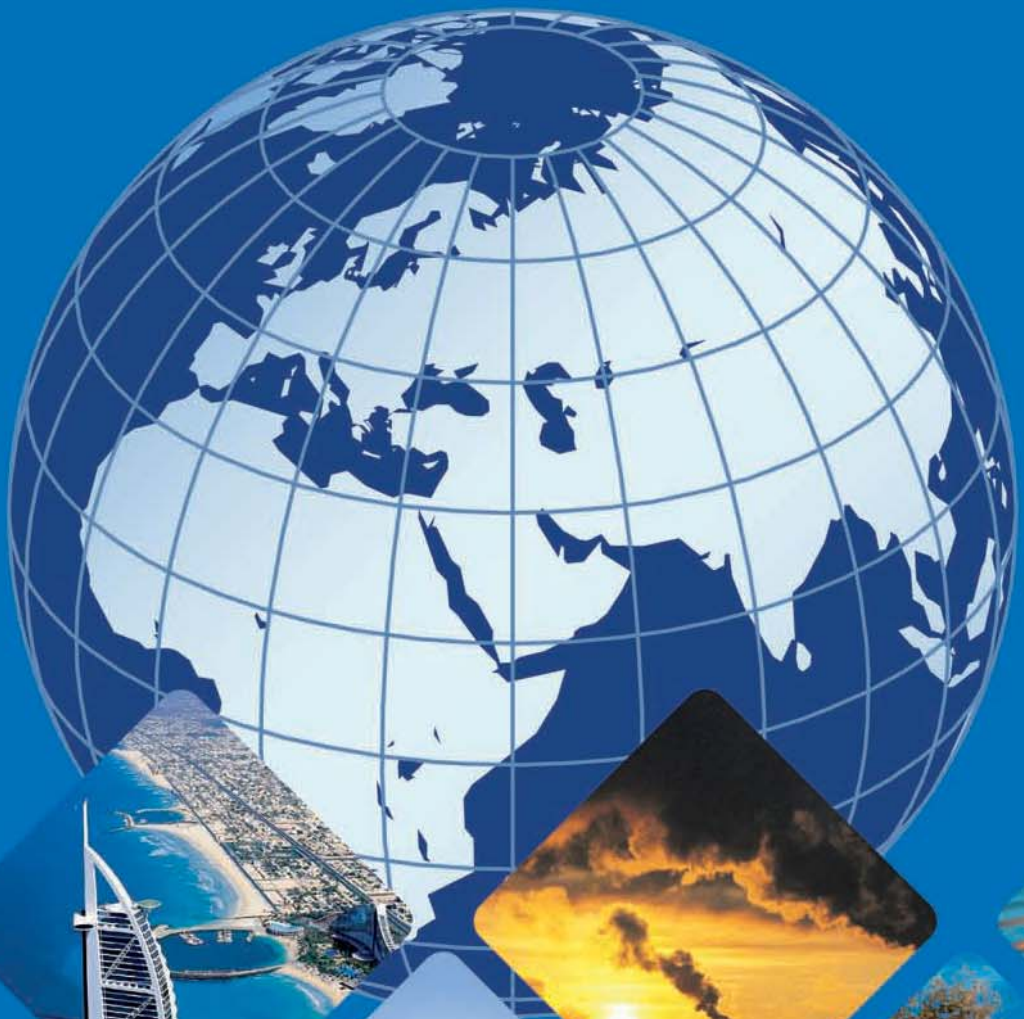
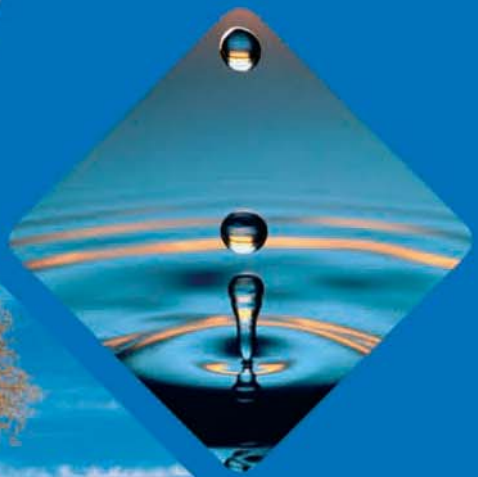
2008 Report of the Arab Forum for Environment and Development

ARAB ENVIRONMENT
FUTURE CHALLENGES

EDITED BY: **MOSTAFA K. TOLBA** AND **NAJIB W. SAAB**





المنتدى العربي للبيئة والتنمية
ARAB FORUM FOR
ENVIRONMENT AND DEVELOPMENT

AFED

Arab Environment: Future Challenges

EDITED BY
MOSTAFA K. TOLBA
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Contents

Preface

Arab Environment: Future Challenges is the first annual report produced by the Arab Forum for Environment and Development (AFED). The policy-oriented report is designed to evaluate the progress made towards the realization of sustainable development goals and a good environmental quality. It also examines the Arab contribution to global environmental endeavours.

AFED was proclaimed as a regional non-governmental organization in June 2006, at the conclusion of a conference on Public Opinion and the Environment, organized in Beirut, Lebanon, by *Al-Bia Wal-Tanmia* (Environment & Development) magazine. The conference deliberated on the results of a pan-Arab survey tracing the environmental views of the public in Arab countries. The outcome has been reflected in AFED's mandate, which gave its work a demand-driven impetus. AFED aims at encouraging Arab societies to protect the environment and use natural resources in a sensible manner, ultimately resulting in sustainable development. The Organization has embarked on a wide ranging programme of activities, the main one being an independent periodic report on the status of Arab environment. The present report launches a series of other reports to follow, each of which will concentrate on specific topics of particular significance to the Arab region.

Alongside tackling major local and global issues and challenges, the outcome of the report is also meant to serve as a baseline for the state of Arab environment, in a manner that will allow measuring progress in the future. It has been developed to set benchmarks, by means of evaluating the state of the environment under different sectors. Moreover, the AFED report is meant to be independent, reflecting the views of the civil society, by relying on the wide participation of researchers and academic institutions, in consultation with active sectors of the society, while ensuring synergy with other initiatives.

The approach to preparing the report has been to build on existing knowledge of environmental issues. It stresses partnerships, takes advantage of ongoing monitoring and research. It promotes the incorporation of the traditional approach of a State of the Environment report into the design of policy-driven, science-based assessments, stressing major issues and challenges.

Based on analysis of the best data available, the report targets the general public as well as policy and decision makers in public and private sectors. Data has been collected from reliable national and international sources, and cross-checked with experts and research institutions. One of the main constraints in preparing this report has been a lack of reliable and coherent national data in various sectors. To overcome this difficulty, authors of the different chapters were selected from among experts with extensive experience in their research areas, who could rely

on first-hand information directly from the field. Wherever possible, authors carried out field surveys to collect accurate and up-to-date data. Some countries of the region are not included in certain tables due to lack of data. Where data gaps still persist, the report tries to identify them in view of triggering further field and laboratory research, not only to collect and collate existing data but to establish permanent reliable monitoring centres and databases.

The Arab Environment Report attempts to answer five key questions:

1. How are environmental conditions in the Arab world changing?
2. What are the causes of environmental deterioration, and how is it linked to human activities and other stresses?
3. Why is environment a significant issue to the Arab world?
4. What is being done about it? How is society responding to the issues through public and private initiatives?
5. Are the measures taken to limit environmental degradation and deterioration of ecosystems enough?

The report provides an easily understood overview of environmental issues for the non-scientist without frustrating the scientific accuracy of the issues discussed.

The editors wish to thank all of those who supported this initiative, and specifically Dr. Mohamed Kassas, who was a source of inspiration from the outset, alongside his unrelenting contribution to all phases of the job, from planning, to setting clear goals and appraising the outcome. Thanks are also due to Dr. Essam El Hinnawy who made an outstanding effort in designing the structure of this report. Our special thanks go to the OPEC Fund for International Development (OFID), which backed this project from its inception. Finally, we thank the team of *Environment & Development* magazine, whose efforts made the production of this report in its final form possible in record time and with limited budget.

