmark in Cairo which combines historical heritage and environmental conservation.

LAS 2005

Box 6. Environment sustainability and sustainable development are part of a whole

Achieving environmental sustainability requires integrating principles of sustainable development into national policies and programmes to stop the degradation of environmental resources. Several measures are recommended to this effect, foremost among which are:

- Integrating management of environmental resources into poverty alleviation strategies and national development plans
- Accommodating the millennium development goals at all levels so as to reflect priorities in the region and in every country.
- Institutionalizing the participation of stakeholders, including civil society organizations and NGOs in decision making and monitoring of environmental resources.
- Consolidating coordination mechanisms between departments and institutions in matters relevant to monitoring natural resources.
- Encouraging the use of renewable energy resources for domestic and industrial purposes equally, allocating resources for the purpose of developing cleaner fuel technology as well as adopting the appropriate means and economic incentives to consolidate the use of such technology.
- Taking the appropriate measures to mitigate land degradation and desertification and restructure land ownership to protect and sustain the use of its resources.
- Integrating the environment budget into the national budget since the cost of environmental resources degradation is higher than the cost of investment in management and conservation of the environment.
- Setting up sustainable development councils with the highest level of executive competencies to consolidate environmental sustainability and socio-economic sustainable development.
- Strengthening and developing technological programmes to capture and store CO2 while consolidating cleaner production

projects. They should also adopt a participatory initiative because imposing a fait accompli will not achieve the purpose. This approach should provide accountability and transparency, and here the role of non-profit organizations such as voluntary organizations becomes apparent as they have the capacity to hold government institutions and private sector companies accountable and are linked to the heartbeat of the street. This approach should also be expanded to include all trends and movements, and allow channels for the implementation of instant and tangible investments. It should be efficient and effective and focus as a whole on human rights and principles of good governance. The new approach relies firstly in adopting and expanding the scope of proven policies and secondly in adopting policies that can cause structural change at all levels which places the environment on equal footing with all other pillars of sustainable development.

Expanding the scope of proven policies

There are some effective policies available. The proven success of an environmental policy in a region or country can be taken as encouragement for other countries to deal with their deeply rooted environmental degradation. Accordingly, the scope of policy application tools should be gradually expanded with more emphasis being placed on economic instruments, information, communication, and voluntary approaches. Governments will need to continue in their application of "strong tools" such as "command and control" regulations to guarantee effective policy implementation. The challenge lies in finding the tool or a combination of tools that are more effective in implementing a policy related to a particular environmental problem and with a certain geographic or cultural context. There has been a wide range of success factors that have been demonstrated as important in best practice policies. These include solid science underpinning the policy, high-level political will, multi-stakeholder involvement and willingness to engage in dialogue with policy opponents, etc. (Dalal-Clayton and Bass 2002, Volkey and Others 2006) (see Box 5).

Transformative policy options

Promising transformative policies

There are many promising policy options that demonstrate the power of innovative policies to effect structural changes needed to resolve urgent environmental problems. Policies that are applicable to Arab countries should be adopted. They include the following:

- Environmental taxes: a small portion of tax returns can be allocated for implementation of measures regarding the protection of the environment and maintenance of its resources.
- Minimizing, re-using, and recycling: recycling plays an important role in protecting natural resources against exploitation, limiting problems resulting from pollution, and providing financial resources for local communities and companies. The implementation of this policy was a success and an example of tested environmental policies in various countries.
- Shifting towards green economy through cleaner production programmes and turning to alternative energy sources.

The position of the environment in the core of the decision making process related to development

The environment in Arab countries is often treated as another sector to be balanced against other social objectives rather than providing the foundation on which life depends. Indeed, there has been tangible but modest progress in moving environmental considerations to the core of socio-economic decision making in many Arab countries. The following matters should be considered by Arab countries to place the environment in the core of the decision making process:

Integrating the environmental dimension into development plans

The responsibility of integrating environmental policy into other policies in the Arab region is currently borne solely by environmental agencies. However, experience has proven the difficulty of effectively intervening in the policy domain of other departments; hence, some countries have transferred the responsibility of incorporating environmental concerns to the sectors themselves. This means that governmental departments (concerned with industry, energy, agriculture, etc.) should be responsible and accountable for their environmental performance (see Box 6) (UNEP 2007).

Assessing the environmental impact of projects

Assessing environmental impact is one of the most successful tools of socio-economic development. It is an appropriate tool for integrating environmental concerns into other sectorial policies including assessment of the environmental impact of projects and effects of legislation and policies. However, the use of this tool varies from one Arab country to another and is less harmonized between countries themselves, which causes environmental dumping and competition risks (El-Fadl and El-Fadl 2004).

The strategic environmental assessment

Strategic environmental assessment is a high level measure applied to policies, plans, programmes, and projects. This evaluation offers a way to circumvent preparing and implementing inappropriate plans, programmes, and projects, and helps outline alternatives as well as define accumulative impacts. There are two types of assessment: sectorial strategic environmental assessment and regional strategic environmental assessment. It is an effective tool for incorporating environmental concerns into sectorial or cross-sectorial planning (OECD 2006).

Decentralization and delegation

Another innovative approach to integrating environmental concerns in the decision making process is the inclusion of environmental objectives in control systems. One of the key lessons that can be drawn from existing examples of decentralization and integration is that decentralization of environmental responsibility leads to increased transparency regarding environmental performance and the policies of different sectors. In this context, there should be a change in governance mechanisms to provide decentralized services in authority and responsibility through giving competencies to lower administrative levels and separating policy from service provision (Hood 1991).

Institutional development and capacity building

Environmental ministries alone cannot assume the responsibility for the environmental management of natural resources or sustainable development. The participation of a group of ministries, authorities, councils, committees, and civil social organizations becomes necessary while the environmental ministries serve as focal points and coordinating tools capable of effective response. This requires reducing bureaucracy, building cadres to improve coordination among ministries and institutionalizing the consultative process. In this context, focus should be laid on strengthening and enabling the existing institutional frameworks to undertake a qualitative change in restructuring institutions and their work mechanisms as well as linking the existing institutional frameworks with the highest level in decision making process.

Government institutions at the local level should be enabled to lay and implement policies effectively with the support of specialized technical cadres, experts and administrative bodies to execute the various tasks entrusted to them.

Conditions for successful implementation of a new environmental policy framework

Integrated planning and programme implementation

- National sustainable development strategies and action plans should be better integrated into existing sector-based work programmes.
- Partnerships between relevant stakeholders from the public and private sectors should be encouraged to participate in decision making during the planning and implementation process.
- Public participation should be promoted by raising awareness through disclosure and dissemination of information.

National and local linkages

- Local and national priorities for sustainable development should be considered and streamlined.
- Sustainable development strategies and action plans should take national and local priorities into consideration.

- Local capacity for policy formulation and implementation should be improved as should local accountability and financial autonomy.

Supervision and accountability

- Institutions and individuals should be transparent and accountable for their performance and ability to achieve stated goals and pre-determined work programmes.
- National councils for sustainable development should be established to coordinate strategies and policies, and create mechanisms to monitor and assess progress towards achieving sustainable development targets based on publicly determined indicators.

Need for supportive measures

Implementation of policies requires a supportive and enabling environment which provides suitable conditions for implementing, monitoring, and assessing policies as well as measuring the progress towards targets. Redefining these targets is a priority. The following sections examine some of these measures.

Redefining the targets:

There are several obvious issues in dealing with environmental degradation such as population growth, urbanization, pollution, depletion of natural resources, increased consumption, globalization, and others. However, there are several risks threatening the Arab region, foremost are climate change and its negative impacts on land and water resources, biodiversity loss, increased natural risks, sea-level rise, inundation of low lying lands, in addition to occupation, internal conflicts and others.

As seen from what is said above, threats and worries do not come together in the sustainability of man's life, but many of them are entrenched in such things as ethics, truth, goodness, and beauty. Environmental management is usually set up on a scientific basis to calculate and assess impacts resulting from activities and in few cases pays attention to socio-economic impacts. The foundation of the Arab civilization was built on important factors such as ethics, conscience, and other lofty human principles upheld by all religions and which should be included in the environmental management process, environmental awareness and education. The Arab region would not be able to achieve integrated environmental management without including natural sciences in such environmental management. There are strong links, for example, between environmental management and geographical science, which focus on a framework for solving problems between man and his surroundings. It is also difficult for environmental management to understand transformations in ecosystems without reverting to the history which interprets changes in positions, behaviour of individuals and decisions. Without an in-depth understanding of the past, it would be difficult to imagine the future.

Environmental management should expand to include stakeholders such as non-governmental organizations, central and local government institutions, and other international parties in order to tackle complicated issues and balance different needs which are often contradictory. This means initiating debates and discussions which should be characterized by comprehensiveness, integration, frankness, truth, legitimacy, honesty and sincerity so as to be able to exchange ideas and opinions. Acceptance of others and listening to others can help individuals and groups to focus on problems, rather than positions, and resorting to objective criteria and finally proposing alternatives so that decisions released regarding a specific issue would be acceptable to all parties.

Arab environmental management should help achieve sustainable development which would affect the welfare of present and future generations. This is particularly important since some politicians and activists are well aware of threats and risks of global environmental changes such as climate change and the need to protect wildlife, water resources, marine and coastal environments, land resources and others. Accordingly, it is imperative to reconsider the definition of goals and objectives temporally and spatially by following the renaissance scenario with its subsequent institutional transformations and additional mechanisms such as economic tools, and the reliance on elements of good governance and human rights as the basis for environmental action.