The Editors

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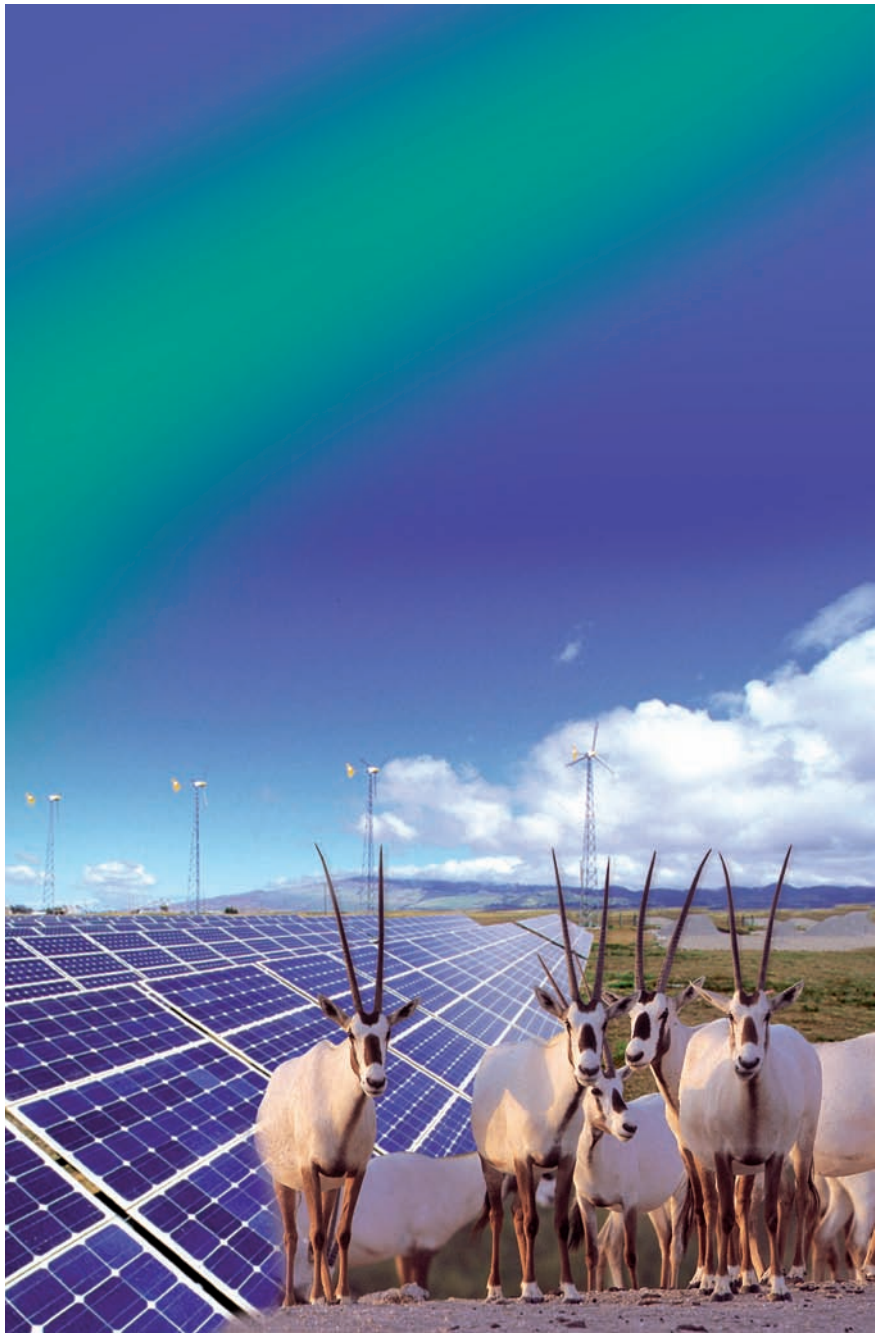
EXECUTIVE SUMMARY

Arab Environment: Future Challenges

MOSTAFA K. TOLBA AND NAJIB W. SAAB



INTRODUCTION

At the beginning of the 21st century, it is clear that the most salient issue facing the world today is that of the environment. Environmental problems have featured heavily in scientific warnings, political agendas, public concern, and media attention. The Arab region is not isolated from the rest of the world when it comes to this topic. This report seeks to highlight in a holistic manner the most important environmental issues facing the Arab world, and attempts to offer advice for policymakers, citizens, scientific and academic institutions, and the media on how to mitigate the dangers created by environmental degradation.

The Arab world has undergone huge changes in the last century. Its population has risen from below 50 million a century ago to over 325 million today. During this same period, the environment has deteriorated and natural resources have dwindled, due to development patterns which were largely unsustainable. In most cases, policies were overwhelmingly sets of provisional short-term measures, meant to tackle momentary challenges rather than engage in long-term planning.

Some parts of the region have seen unprecedented growth, bringing both economic and social prosperity to millions of Arabs during the last decades, thanks, largely, to the rising income from oil. Has this economic development, however, come at a cost? Can the patterns of development which some Arab countries are experiencing continue, while sustaining livelihood and quality of life for future generations? We doubt.

Today, the state of the Arab environment stands at a pivotal juncture, with numerous environmental problems both current and imminent threatening the region. At the same time, awareness of the issues, as well as signs of political and social willingness to act, provide hope for timely intervention.

This report, the first of its kind to be compiled and authored by independent experts from across the Arab region, offers an overview of the state of the environment in the Arab world, highlighting environmental challenges, social, political, and demographic trends, progress in regional and sub-regional cooperation, and recommendations for future action.

THE REGIONAL CONTEXT

The Arab region, which stretches from Morocco and Mauritania in the west, through northern Africa and the Levant, to the Arabian Gulf in the east, is a region facing distinctive environmental circumstances and challenges. Although the region is endowed with unique and rich natural resources, there is insufficient awareness of the importance of the environment in fuelling and sustaining economic growth and human welfare. Environmental considerations are insufficiently integrated in national development plans and policies, resulting in the unsustainable use of natural resources for development programmes.

Climate change, high population growth rates, and in some countries, rapid economic growth and urbanisation, all amplify the region's vulnerability to environmental challenges and constrain its ability to manage them. Among the major challenges that the region faces are water scarcity, land degradation and desertification, inadequate capacities for waste management, coastal and marine environment degradation, air pollution and global warming.

THE COSTS OF ENVIRONMENTAL DEGRADATION

Although they are often largely invisible or ignored, the economic costs of environmental degradation in the Arab region are real, substantial, and growing. Natural resources are being used unsustainably, undermining economic development and poverty reduction efforts. The World Bank estimates that the annual cost of environmental degradation amounts to between four and nine percent of GDP for certain Arab countries. To place these figures into perspective, in Eastern Europe and the OECD countries the ratios are five and two to three percent of the GDP respectively. In the Arab region as a whole, the cost of environmental degradation is estimated at five percent of GDP.

At the same time, governments of the region have failed in addressing these mounting economic costs with clear and effective policies. The budgetary allocations for environmental purposes do not even come close to one percent of GDP for any of the countries in the region. Moreover, the environmental agencies that do exist have not been granted any real support or powerful legislative mandates, limiting their ability to be effective.

INSTITUTIONAL REFORM

It should be clear from this report that environmental issues urgently need to be recognized as deserving political and economic priority, on par with other major macroeconomic issues. Specifically, the issue of environmental sustainability needs to permeate into all aspects of development and macroeconomic policies. Currently, this is not the case.

Once the importance of environmental issues within the countries of the Arab region has been recognized and acknowledged, the capacities for action need to be strengthened. This has to be tackled through a two-pronged approach: firstly holistic, integrated, clear, and effective legislation needs to be created, and secondly it needs to be ensured that environmental agencies are endowed with both the resources and the political mandates to achieve the necessary progress.

Alongside strengthening official agencies and legislation, governments of the region need to support research and development efforts. The private sector should also take more initiatives to integrate environmental considerations into its planning, moving from the charity attitude towards the social responsibility concept and the environmental responsibility perception. None of this would work without the support of the people, which cannot be achieved in the absence of a real effort on the part of the media and the civil society, especially non- governmental organizations, to raise awareness.

WATER

Is it acceptable to drain groundwater to the last drop? Is it rational that the level of water consumption per capita in some of the most water-scarce Arabian Gulf countries is among the highest in the world? The unfortunate result of such unsustainable policies has been that these countries lost basic elements of water security.

The dilemma for the Arab region is that it is among the water-scarcest regions in the world. The average annual available water per capita in the Arab countries was 977 cubic metres in 2001, falling below the UN definition of water scarcity. The projections are bleak: by the year 2023, the figure is expected to decrease to 460 cubic metres. In fact, with the exception of Egypt, Sudan, Iraq, Lebanon, and Syria, all the Arab countries are projected to experience severe water stress by the year 2025.

Even at present, most countries in the Arab region find themselves with levels of renewable water resources far below the levels of other major regions in the world. In fact, for many, if not most Arab countries, renewable water resources cannot cover the sustainable human needs as defined by the United Nations. Projected global warming and consequently climate change have the potential of placing increasing pressure on already dwindling water supplies.

Policy issues remain a problem when it comes to water. Most of the available water supplies in the Arab region, surpassing 80%, are used for irrigation. In addition, water use efficiency levels are relatively low in the region, typically ranging between 37% and 53%. Water loss and inefficient technologies need to be corrected. As per capita water supplies get tighter, governments will have to implement strategic planning that can both increase water use efficiency and optimise the allocation of this scarce resource among the agricultural, industrial, and domestic domains. As this report thus suggests, water policies in the Arab region will require improved management of both the supply side and the demand side, together with dedicating more resources for developing local desalination technologies.

A particularly striking example of the conflict that exists between rapid economic development and scarce water resources is the recent boom in the construction of golf courses in certain parts of the region. In fact, most of the current and planned golf courses are in Egypt and the Gulf region, particularly the United Arab Emirates, where water resources are already low, even by regional standards. Expansion of water-intensive projects like grass golf courses cannot go on unchecked, especially with meagre investments to develop sustainable desalination technologies. There are plans to increase the sixteen golf courses operating in the GCC countries now to 40 in the near future. In most cases, golf courses in the region are irrigated with desalinated sea water, treated effluent or a combination of the two. A 2007 report released by the international consultants KPMG estimated the use of water for each golf course in the region at an average of 1.16 million cubic metres per year, reaching 1.3 million cubic meters in Dubai, enough to cover the water consumption of 15,000 inhabitants.

Using such an amount of water on leisure projects in an arid desert throws up questions about sustainability and how could this infringe on the water needs of the local community. This is not at all a call to impede development, but rather to allocate more resources towards inventing innovative environmentally-friendly desalination methods and reliable saline agriculture techniques, suitable for the arid desert environment.

CLIMATE CHANGE

Among global environmental issues, the one that has received most attention across nearly all domains (political, media, scientific, and civil society) is that of climate change. Although the Arab region does not contribute more than 5% to

the causes of global climate change, its effects on the region will be very severe. In fact, the region is particularly vulnerable given already scarce water resources, high levels of aridity and the long coastal stretch threatened by the rising sea levels. Natural and physical systems in the Arab world are already facing heavy pressures, and these will only be intensified as temperatures in the region get higher and/or precipitation gets lower.

According to recent modelling studies, the Arab region will face an increase of 2 to 5.5°C in the surface temperature by the end of the 21st century. In addition, this temperature increase will be coupled with a projected decrease in precipitation of between 0 and 20%. The results for the region include shorter winters, dryer and hotter summers, a higher rate of heat waves, increased weather variability, and a more frequent occurrence of extreme weather events. Clearly, adaptation and mitigation strategies need to be researched, discussed, and implemented.

Sea level rise, or SLR, due to rising temperatures, has the potential to cause the loss of significant portions of agricultural land in the Arab region. As an example, even a 1 m SLR could potentially cause the loss of 12% to 15% of agricultural land in the Nile Delta region, and could reduce Qatar's land area by 2.6%. In addition to the agricultural sector, the industrial and tourism sectors, urban areas and the GDP in a number of Arab countries are threatened to be negatively impacted by sea level rise.

Higher temperatures will also increase the incidence and impact of drought in the region, threatening water resources and productive land. As this report shows, drought frequency has already increased in Algeria, Morocco, Syria, and Tunisia. Recent droughts in Jordan and Syria were the worst recorded in many decades. In addition, increased precipitation variability and water resource availability directly related to climate change affect a number of the countries in the region. A warmer climate brings with it increased climate variability, higher risk of both floods and droughts, and exacerbates the already precarious situation created by chronic water scarcity faced by most Arab countries.

This report recognizes an alarming deficiency in scientific and technological capabilities, as well as the political will to address and face problems posed by climate change in the Arab region. Not enough scientific facilities exist to study this phenomenon, insufficient funds are allocated to such research, and the studies that are undertaken still leave gaps to be filled. Climate change mitigation and adaptation need to be integrated into development strategies, and issues of planning, scientific capacity, stakeholder involvement, and public awareness need to be urgently addressed.

AIR QUALITY

As the air quality in Arab cities continues to steadily deteriorate, the costs of health and environmental consequences are drastically rising. Health problems attributed to air pollution from the transport sector alone cost Arab countries over five billion dollars annually.

Countries in the Arab region are highly reliant on personal transport, a fact highlighted by the soaring car ownership rates. For example, the number of vehicles per 1000 inhabitants is 434 in Lebanon, 378 in Qatar, 357 in Kuwait, 336 in

Saudi Arabia, and 322 in Bahrain. The transport sector is responsible for approximately 90% of total emissions of carbon oxides in Arab countries. In spite of many welcome initiatives to ban it, lead remains an additive in petrol in some Arab countries, and still accounts for more than half of total lead atmospheric emissions. Some countries abruptly introduced unleaded fuel, without imposing the use of additives required for efficient operation of the old fleet of vehicles with older engines, which constitute the bulk of the cars in most countries. The inefficient combustion has consequently led to an alarming increase in the levels of ground ozone, a gas with devastating effects on health.

Per capita carbon oxides emissions have risen steadily in most countries of the region in the last three decades. Regionally, the Gulf countries emit about 50% of the total of all Arab countries; in addition, the countries in this Arab subregion are the only ones with carbon dioxide emissions levels above the world average. To give a few examples, in 2003, emissions in the United Arab Emirates, Qatar, Bahrain, and Kuwait were respectively 13, 9, 8, and 7 times higher than the world average. Countries such as Libya, Oman, and Saudi Arabia also have per capita emissions higher than the world average, while the rest of the Arab countries are approximately equal or fall below it.

A major problem in the Arab region is that only a few countries monitor air pollution levels sufficiently, systematically and consistently, which makes scientific research and policy recommendations difficult. Monitoring results in Egypt recorded levels of emissions in urban areas and coastal industrial complexes that have reached pollution levels between six to eight times higher than the limits set by the relevant Egyptian environmental laws. Similar results were collected in Lebanon and Syria.

More action needs to be undertaken. In the transportation sector, engines need to be made more efficient, hybrid vehicles and cleaner fuels needs to be advocated, and public transport needs to be developed and promoted, alongside more sensible urban planning which reduces the use of cars to communicate between residential, work, commercial and leisure locations.

Energy generation and consumption in the Arab region tend to be inefficient in most countries. This report recommends for market-distorting subsidies to be phased out, thermal efficiency to be improved through technological advancement, hydropower resources to be fully utilised, renewable energy sources, especially solar and wind, to be widely used, and less polluting fuels, such as natural gas, to be increasingly utilized.

MARINE AND COASTAL ENVIRONMENT

Stretching from the Atlantic to the Indian ocean, and including the Mediterranean, the Red Sea, and the Gulf, Arab countries have over 30,000 kilometres of coastal line, 18,000 kilometres of which are populated areas. The fragile marine and coastal environment of the Arab region is threatened by pollution, over-fishing, loss of biodiversity, climate change, and other problems. However, such areas are of vital importance to the Arab countries, providing benefits to public health, food security, leisure and other economic and social benefits.

Within the Arab region, three major marine regions can be identified: the Mediterranean, Red Sea and Gulf of Aden (RSGA), and the ROPME (Gulf)

regions. The UNEP Regional Seas Programme classifies these three as the MAP, PERSGA, and RSA regions, and together they encompass twenty of the twenty-two member countries of the League of Arab States.

The semi-enclosed Mediterranean Sea lies off the coasts of North African and eastern Mediterranean Arab countries. Its fragile environment is threatened by large-scale industrial activity on its coasts: more than 200 petrochemical and energy installations, chemical industries, and chlorine plants are located along it. Eutrophication – a process by which water is enriched with nutrients that stimulate primary aquatic production and cause excessive algal blooms – is a chronic problem in certain areas of the Mediterranean, where residues from agricultural, mainly chemical fertilizer, and non-treated industrial and urban wastewater discharges enter the marine environment. In addition, there is heavy tanker traffic in the Mediterranean, connecting major consumption centres in Europe with the oil production centres of the Middle East. The most important oil traffic lane is the Suez Canal, through which 90% of total oil tanker traffic passes.

The RSGA, one of the world's most unique coastal and marine environments, is threatened by a variety of human activities, such as dredging and filling operations, the disposal of domestic and industrial effluents, and the expansion of the tourism industry. Most of these environmental threats are relatively recent in origin, and can therefore at least partially be attributed to unsustainable development.

The RSA (ROPME Sea Area) is considered a high risk pollution area, due in particular to the large number of offshore oil and gas installations, tanker loading terminals, and the high volume and density of the marine transportation of oil. It is estimated that roughly 2 million barrels of oil are spilled annually from routine discharges of ballast, tanker slops, and from 800 oil and gas platforms.

Overfishing, the unsustainable exploitation of fish stocks, is a major problem in the Mediterranean and the RSGA regions. Primarily, the main problems are the lack of information on transboundary stocks, inadequate cooperation in the management of shared stocks, and a lack of surveillance and enforcement of existing fishing regulations. In addition, the coral reefs in the RSA and the RSGA, in the vicinity of which much fishing occurs, are threatened by a diversity of environmental stresses, particularly global warming.

Uncontrolled tourism and extensive urban development are the main contributors to the environmental degradation of coastal and marine environments, and this finding is applicable to all three regions. Several current or proposed marine protected areas (MPAs), especially in the RSGA, are under high pressure from overfishing and tourism.

Finally, in terms of legislation, not enough designated MPAs exist, and the ones that do exist are not in all cases adequately and efficiently managed. As is the case for much environmental legislation in the region, issues of efficient institutional capacity remain. Existing laws and regulations are not sufficiently implemented, compliance is not properly monitored, and regional/transboundary cooperation remains inadequate. It is unlikely that the state of marine environment in the Arab region is better today compared to three decades ago, when Arabs first started to join the international and regional seas conventions and programmes.