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Environmental awareness, education and training

There is a close relation between environmental awareness and understanding of key environmental issues on one hand, and formal and informal environmental education on the other. Awareness is a prelude to sound environmental action since resolving environmental issues depends on public awareness, understanding and support. It is also the basis for policy formulation and expanding participation in decision making, thus mobilizing public support to implement these policies. Accordingly, the commitment of Arab governments to protect the environment is linked to their efforts in the field of environmental awareness, training and education in their institutions, civil society organizations, academic and research institutions, the private sector, industry and media.

Strengthening emerging organizational principles:

Experience over the last few decades from initiatives at the global, regional, national and local levels to address environmental and inter-sectorial issues demonstrates some generic principles for public policy formulation and implementation (UNEP 2007). These include:

- Decentralizing power to lower levels of decision-making where it is more timely and meaningful.
- Transferring authority to other stakeholders who have relative advantage, stake and competence in assuming responsibility.
- Strengthening and reinforcing the normative capacity of agencies operating at a higher level.

- Supporting and facilitating the active participation of women, local communities, and vulnerable groups.
- Strengthening the scientific base of understanding ecosystem mechanisms and identifying their capacity.
- Applying an integrated ecosystem monitoring approach.

Diversifying environmental management tools:

Environmental economic assessment and the economic cost of environmental degradation and rehabilitation should be included in the environmental policy by revising the prevailing Arab economic system in dealing with natural resources. This can be done by adopting two main economic principles: 1) he who pollutes the environment should bear the cost of its rehabilitation ("the polluter pays") and 2) whoever uses natural resources should pay their value to society ("the user pays") (see Box 7).

Monitoring and evaluation

It is necessary to know if the set goals and objectives are being met. Not only is monitoring needed, but also regular assessment and evaluation in terms of effectiveness of policies is important. Only a few developed countries have conducted independent evaluation of their overall policy performance (Mog 2004).

Financing the environmental agenda

Expenditure on the environment in the Arab region varies from one country to another, but in general, each economic sector bears the cost of environmental management of the production and consumption of goods and services. Sources of funding are international, local, private or public, and can be in the form of shares and loans, bilateral or multilateral financing. Financing sources for Arab environmental issues are very limited especially in non-oil producing countries due to the fact that government budgets are already over-burdened with demands to provide social services and invest in economic development programmes. The Arab region has not received a generous share of international aid because according to donors, the Arab region is rich in resources and many Arab countries are classified among the medium-income countries; hence, have no priority in official

Box 7. Economic tools

Economic tools are one of the most modern and most effective tools for environmental policy application. They aim at changing economic unit behaviour through including environmental costs by changing the incentive structure available for these units. The most used economic tools are emission taxes, charges on use, products, non-compliance, re-insurance systems, tradable quotas or licenses (trade in emissions), environmental performance bonds, environmental responsibility payments, grants, soft loans, licenses, discounts and tax exemption.

The advantage of economic tools lies in their lower total costs, social returns, and flexibility in realizing the environmental targets for decision-makers. However, their application should enjoy sustainability, feasibility, fairness, transparency, institutional enforcement capacity and matching with targets. There are several environmental problems which cannot be resolved by economic tools but only by the use of the "command and control" system. Hence, it is advised to merge both systems when implementing promising programmes for structural reform.

Many Arab countries are currently using economic tools. The ministry of environment and sustainable development in Tunisia, for example, is using a set of tools including the banking loans environmental line and Pollution Combat Fund, in addition to other economic privileges.

(OECD/EEA 2010, Rauf 2008)

development aid. This mistaken view ignores the fact that more than 25 per cent of the Arab population lives in countries that are classified among the LDCs and are therefore, in dire need of more development, aid and finance (see Box 8 and Table 1). It is worth mentioning that Egypt, Morocco, Tunisia, and Jordan topped the aid extended by the Global Environment Facility in 1991 and 2005 successively which did not exceed US$213 million (Abaza 2008).

In the Arab region there isn't an official source that determines the cost of pollution or the depletion of natural resources. Additionally, there isn't an official source of finance for environmental affairs except the budget allocated for environment ministries. Several Arab countries have set up national and regional mechanisms to raise the limited finance available for environmental programmes and activities such as: Egypt's Environment Protection Fund, Saudi Arabia's award for environmental management, Sheikh Zayed Bin Sultan Al-Nahyan's award, Dubai's international award for best practices to improve the living environment, and Prince Sultan Bin Abdel Aziz international award for water. Many Arab countries co-finance international development aid through financial mechanisms such as the Abu Dhabi Fund, the

Box 8. Arab development aid

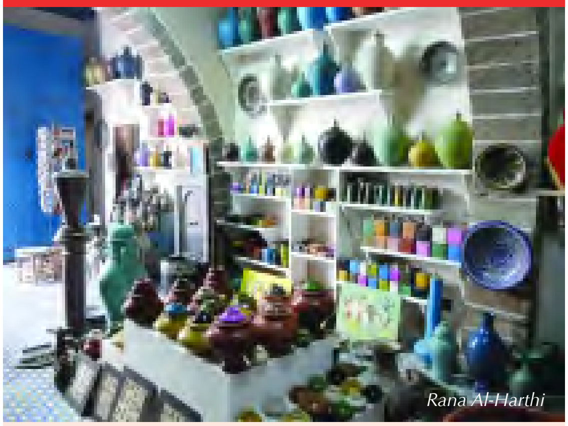
The Gulf Cooperation Council offered some US$13 700 million for development aid in 2000 and 2003. Saudi Arabia is the biggest donor as it contributes 58 per cent of the total aid. In 2003, it donated US$2 800 million, about 1.3 per cent of the Saudi gross domestic product (GDP), from a total of US$3 100 million. Kuwait and UAE offered US$82 and US$130 million respectively, while Qatar offered US$ 126 million as official development aid to developing countries. In 2002, Qatar's official development aid represented 0.7 per cent of its GDP hence the Gulf Cooperation Council's aid exceeded that offered by several major industrial countries.

(UN ESCWA 2005)

Table 1. Some financing organizations operating in the Arab region, financing priorities and priority areas

Organizations	Financing Priorities	Priority Areas
The Arab fund for economic and social development	Electricity, transportation, communication, agriculture and sanitary drainage, social services, work in minesrural development, water storage, sanitary drainage, social services, work in mines	Arab region
Saudi fund for development	Transportation and communication, social infra-structure, electricity, agriculture, industry, work in mines	Developing countries
Kuwaiti fund for Arab economic development	Transportation, electricity, agriculture, industry, water, sanitary drainage, communication, social services	Arab region
African Bank and Development Fund	Agriculture, transportation, multi-sector, energy, social services, finance, water, sanitary drainage, environmental management	African countries
OPEC fund for international development	Socio-economic development, water storage, sanitary drainage	Less developed countries
Gulf Cooperation Council	Political, economic and social affairs, strategicenvironmental policy issues.	Gulf Cooperation Council Countries
Arab Gulf Program for UN Development Organizations	Education, health, training, developing countries' institutional structure	Most needy
World environment facility	Biodiversity, climate change, international waters, land sustainable management (desertification, permanent organic pollutants)	Developing countries
Montreal multilateral Protocol Fund	Ozone layer depletion elements	Developing countries

Box 9. Environmental Protection Fund in Egypt



Rana Al-Harthi

The environmental policy in Egypt adopts several tools to realize its targets. In addition to fines clamped on violations according to the environment law, there are several incentive programmes for environmental compliance and commitment. For example, the Environmental Affairs Agency, in cooperation with the Ministry of Finance, offers incentives to establishments and owners of enterprises and projects that conserve the environment. The agency believes that providing a financial support mechanism to invest in the field of management and protection of the environment is the best method to face environmental challenges. Consequently, the Environmental Protection Fund was set up according to article 7 of environment law no. 4 for 1994 to encourage investments in the environmental sector. The fund's financial resources include fees for visiting natural protectorates, fines and compensations for any harm inflicted on the environment. The fund offers aid to environmental projects on a competitive basis. Beneficiaries of the aid include various sectors of the community and its organizations. The fund issues an annual plan specifying the nature of the financial support programme with details about the types and mechanisms of the support offered and centres of attention according to national environmental priorities. It also provides other financial support in the form of soft loans or grants to non-profit environmental projects provided that the receiving party contributes to the project's cost from its own resources.

(EEAA [undated] MEGACEM 2008)

Kuwaiti Fund, and the Saudi Fund which finance potable water and sanitary drainage projects in several Arab and Islamic countries (see Boxes 9 and 10).

Arab companies interested in financing environmental affairs and development initiatives are still few, while a big number of NGOs lack the capacity to mobilize resources and contact the donor agencies. However, there are several voluntary non-profit organizations which have succeeded in financing and implementing various environmental initiatives.

Protecting the environment and achieving sustainable development targets require vast resources; therefore, unconventional financial alternatives should be sought through encouraging the private sector and NGOs, as well as regulating government financial resources at the central and local levels. There is an urgent need to avoid placing additional financial burden on governments for financing environmental projects due to the critical financial position of most countries of the region. There are alternatives which can be helpful such as producing promotional products, encouraging environmental tourism, working with voluntary organizations, setting up environment funds, and benefiting from the carbon trade.