ARIDITY, DROUGHT AND DESERTIFICATION

A particularly pressing concern for much of the Arab world is the high degree of aridity and the associated increased vulnerability of lands to climate change as well as water scarcity and variability. In particular, the land resources of the Arab region face three main challenges: aridity, recurrent drought, and desertification.

The primal importance of the issue can hardly be overstated; as the productive capacities of Arab agricultural lands are compromised by land degradation, the bases of food security are undermined. As populations increase and economic growth causes per capita consumption rates to rise, the gap between production and consumption of food increases, and dependence on the importation of food grows.

The issue of aridity is closely related to that of the scarcity of water resources. In fact, all agriculturally productive lands in the Arab countries are fragile systems prone to degradation and highly vulnerable to desertification. This report recognizes desertification as posing the most pressing threat to productive lands in the whole Arab region. What is extremely important is to recognize that desertification is essentially a man-made phenomenon which is exacerbated by climate change. Meaningful measures are needed in every Arab country to reduce the human role in expanding desertification.

As for cooperation in international endeavours, a number of regional examples exist. Sudan formulated a national plan of action to combat desertification in 1976, as did Tunisia and Egypt shortly afterwards. However, the response of other Arab countries has so far been lacking, as an insufficient degree of priority has been attached to the formulation and implementation of plans and programmes for combating desertification.

What is needed in the Arab region is an integrated approach that recognizes the urgency of addressing the menaces of land degradation. Such an approach should comprise scientific, industrial, social, and legislative efforts. Institutes such as ACSAD (Damascus) and ICARDA (Aleppo) exist, as do dedicated university research units and national research centres on desertification. However, more resources need to be mobilised to support scientific research geared at devising solutions which find their way to implementation. Promising examples are the initiatives in Saudi Arabia, Qatar, the United Arab Emirates and Egypt to establish funds for supporting research, which will hopefully include programmes for the sustainable development and management of land and water resources.

BIOTECHNOLOGY, FERTILISERS AND PESTICIDES

Fertilisers and biotechnology play an important role in the agricultural sector in the Arab region. Except for a few products for health care, none of the Arab countries currently produce their own biotechnology products. However, thirteen Arab countries are parties to the Cartagena Protocol on Biosafety (CPB) which regulates the import and export of genetically modified organisms (GMOs). The issue is therefore limited to the import of biotechnology commodities by Arab countries, and the role of the Arab region in international negotiations on the issue should also be viewed from this perspective. At present, the main problem in the Arab region is one of insufficient implementation of the protocol, leading to situations in which certain GMO commodities (such as

maize, long grain rice, soybean seeds and cooking oil) are imported and available in Arab markets undeclared and unlabelled. The crux of the problem is a lack of regulatory and enforcement mechanisms, legislation, administrative structures, and technical expertise. As such, more resources need to be directed to the areas of biotechnology development, allowing Arab countries to take informed decisions on the products they import, as well as developing their own technologies in areas such as agriculture, medicine and chemicals.

Pesticides and fertilisers are widely used in the Arab region, and in many cases, misused. The use of NPK fertilisers in Arab countries quadrupled between 1970 and 2002, with the UAE and Egypt (more than 900 kg fertilisers per hectare), Oman (644 kg), and Lebanon (414 kg) using some of the highest quantities of fertilisers per hectare in the world. The heavy use of pesticides and fertilisers brings about concerns regarding food safety as a public health issue. What is lacking in most of the Arab region is regulation and control over the sale, handling, and use of pesticides. In addition, accredited pesticide residue analysis laboratories are not available in most Arab countries. As such, new legislation and institutional commitments are necessary in this regard. These issues need to be tackled at the regional level. Many countries in the region have the resources and capacities for a better performance; what is missing is clear awareness of the subject.

With several parts of the world moving towards organic farming, the demand for chemical fertilizers is expected to dwindle. This will pose a serious challenge to the big producers of fertilizers in the Arab petro-chemical industries, who will have to be ready for diversification into new products.

WASTE MANAGEMENT

The Arab region produces some 250,000 tons of solid waste every day, with most of it ending untreated in makeshift dumps. Less than 20% is properly treated or disposed of in landfills, and no more than 5% is recycled. The per capita production of municipal solid waste in some Arab cities, such as Kuwait, Riyadh, and Abu Dhabi, is over 1.5 kg per day, making it one of the highest levels in the world. Furthermore, parts of the Arab region that are undergoing rapid economic development and urbanisation are also producing a lot of demolition and construction waste. Therefore, a by-product of increasing economic development, and prosperity, is that per capita waste production levels are increasing.

This report identifies a number of weaknesses of waste management in the Arab region. In some countries, a significant proportion of the waste produced is not collected. In Egypt, for example, it is estimated that 35% of municipal solid waste is not systematically collected. Another issue is the improper handling, collection, and treatment of hazardous wastes originating from agricultural, industrial, medical, and urban activities. In this regard, however, the report recognizes a number of promising initiatives that are being undertaken in the Arab region, such as legislative initiatives in the GCC, Egypt, and Oman, as well as investments into facilities that can separate and handle hazardous wastes, and an increased private sector investment in recycling industries, especially in Saudi Arabia and UAE.

Ultimately, what this report suggests is that countries in the Arab region embark on projects towards creating an integrated system of waste management, capable of safely handling and disposing of the rising quantities of wastes that are being

produced, starting with reduction and reuse, and soon reaching a high percentage of recycling. As for industries, cleaner production technologies should be applied to reduce waste generated, instead of limiting efforts to end-of-pipe remedial treatment. New technologies are not a financial burden, as they have a very high rate of return on investments, in addition to meeting the social and environment responsibilities of industry and business in general.

URBANIZATION

Urbanisation is a phenomenon that can be observed across the Arab region, and is fuelled by such factors as high fertility rates, rural-urban migration, international labour migration, and the concentration of economic activity in urban areas. While the urban proportion of the Arab population is currently estimated to be 56%, this figure is projected to rise to 66% by 2020; urbanisation levels are especially high in Kuwait (97%) and Bahrain and Qatar (92%). Thus, in addition to rapid population growth levels, the countries of the Arab region struggle with bringing about the necessary improvements in infrastructure capacity in the growing urban centres. Main challenges include waste management, health care provisions, educational institutions, and transportation systems. One striking remark is that urban development is overwhelmingly based on models copied from other countries, largely ignoring the cultural and natural characteristics of the region.

The rapid rate of urbanisation in the Arab region brings with it many pressures on the environment. Large-scale economic development projects are not currently preceded by sufficient and transparent studies of their environmental impacts (strategic, cumulative and project). It therefore remains to be seen whether the high pace of urbanisation in the Arab region can be matched by equally high rates of human development and infrastructure provisions.

ENVIRONMENTAL SCIENTIFIC RESEARCH

Effective environmental scientific research stands at the very basis of combating environmental degradation. In simple terms, the basic indicators of scientific research can be reduced to inputs and outputs.

Inputs can generally be divided into the number of researchers and the rate of expenditure on scientific research, both in relative and absolute terms. While the number of researchers in the Arab world stands close to that in the rest of the world, and has been growing by 6-7 percent annually between 1994 and 1998, double the population growth rate, the rate of expenditure on scientific research as a percentage of GDP is abysmally low in the Arab region, at around 0.2%. The world average is 1.4%, with the rate being 4% in Japan. The Arab region's rate is the lowest regional rate in the entire world. Thus, the state of inputs into environmental scientific research can holistically be described as one in which many Arab scientists, whose number is increasing, are faced with drastically insufficient resources.

Exacerbating this situation, and a direct corollary to the situation just described, is the so-called "brain drain": vast numbers of Arab researchers are emigrating in search of better research conditions. For example, 12,500 Egyptian and 11,500

Lebanese researchers were working in the United States in 2000. This phenomenon can certainly in part be explained by the general financing crisis addressed earlier, combined in many cases with inadequate scientific and academic standards.

As for outputs of scientific research, these can be assessed by looking at the number of research studies and the number of patents. While the Arab world's share of the former is low, its contribution in the latter is entirely negligible.

In order to rectify the deficiency of environmental scientific research in the Arab region, this report offers a number of recommendations. First of all, it strongly recommends that Arab countries formulate clear and effective strategies specifically for environmental scientific research in addition to the existing strategies for scientific research in general.

As such, the great diversity of related fields, and the concurrent scattering of the available resources, can be made more effective by adequate management and integration, the setting of clear priority areas, and efforts of attracting and steering investments towards these strategic goals.

Regarding the issue of financing, this report recommends that both public and private agencies, bodies, and actors take their responsibility. High-level research critically depends on the sufficient availability of resources. While governments can contribute by directly providing financial support for research, legal and economic incentives must also be created in order to stimulate private sector participation in the provision of scientific research finance.

Finally, this report recommends that regional scientific databases be created and strengthened. Making environmental research accessible reduces the possibility of unnecessary repetition of the same research, and makes it possible for experts and professionals in any field and from various research institutions to have access to existing data. This would be even more effective if it can be undertaken on a regional scale, integrating the environmental scientific research efforts across the Arab region.

ENVIRONMENTAL EDUCATION

Closely related to the issue of environmental scientific research is that of environmental education at all levels. A number of initiatives have been taken in this regard in the Arab region. The report could trace 40 research centres on environmental studies, 27 undergraduate degree programmes and 24 graduate programmes on environment. Yet, those programmes are still in their infancy, and many disciplines are lacking, such as environmental legislation and management, as well as the integration of environment into development plans, programmes and projects. On the other hand, extracurricular activities for environmental education and awareness have been integrated into many school programmes. In addition, articles and material from environmental publications, such as *Al-Bia Wal Tanmia* (Environment and Development) magazine are widely used in schools as extra reading material. An Egyptian programme called the Egypt Environmental Education and Outreach Programme (E3OP) has been implemented and is designed to promote environmental education in primary and preparatory schools in Egypt, aiming to increase awareness and skills pertaining to the environment.

On the whole, the trend in the Arab world has been one of increasing attention in educational curricula – and in official policies in general – for environmental issues. However, more can still be done at various levels, mainly to expand the scope of environmental programmes offered in higher education, and make them more responsive to national requirements, strengthen the environmental content of basic education curricula, and provide credible textbooks.

THE ENVIRONMENT IN ARAB MEDIA

An important component of effective action towards environmentally sustainable development is the role of the media, in particular for disseminating information, providing environmental education, and critically observing the actions, or the lack thereof, taken nationally and regionally to address environmental concerns. In the Arab region, environmental issues have greatly proliferated in the media during the last decade, and the report traced 100 Arabic periodicals and newsletters with environmental titles. However, the subject is seldom dealt with in depth, and critical analysis and expert insights are rarely provided. Although the increase in interest for the environment is exhibited by greater reference to environmental issues in the Arab media, they are often limited to reporting disasters, and miss a critical, analytical perspective. This deficiency is illustrated, for example, by the fact that less than 10 percent of the Arab newspapers have full-time editors or reporters specialised in issues concerning the environment and sustainable development, with a similar percentage of all mass media (Press, Radio and TV) designating a weekly page or a regular programme for environmental issues. A positive development, however, is that an increasing number of television networks have started to include environmental issues as a part of their news bulletins.

ENVIRONMENTAL LEGISLATION

There exists a general weakness of environmental legislation in the Arab region. The environmental standards provided for in relevant laws in the Arab region are often set in conformity with effective standards applied in developed industrialised countries, and are in many cases unreflective of the specific environmental conditions as well as the technical and economic situation in Arab countries. This issue makes it difficult, from the economic perspective, to abide by these standards or make them functional. Furthermore, the legal standards are often rigid and uniform, applying to production and service activities irrespective of the particular pollution-combating costs and techniques.

Problems also exist in terms of environmental agencies and their personnel. Environmental affairs agencies and legislative responsibilities are often in the hands of non-specialists, as there is an absence of qualified personnel and expertise to draft and enforce environment related legislation. In addition, there is a lack of coordination between authorities in charge of the execution of environmental laws, contributing to non-compliance.

As for the legislation itself, it does not create sufficient economic incentives for the development and utilisation of clean technologies. Economic and fiscal tools and incentives can harness market forces with the aim of effectively achieving compliance with environmental legislation. Furthermore, such legislation is often lacking when it comes to punitive provisions, as apprehension exists regarding

the social ramifications of implementing such provisions. For example, fears regarding the fate of workers may impede the shutting down of major industrial facilities in breach of environmental regulations. In addition, there is rarely a specialised police force that is entrusted with ensuring environmental protection and monitoring adherence to environmental legislation in most Arab countries.

When it comes to multilateral environmental agreements (MEAs), the ratification and implementation thereof in the Arab region has not been ideal. In 49% of the cases, Arab countries have joined international treaties only after their entry into force; this can be attributed both to a lack of involvement of Arab countries in the drafting of such treaties, and the slow ratification processes in the respective countries. A particular point on which this report recommends further research is that of the link between the success and speed of implementation of MEAs and the availability of financial and technical resources allocated to this end and made available to the countries of the region. This report recognizes that the main impediments to the satisfactory implementation in the region of MEAs are inadequate national and regional resources, infrastructure and expertise.

In general, MEAs have spurred Arab countries into promulgating more environmental legislation and creating new environmental institutions. Arab involvement in MEAs has been most strong with the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, both during the negotiation and implementation stages, as the region is highly vulnerable to the potential impacts of climate change. However, some other MEAs that also deserve strong Arab involvement and interest have achieved limited success in the region, such as the United Nations Conventions on Biodiversity and the UN Convention to Combat Desertification (UNCCD).

FINANCING OF ENVIRONMENT PROGRAMMES

In the Arab region, efforts towards the financing and functioning of environment programmes must be made by governments, private, and non-governmental sectors. The public sector's main responsibility is to incorporate the environment into national development policies, including sufficient planning and budget allocation. The environment should be regarded as a necessary prerequisite for sustainable development, and considered as an important part within the overall macroeconomic picture. The current system of national accounts needs to be modified so as to provide a true indicator for sustainable development; in other words, the depletion and degradation of national environmental resources need to be reflected as costs instead of income.

A larger proportion of the budget needs to be dedicated to strengthening the capacities of environmental authorities, and the funding of environmentally sustainable projects should come to rely less on external funding, as aid flow is dependent on geopolitical circumstances. This report therefore recommends that environment, as a major component of sustainable development, be included as a priority area within funding mechanisms, with the long-term strategic goal of reducing the region's reliance on external funding.

As mentioned earlier, governments need to allocate more resources for research and development, focusing on technology, monitoring, laboratory and field

research, data collection, institutional and technical capacity of the public and private sectors and education. In addition, governments should strive towards promoting market incentives as a means of economically quantifying environmental and social costs and encouraging production and consumption patterns to move towards more sustainable models, with the aim of increasing efficiency, reducing waste, and encouraging innovation.

There is a lot of potential for private sector contributions to environmental and sustainable development initiatives in the Arab region. Unfortunately, this potential is not being fully utilised. Nonetheless, this report recognizes that there has been an increase in the number of private initiatives contributing to environmental protection.

A network of vibrant, effective, and organised civil society groupings working on raising awareness, with financial resources necessary to address key environmental challenges, is still largely lacking in the Arab region. In recent years, however, a limited number of Arab NGOs have become well established and successful.

ENVIRONMENT AND CONFLICT

An unfortunate, but nonetheless important factor in the Arab region is the impact of wars and conflicts on the environment. At present, there are in the Arab region at least two major ongoing international conflicts (the Arab-Israeli conflict and Iraq) and at least five internal conflicts (Algeria, Somalia, Sudan, Western Sahara/Morocco, and Yemen). Lebanon suffered a brief but major war in summer 2006, and some countries are suffering from a combination of international and civil conflict, such as in Iraq, the Palestinian territories, and Somalia. Although the social, political, and economic elements usually grab the spotlights when it comes to such conflicts, there are also negative environmental ramifications of conflicts in the Arab region.

Among the many causal factors behind conflicts are environmental factors, and in particular natural resources, also known as "ecosystem goods and services." As discussed in this report, environmental degradation aggravates natural resource scarcity. In the Arab region, scarcity of water and land (agricultural) resources stand out in particular. It must of course be emphasised that the environmental link to conflict is not necessarily direct. It often acts in concert with other social, political, and economic stresses.

Besides analysing in detail the environmental impacts of conflict in the aforementioned cases, this report offers a number of suggestions for Arab states in this area. It is proposed that an Arab fund be launched to help countries deal with the environmental root causes of conflict, and also to address the most immediate impacts of war. In addition, more regional and international cooperation is recommended in order to provide early warning and assessment capacity of the linkages between conflict and the environment. Closer cooperation with international organisations, particularly the United Nations, is also recommended in order to draw on the available international scientific, technological, and financial resources and experience in analysing and mitigating the environmental impacts of war, specifically in areas which have not received enough attention like the impact of depleted uranium (DU) warheads, and mines.

CONCLUSION

In the past, short-term planning was a major obstacle to environment and sustainable development policy making. Today, some attempts go to the opposite extreme, ignoring pressing current environmental challenges while setting long-term grand plans, in a practice which could be termed 'fleeing forward'. While looking forward to the future is needed for sound environmental planning, ignoring current problems will not solve them, however noble the long-term goals might be. Problems unaddressed in the present will multiply, creating even bigger challenges in the future. Some excellent grand schemes announced in the region regarding key issues as renewable energy, water and coastal management, with global ambitions, should not divert attention from simple measures urgently required at the local level to ensure more efficient and sound use of resources.

What is needed is the implementation of long-term environmental management strategies, as well as powerful and effective environmental agencies and institutions backed up by clear political and legislative mandates in addition to sufficient resources. Long- and short-term planning should go hand in hand to solve today's and tomorrow's problems.