Rationalizing government expenditure is one method that can save financial resources for the government sector through more efficient government expenditure, especially the sums allocated for operation, wages, and projects which are implemented to meet a short-term political need regardless of the environmental, financial or socio-economic impacts. An important condition to reform the government expenditure is to have the political will, to follow good governance principles in decision making, to allow individuals and groups access to their resources, their future and their children's future. Other conditions include transparency, accountability, the rule of law, prompt response to the public's desires, reaching consensus on issues and work trends which give the public the feeling of ownership of environmental projects and

Box 10. Arab mechanism for environmental financing The Arab Environment Facility

The socio-economic accumulative targets of the Arab Environment Facility include the following:

- Promoting Arab qualifications and expertise, increasing job opportunities, hence limiting the emigration of youths and specialists.
- Increasing investments in the Arab region and the size of the environmental market which at present does not exceed 1.3 per cent of the global environmental market which is around US$700 000 million per year.
- Spreading environmental culture and enhancing cooperation in the field of environmental services in the Arab region.
- Encouraging and developing the private sector and the Arab environmental services market through assigning prominent and effective roles in implementing projects.
- Strengthening contacts with international and Arab authorities to finance Arab environmental projects.

The facility's membership is proposed to be formed of governments of Arab countries and partners from the different development funds and banks in the Arab region and Islamic world which would be represented in the facility's board of trustees. This would strengthen contacts between the facility and the Arab private sector. Its budget is expected to be US$30 million and to rise to US$300 million after one decade. The Council of Arab Ministers Responsible for the Environment (CAMRE) agreed in its 18th session (Algiers, December 2006) on the statute of the facility. The secretariat of the Arab Environment Facility at the Lebanese Environment Ministry drew the operational plan of the facility, which includes the administrative and financial phases for launching its operation. In July 2008, CAMRE agreed on the draft plan for the operation of the facility, and asked the Arab Summit to approve it. In September 2008, the Arab League Ministerial Council approved the facility's statute. In December 2008, CAMRE requested parties concerned with the environment in Arab countries to speed up signing and ratifying the facility's statute.

provide legitimacy and resources to the initiative to guarantee sustainable development as a whole.

The private sector needs incentives to encourage investments for environmental projects. It is therefore necessary to support frameworks and appropriate conditions so that Arab countries can set up markets for environmental projects. This can be accomplished through better use of development aid and official assistance in new partnerships between public and private sector companies which can attract financial flow to sectors that impact the environment, such as energy, water and land.

Sustainable development is hard to achieve without true, integrated, and coherent partnerships at all levels. Accordingly, it is important to identify roles and relations between partners. Building partnerships and integrating roles require following a system which eases administrative centralization by shifting authorities and competences from the centre to the sidelines and by giving freedom and flexibility to local authorities in management of resources and other matters. The government, for instance, can finance scientific research, support development initiatives, and promote technology compatible with local conditions. The private sector institutions can co-finance applied research and implement mega projects with the government sector. Non-profit institutions like voluntary organizations and NGOs can adopt some environmental projects, raise awareness about them, and mobilize local resources, expertise and donations, in addition to participating in monitoring and following up processes. They can also adopt scientific research topics and applications for development, environmental protection, and renovation.

Conclusion

The countries of the Arab region face a number of challenges and environmental issues in their search to achieve sustainable development.. Despite the challenges and inability of environmental policies to find solutions to some issues and tackle others, achieving sustainable development is not an improbable goal. Sustainable development can be reached at all levels through adoption of best governance policies for environmental issues, which include curbing population growth and following economic policies that can be integrated into the environmental situation. Arab countries can fill the gaps in environmental policies and environmental governance systems through: efficient use of resources, capacity building, generous expenditure on environmental issues and capitalizing on achievements in different fields while adopting best practices and benefiting from the experience of others. It is also important to effectively contribute to the global environmental agenda and implant environmental awareness in all domains and among all sectors of society as well as adopt best criteria and systems to achieve sustainable development.

It is necessary to adopt a strategic approach to upgrade the quality of life of Arab citizens and ward off the threats of aggravated environmental problems. This can be accomplished by creating a strategy aimed at improving environmental performance through measures that deal with the roots of environmental problems, change production and consumption patterns, and stop depletion and degradation of natural resources. Furthermore, the participatory approach should be embraced as a code, and best environmental practices strengthened. This new approach focuses on adopting and expanding the scope of proven policies and adopting bold practices that cause structural changes at all levels which ensure placing the environment on equal footing with other pillars of sustainable development.