The situation is not entirely bleak. Most Arab countries now have either a Ministry of Environment, a state Environment Agency or both. The civil society and the private sector are getting more involved in environmental matters, though with varied levels of effectiveness. Some government bodies responsible for the environment have moved into strategic planning, spearheaded by the Environment Agency of Abu Dhabi (EAD), which launched in April 2008 an Environment Strategy for the Emirate. This model strategy sets two-year and five-year targets, covering ten priority areas: environmental sustainability, water resources management, air quality, hazardous waste, biodiversity, environmental awareness, safety systems, organizational efficiency, emergency management and information systems. Such initiatives are required all over the region, with significant emphasis placed on preparing for proper implementation over the long term.

The Arab region's fate is inextricably tied to the state of its environment, which in turn binds the region together internally as well as giving it a stake in global environmental initiatives. This report hopes to raise awareness in the Arab region, for governments, citizens, academic institutions, the private sector, and the media, of the urgency of incorporating environmental concerns into national development plans. As this report shows, a lot has been achieved in the Arab region when it comes to environmental awareness and initiatives, but much more is still needed.

Human Development and Patterns of Production and Consumption

Ibrahim Abdel Gelil

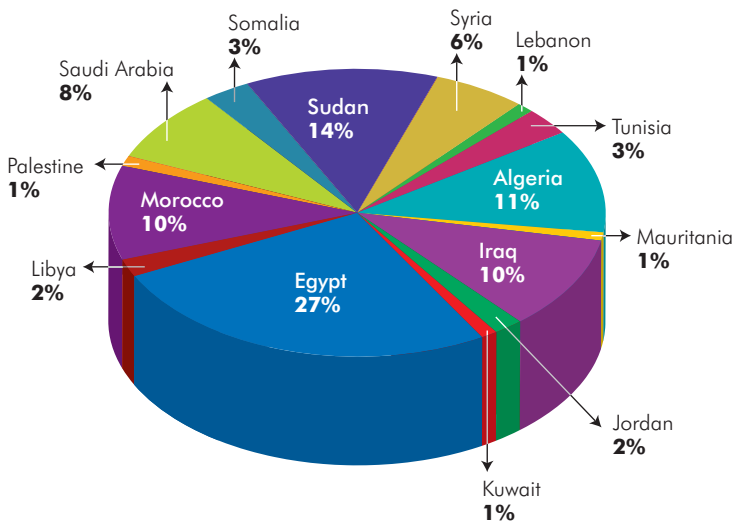
I. INTRODUCTION

The Arab region is politically and economically heterogeneous, and within it are shared common religious, cultural and ethnic profiles. Though the Arab countries vary in size, natural resources and energy endowments, income levels, social and political structures, and institutions, they have a range of shared economic and environmental challenges.

Where relevant, one can also distinguish between three geographic sub-regions that tend to share closer relations: the Mashreq region groups Egypt, Iraq, Jordan, Lebanon, Palestine and Syria together; the Maghreb region is composed of Algeria, Libya, Morocco and Tunisia; while the Gulf region includes the six members of the Gulf Cooperation Council (GCC: Bahrain, Kuwait, Oman, Qatar, United Arab Emirates, and Saudi Arabia) as they share common identities, interests and resources. While Yemen may be considered part of the larger Gulf sub-region in certain cases, it also belongs to a fourth cluster of countries that includes the Comoros Islands, Djibouti, Mauritania, Somalia and Sudan since these along with Yemen are all listed by the United Nations and the World Trade Organization (WTO) as least developed countries (LDCs) and are characterized by a high degree of poverty.

Though the region is richly endowed with hydrocarbon resources, the scarcity of fresh water and

FIGURE 1 ARAB POPULATION BY COUNTRY (2005)

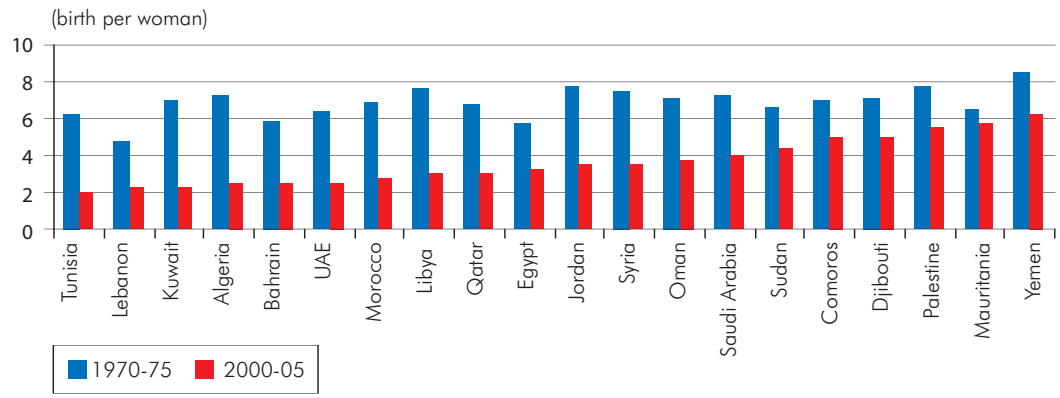


the region's growing demand for it are increasingly seen as barriers to development. Water scarcity is linked to other environmental problems including deforestation, desertification, difficulties in preserving and protecting coastal area, and the relative scarcity of arable land.

Demographic development in the region has been a determinant development factor affecting demand on natural resources, rates of waste generation, and increasing environmental pressures on ecosystems leading in some instances to negative impacts on human well-being.

In 2002, the Arab Human Development Report of the UNDP revealed many alarming signals concerning population and human development in the region: 65 million Arab adults are illiterate, two thirds of whom are women, and 10 million children are out of school. Only 0.6% of Arabs use the internet, and spending on research and development (R&D) is one seventh of the world average. Arab unemployment, at 15%, is the highest in the developing world. While the Arab region has harboured some of the most ancient civilizations in the world, it currently has the largest number of young people of any region. The age structure of the population is significantly younger than the global average, with almost 38% under the age of 14 (UNDP, 2002). In many of the Arab countries, mainly because of the decline in fertility and in infant mortality, the proportion of young people in the population may have peaked. While this presents a number of challenges, it could also bring many rewards, if development strategies and policies place the right focus on issues affecting younger age groups and the working-age population.

FIGURE 2 TOTAL FERTILITY RATE



This chapter highlights the relationships between population, consumption and human development.

II. POPULATION

During the last 55 years, the Arab population has increased from around 72 million in 1950 to about 300 million in the year 2005, or about 5% of the total world population. Egypt is by far the most populous (74 million) accounting for nearly one in every four Arabs (Figure 1). Sudan and Algeria have the next largest population sizes (36 and 33 million respectively); while countries such as Bahrain, Qatar and Djibouti all have population sizes less than 1 million.

Population growth rates differ widely across the region, reflecting divergent economic, social and cultural factors. Population has grown fastest in the past three decades in the oil-producing Gulf countries, due partly to a massive influx of foreign workers and increased spending on the provision of health services, which boosted fertility rates and cut infant mortality rates sharply. Although inflows of foreign workers have slowed markedly since 1990, today nationals still make up less than half the population in Kuwait, Qatar and the UAE. The average fertility rate (births per woman) has decreased from about 7 between 1970 and 1975 to 3.7 between 2000 and 2005 (Figure 2). Currently it varies among the Arab countries from as low as 2 in Tunisia to as high as 6.2 in Yemen.

FIGURE 3 ARAB POPULATION GROWTH

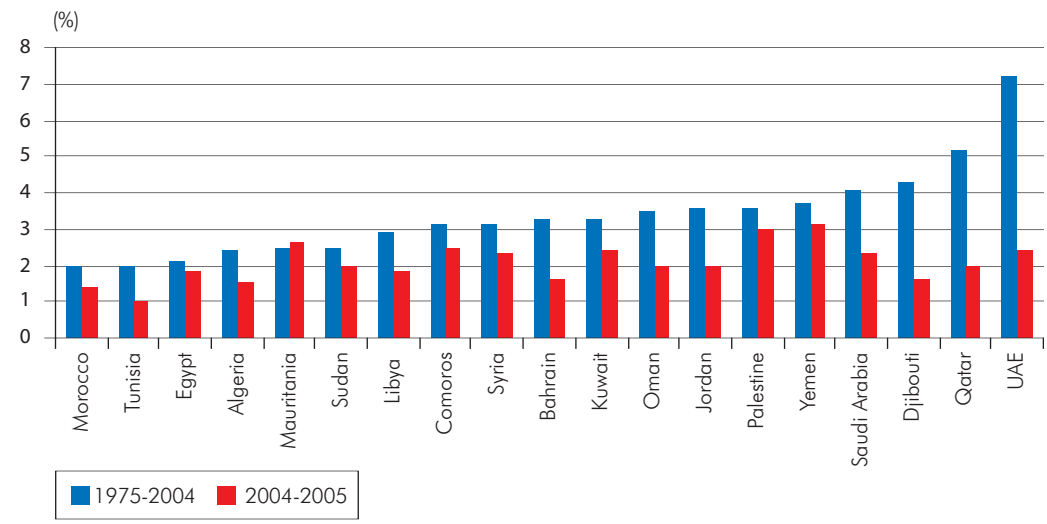


FIGURE 4 **URBAN POPULATION**

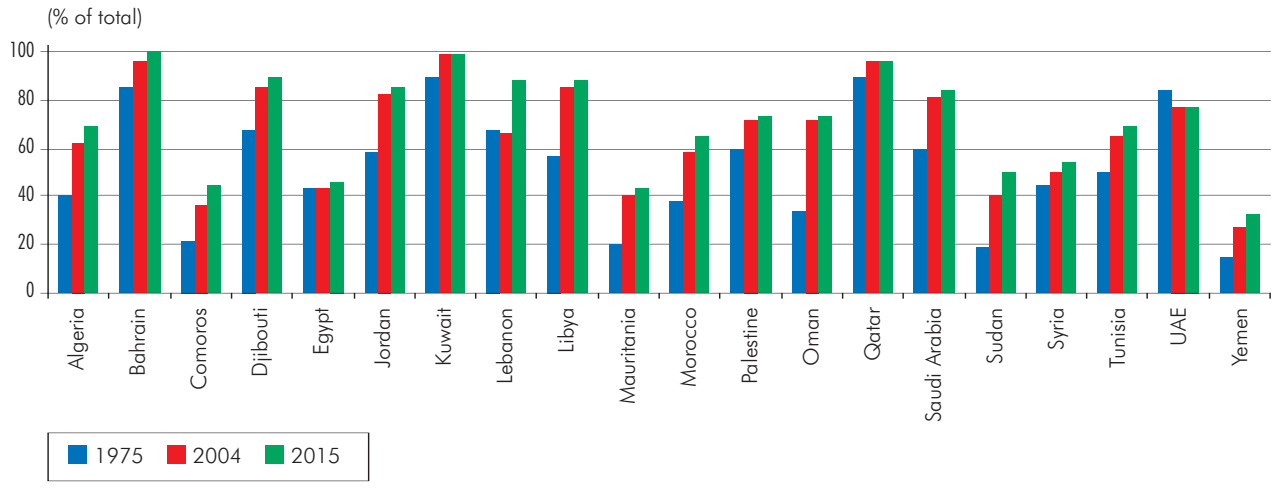
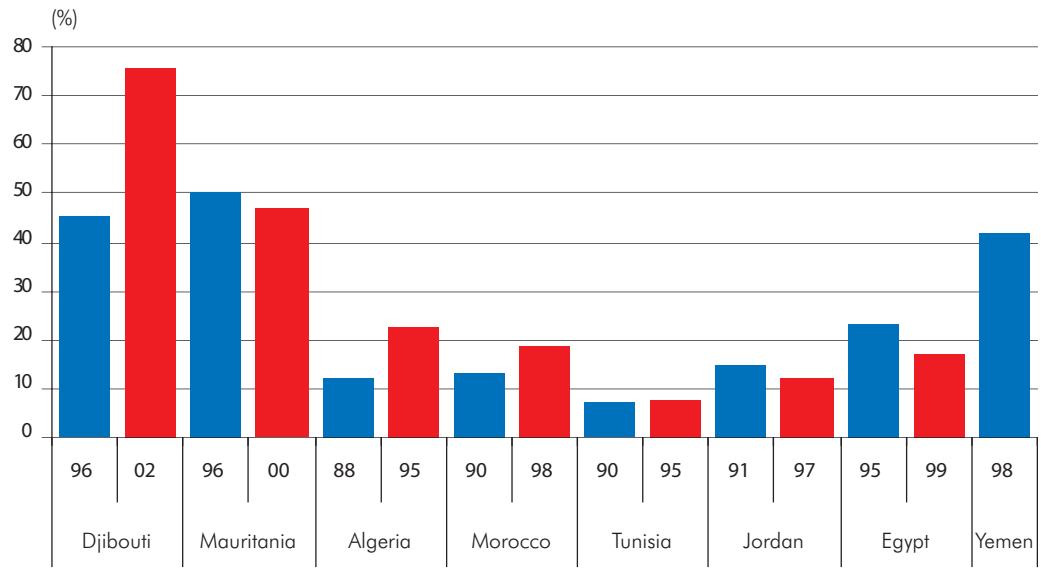


FIGURE 5 **NATIONAL POVERTY LINE IN SELECTED ARAB COUNTRIES**

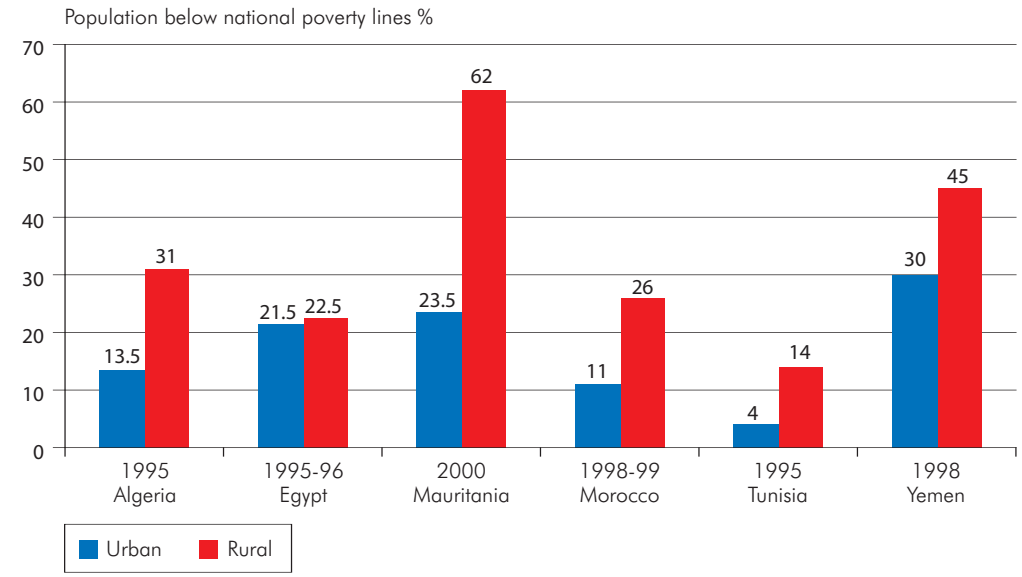


Source: World Bank, 2003.

In terms of population growth, the Arab region has the highest figures in the world. Between 1975 and 2004, the average growth rate was 3.3%, with only Lebanon (at 1%) below the global average of 1.4%. UAE with 7.2% growth in the same period has the highest growth rate among the Arab countries (Figure 3). It is expected that this high growth rate will drop on average to 2% between 2004 and 2015 with the highest rate above the average to remain only in Yemen (at 3.1%).

In 2005, urbanization levels varied from as low as 27% in Yemen to as high as 98% in Kuwait. Generally, the GCC countries have higher urbanization levels than the rest of the Arab countries. Percentages of urban population are exhibited in Figure 4. The average percentage of Arab urban population increased from about 52% of total population in 1975 to 66.5% in 2004, and is projected to increase to 71% by 2015.

FIGURE 6 DISPARITIES IN POVERTY LEVELS



Source: World Bank, 2003.

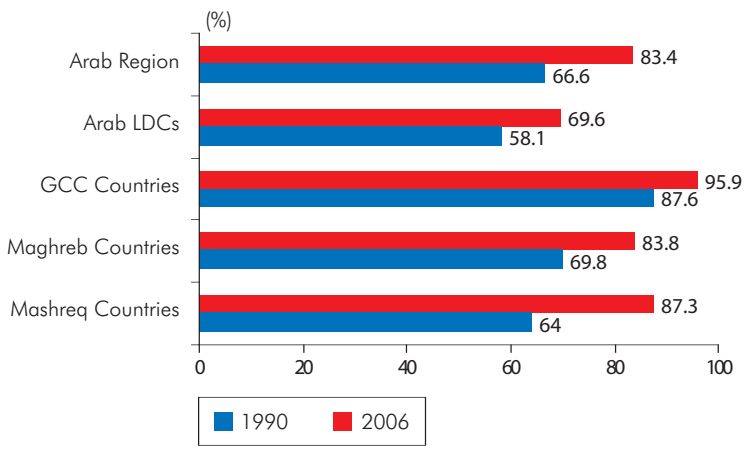
It should be noted that urban growth has a number of positive impacts on the environment and human well-being; for example, higher population densities mean lower per capita costs of providing energy, health care, infrastructure and services. Also, urbanization has historically been associated with declining birth rates, which reduces population pressure on land and natural resources. Despite these positive impacts, almost all major cities of the region are increasingly plagued by environmental problems. Some major aspects are as follows:

- As a direct result of urbanization, great threats to health and safety have arisen in cities due to water and air pollution, especially at the household and community levels. Waterborne diseases are found most commonly in low-income neighbourhoods as a result of inadequate sanitation, drainage and solid waste collection services. Health risks, especially to the poor, are also posed by pesticides and industrial effluents. These kinds of hazardous situations can often be easily found in the slum areas of many Arab cities such as Cairo, Damascus, Rabat, Sana'a, and others.