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Acronyms and Abbreviations

UN-ESCWA	Economic and Social Committee for West Asia	CO	carbon monoxide
ACSAD	Arab Centre for the Studies of Arid Zones and Drylands	CO2	carbon dioxide
OPEC	Organization of the Petroleum Exporting Countries	CP	cleaner production
AIDS	acquired immune deficiency syndrome	Db	decibel
GEO-3	Global Environment Outlook 3	DFID	UK Department for International Development
GEO-4	Global Environment Outlook 4	DPSIR	drivers-pressures-state-impacts-responses
CEDARE	Centre for Environment and Development for the Arab Region and Europe	EG	Egypt
AFTA	Asian Free Trade Area	EMS	Environmental Management System
AGERI	The Agricultural Genetic Engineering Research Institute	EPI	Environmental Performance Index
AOAD	Arab Organization for Agricultural Development	ESI	Environmental Sustainability Index
AQL	air quality level	EU	European Union
BGR	The German Federal Institute for Geosciences and Natural Resources	EU MICE	European Union's Modeling Impacts of Climate Extremity
BOD	biological oxygen demand	E-waste	electronic waste
BTU	British thermal unit	FAO	Food and Agricultural Organization of the United Nations
CBD	Convention on Biological Diversity	GDP	gross domestic product
CFCs	chlorofluorocarbon compounds	GE	genetic engineering
CGEM	La Confederation Generale des Entreprises Du Maroc	GEF	Global Environment Facility
CHL	combined hydrocarbon lease	GHGs	greenhouse gases
CHM	Clearing House Mechanism	GISP	Global Invasive Species Programme
CIESIN	Centre for International Earth Science Information Network	GMOs	genetically modified organisms
CITES	Convention on International Trade in Endangered Species of Wild fauna and Flora	GTZ	The German Organization for technological Cooperation
CITET	Centre International des technologies de L'Environnement de Tunis	HDI	Human Development Index
CMPP	Moroccan Cleaner Production Centre (Centre Marocain de Production Propre)	HIV/AIDS	human immunodeficiency virus
CMS	Convention on Migratory Species	ICARDA	International Centre for Agricultural Research in the Dry Areas
CNG	compressed natural gas	ICT	information and communication technology

IPCC	Intergovernmental Panel on Climate Change
IPEN	International POPs Elimination Network
ISO	International Organization for Standardization
ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature
IWRM	integrated water resources management
LCPC	Lebanese Cleaner Production Centre
LMOs	living modified organisms
MA	Millennium Ecosystem Assessment
MAP	Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships. MARPOL is short for Marine Pollution
MDGs	Millennium Development Goals
MSW	municipal solid waste
NBI	Nile Basin Initiative
NCPCs	National Cleaner Production Centres
NEAPs	National Environmental Action Plans
NGO	non-governmental organization
NIPPP	National Industrial Pollution Prevention Programme
NIPs	National Implementation Plans
NOSCP	National Oil Spill Contingency Plan
NOx	nitrogen oxides
NSDS	National Sustainable Development Strategy
PCBs	polychlorinated biphenyls
PERSGA	The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
POPs	persistent organic pollutants
PPP	purchasing power parity
PTSs	persistent toxic substances
RAED	Arab Network for Environment and Development
RAMSAR	The RAMSAR Convention on Wetlands
ROPME	Regional Organization for the Protection of the Marine Environment
SCBD	The Secretariat of the Convention on Biological Diversity
SCP	sustainable consumption and production
SDC	Swiss Agency for Development and Cooperation
SEAM	sustainable environmental assessment management
SECO	the General Federation for Moroccan Institutions
SMEs	small and medium enterprises
SO2	sulphur dioxide
SRAP	Sub-regional Action Programme
SSC	Species' Survival Committee
SSR	self sufficiency rate
TCP	Technical Cooperation Programme
U5MR	under-five mortality rate
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
WCPA	World Commission on Protected Areas
WRI	World Resources Institute
WTO	World Trade Organization

Glossary of Terms

Multilateral Environmental Agreements (MEAs)	Conventions, agreements, protocols and contracts between a number of countries on activities related to specific environmental problems
Gross Domestic Product (GDP)	Annual Indicator of economic performance and market value of all end services and commodities within the boundaries of the state
Global warming	Changes in the surface air temperature, referred to as the global temperature, brought about by the greenhouse effect which is induced by emission of greenhouse gases into the air.
Dry lands	Lands which are characterized by lack of water which hampers two major ecosystem services: primary production and foodstuff recycling. There are four kinds of dry lands: hype-arid, arid, semi-arid, and sub-humid. Generally, this definition applies to all lands whose aridity index is less than 0.65
Wetlands	An area of swamps, peat, mud or water. It could be natural or artificial, permanent or provisional. It comprises stagnant or current, fresh or semi-saline/saline areas including seawater whose depth in low tide areas does not exceed 6 metres
Overuse	The use of raw materials regardless of their ecological impacts in the long term
Sustainability	The state or condition where needs of local population are met without compromising the needs of future generations or population in other areas.
Hugo framework 2005–2015	Building nations' and communities' capacities to handle disasters. It underlines the necessity of adopting a comprehensive methodology upon defining and implementing complex and diverse risk reduction measures
Overseas	Oceans located beyond the control of the national authority, far from the economic area and the territorial waters of a country
Seagrass bed	Benthic community in the shallow, sandy or muddy sea beds which is dominated by grass-like marine plants
Food security	When all people, at all times have physical, social and economic access to sufficient, safe, and nutritious food which meets their dietary requirements for an active, healthy life.
Invasive alien species	An alien species which invades and modifies ecosystems, habitats or species
Evaporation	Loss of water due to soil and surface water evaporation, plant and animal transpiration
Ecological footprint	An index of the area of productive land and aquatic ecosystems required to produce the resources used and to assimilate the wastes produced by a defined population at a specified material standard of living, wherever on Earth that land may be located
Carbon footprint	Carbon emissions from industrial operations, transport and other activities in a certain country or area leading to global warming
Greenhouse effect	Greenhouse gases have high emissive capacity at specific infra-red wavelengths. Atmospheric infra-red radiation is emitted in all directions through greenhouse gases, including downward towards the surface of the Earth. Therefore, greenhouse gases raise the temperature of the lower layer of the atmosphere resulting in much higher atmospheric temperature. In the lower atmospheric layer, temperature generally decreases with higher altitudes. The infra-red radiation emitted to space originates from an altitude with a temperature of, on average, - 19□C in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14□C. Increased concentration of greenhouse gases leads to increased atmospheric porosity to infra-red radiation. This results in unstable radiation and a state of imbalance which can only be compensated by increasing the temperature of the lower atmospheric layer, which is known as the increased greenhouse effect.
Abatement	Structural and non-structural measures undertaken to reduce the adverse impacts of natural hazards, environmental degradation and technological risks

Land degradation	Reduction or loss of productivity, and complexity of biological and economic aspects in arid, semi-arid, semi-humid, irrigated and non-irrigated lands, as well as rangelands, steppes and forests, due to unsuitable usages, anthropogenic activities and settlement patterns.
Climate change	Any alteration which may occur with the elapse of time due to natural or anthropogenic changes. According to the United Nations Framework Convention on Climate Change, climate change is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."
Photochemical reaction	A chemical reaction that takes place by means of solar energy. An example of a photochemical reaction is the reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone.
Climate fluctuations	They refer to change in statistics like standard deviations and occurrence of extreme climatic events on all temporal and spatial scales beyond exclusive weather phenomena.
Biotechnology	Any technological applications in which biosystems and micro-organisms or their derivatives are used in order to manufacture goods intended to improve the quality of human life.
Clean technology	An economically competitive and productive technology that uses less material and/or energy, cuts and eliminates pollution and waste, and causes less environmental damage than its alternatives. In clean as opposed to "end-of-pipe" technology, the environmental equipment is integrated into the production process
Adaptation	The adjustment in natural and human systems to a new or changing environment. It includes anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Pollution by nutrients	Pollution of water resources by extra nutrients
Sustainable development	The development that meets the needs of the present generation without any adverse impacts on future generations.
Genetic diversity	It refers to the total number of genetic characteristics in the genetic makeup of a species or strain.
Ozone hole	Seasonal sharp reduction of the ozone concentrations in the upper atmospheric layer which takes place over the Antarctic, annually between August and November. Since it was discovered in the late 1970s, the Ozone hole has been appearing on an annual basis.
Small particulates	Atmospheric small particles whose size is less than 2.5 microns
Aerosols	Solid or liquid airborne particles whose size ranges from 0.01 to 10 micrometres. They may be of natural or anthro-pogenic origin and remain in the atmosphere for several hours.
Governance	The system through which society monitors resources. It refers to the mechanisms for resource control and ac-cessibility. For instance, 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 different forms of social regulation
Risk	Natural events, phenomena, or human activities which may lead to damage, injury, death, damage to property, social or economic losses or environmental degradation.
Hydrological cycle	It is the journey water takes as it circulates from the atmosphere to land and back again. This journey includes evaporation from land, sea and inland water, condensation which leads to formation of clouds, precipitation, water impoundments in the soil and water surfaces, and ultimately re-evaporation.
Sediment	Solid substances often made of crushed rocks and is carried by, suspended in or deposited from water
Smog	It is a mixture of smoke and fog in which products of combustion like hydrocarbons, small particulates, sulphur and nitrogen oxides occur in concentrations harmful to humans and other organisms. It takes the form of photochemical smog when sunlight acts on nitrogen oxides and hydrocarbons to produce atmospheric lower-layer ozone

Ozone layer	The general stratum of the upper atmosphere in which there is an appreciable ozone concentration. It is found at an altitude of 10–50 km above the Earth's surface.
Environmental label (Eco-label)	A label that is put on the product as evidence of its environmentally sound nature
Phytoplankton	Microscopic organisms that float or swim weakly in fresh or saltwater bodies.
Globalization	The increasing integration of the world's economies and communities, particularly through commercial and financial flows, and the transfer of culture and technology.
Greenhouse gases	Gaseous constituents of the atmosphere, both natural and anthropogenic that absorb radiation and send definite longitudinal waves towards the direction of infra-red radiation emitted from the planet's surface as well as atmosphere and clouds. Atmospheric greenhouse gases include but are not limited to water vapor, carbon dioxide, nitrate oxide, methane and ozone. Atmosphere also contains anthropogenic greenhouse gases like halocarbons, chlorine and bromine. In addition to carbon dioxide, nitrate oxide and methane, Kyoto protocol added sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons to the list of greenhouse gases.
Poverty	Deprivation of welfare
Genetically modified organisms	An organism that has undergone external processes by which its basic set of genes has been altered.
Climate variability	Variations in the mean state and other statistics like standard deviations and occurrence of extreme climatic events on all temporal and spatial scales beyond exclusive weather phenomena. These changes may occur due to internal processes in the climate system (internal variability) or other natural or anthropogenic factors (external variability).
Monitoring (environmental)	Regular and standardized measurement and observation of the environment (air, water, soil, land use and biota)
Green procurement	Taking environmental aspects into consideration upon making general and institutional procurement
Renewable energy sources	Sources that do not rely on limited stocks of fuel. Electro-hydraulic energy is one of these sources. Other types of renewable energy include biomass, solar, tidal, wave and wind energy.
Carbon sequestration	Absorption of carbon dioxide emissions resulting from industrial and other related activities. This is done by using non-emissive energy production means like wind farms and solar energy.
Nutrients	Chemical substances which are essential for the growth of organisms. They are 20 substances including nitrogen, sulphur, phosphorus and carbon.
Pollutant	Any substance which may cause damage to the environment when mixed with soil, water or air
Primary pollutant	Air pollutant which is directly emitted from a source
Secondary pollutant	It is not directly emitted but formed when other pollutants react in the atmosphere
Protected marine area	A geographically designated area which is designed, organized and managed to realize protection-related goals
ROPME Sea Area	It is the sea area surrounded by the eight Member States of ROPME: Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.
Organizations	Entities consisting of individuals who have specific goals. Organizations may be political (parties, governments and ministries), economic (industry federations), social (non- governmental organizations, self-help groups) or religious (church and religious federations). There should be clear distinction between organizations and institutions.
Obsolete chemical substances	Pesticides or other industrial chemicals which have expired and have not been used. They should be disposed of in a safe manner.

Ozone depleting substances	Any substance with an ozone depletion potential greater than 0 that can deplete the upper atmospheric ozone layer
Inundation	The rising of rain, molten ice or irrigation water which overflows onto normally dry land before it returns to water courses. It may catch air or ground pollutants and transmit them to the recipient water.
Ecosystem	Complex, dynamic group of plants, animals, micro-organisms and their non-living habitats which interact as a functional unit
Geographic information system	A computer-based system used in regulating geographical data.
Electronic waste	A generic term that includes various types of electrical and electronic equipment which are to be disposed of. Another definition is "any electrical appliance which no longer performs its intended function."
Hazardous waste	By-products which can constitute major and potential hazards to human health or environment if not properly managed. They are characterized by inflammability, erodibility, reactivity and toxicity. They may also be included in special lists.
Liquid waste	Treated or untreated wastes discharged to the environment from several sources like industrial processes, sewage treatment units, etc.
Fossil fuel	Coal, natural gas, and oil products formed from decomposed animals and plants that died millions of years ago.
Biological fuel (Bio-fuel)	Fuel produced from dry organic matter or combustible oils from plants, such as alcohol from fermented sugar, black liquor from the paper manufacturing process, wood and soybean oil
Small particulates	Atmospheric small particles whose size is less than 2.5 microns

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Environment Outlook for the Arab Region

The Environment Outlook for the Arab Region (EOAR) report is the first official, comprehensive, and integrated assessment of the state of environment in the Arab region.

The report is a credible scientific assessment that provides a base for policy formulation in the region. It explores the future of human-environment interaction; hence, the main theme of the report: "Environment for Development and Human Well-being".

This report was prepared in response to a decision by the Council of Arab Ministers Responsible for the Environment, in its 17th session, held at the headquarters of the General Secretariat of the league of Arab States, in Cairo, Egypt, in December 2005. The Council invite the United Nations Environment Programme to prepare an environment outlook report for the Arab region, in cooperation with specialized Arab organizations and GEO collaborating centres in the Arab region.

The EOAR report was produced through a participatory process in which experts and scientists from national, regional, international, and civil society institutions; and the private sector; as well as independent experts, and academics collaborated in its development and review. The EOAR process has followed the model of the global Environmental Outlook (GEO) reports, which began in 1995 with a global environmental assessment processes that is participatory, incorporates regional views and perceptions, and builds consensus on priority issues and actions through dialogue among policy-makers and scientists at regional and global levels; resulting in outputs that provide guidance for decision-making processes such as the formulation of environmental policies, action planning, and resource allocation.

In five sections consisting of twelve chapters, the EOAR report reviews the different facets of integrated environmental assessment, by analyzing the causes and drivers of environmental change, environmental pressures and changes and their effect on human beings and ecosystems, and the policies and responses to environmental issues, as well as exploring the future of environment and development according to four plausible scenarios. Finally, the report also presents the policy options and alternatives that can provide the basis for decision-making in the Arab region.

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