- The productivity of many cities is adversely affected by traffic congestion, air quality deterioration and water pollution. The loss in productivity includes the total productive time wasted in traffic and the associated increase in the costs of operating and maintaining vehicles, increasing health care costs, and loss of working hours. Furthermore, the rising costs of treating water for industrial and domestic purposes are damaging the productivity of urban economies.

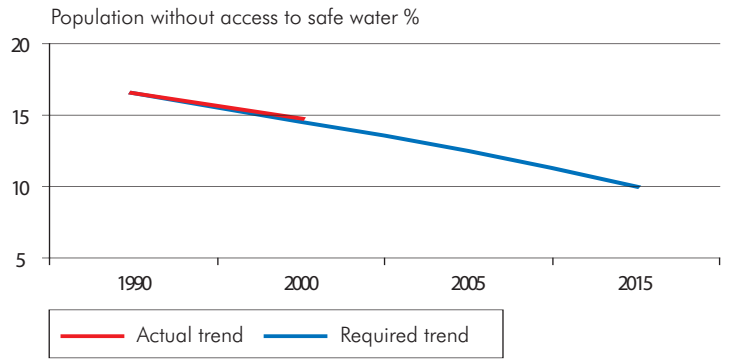
- Uncollected and improperly handled solid waste can have serious health consequences by

FIGURE 7 LITERACY RATES IN THE ARAB COUNTRIES



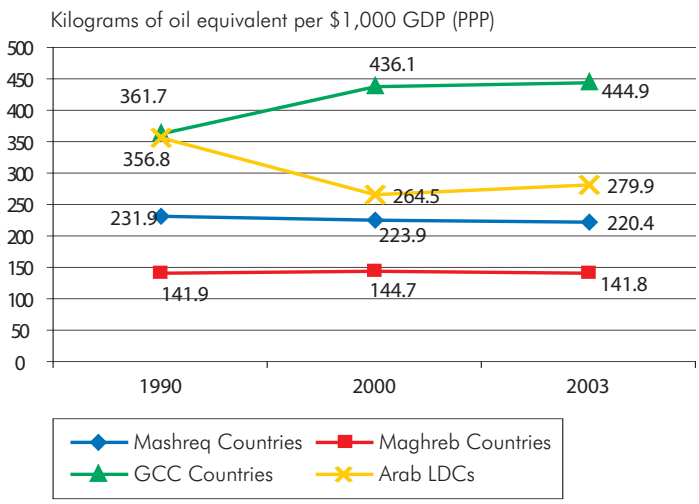
Source: UNESCWA, 2007.

FIGURE 8 ACCESS TO SAFE WATER



Source: World Bank, 2003. Human Development Report, 2003.

FIGURE 9 ENERGY INTENSITY IN THE ARAB COUNTRIES



Source: UNDP, 2003.

TABLE 1 ARAB HUMAN DEVELOPMENT INDICATORS

Country	HDI Value	Rank
Kuwait	0.871	33
Bahrain	0.859	39
Qatar	0.844	46
UAE	0.839	49
Oman	0.810	56
Libya	0.798	64
Saudi Arabia	0.777	76
Lebanon	0.774	78
Jordan	0.760	86
Tunisia	0.760	87
Algeria	0.728	102
Syria	0.716	107
Egypt	0.702	111
Morocco	0.640	123
Comoros	0.556	132
Sudan	0.516	141
Djibouti	0.494	148
Yemen	0.492	150
Mauritania	0.486	153

Source: World Human Development Report, 2006.

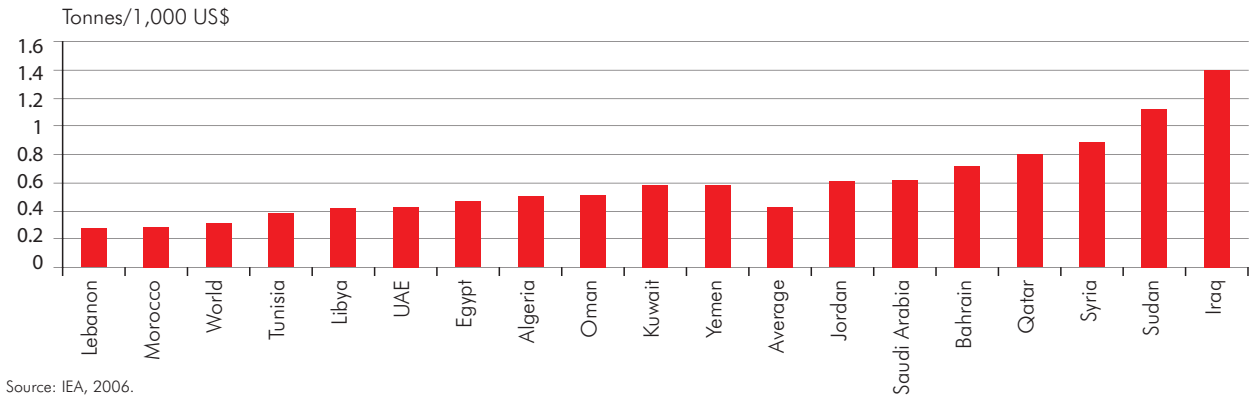
blocking drainage systems and contaminating groundwater at landfill sites. In many cities, it is difficult to secure land for waste disposal facilities, especially onshore landfill sites. Most cities in the region are also unable to manage the increasing amounts of hazardous wastes generated by rapid industrialization. Properly engineered landfill sites such as those in Alexandria, Jubail, and Bahrain are unfortunately a rarity in Arab countries.

- Conversion of agricultural land and forest, as well as the reclamation of wetlands for urban uses and infrastructure, are associated with widespread removal of vegetation to support urban ecosystems, putting additional pressure on nearby areas that may be even more ecologically sensitive. This is the case in most of the urban centres in the Arab countries.

- Urbanization in coastal areas often leads to the destruction of sensitive ecosystems and can also alter the hydrology of coasts and their natural features such as mangrove swamps, reefs and beaches that serve as barriers to erosion and form important habitats for species. This is the case in tourism development in the Red Sea and Gulf of Aquaba, and in many coastal areas of the GCC.

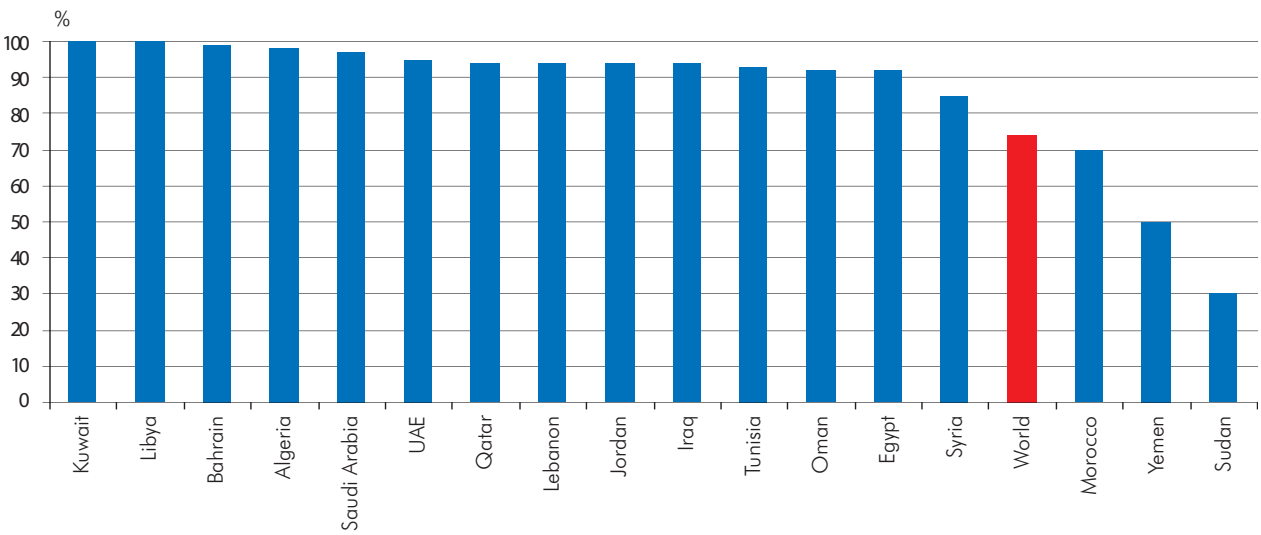
Urbanization has been a key characteristic of the region, though in different degrees between the Mashreq, Maghreb and the Arabian Peninsula. In addition to political and socioeconomic conditions, continued military conflicts and political instability have led to massive population displacements in many countries. This has led to greater population densities, increased water and energy demand, deterioration of air quality, waste management problems and a generally deteriorated urban environment. These factors combined have caused an expansion of slum areas and refugee camps especially around the

FIGURE 10 ENERGY INTENSITY IN THE ARAB COUNTRIES



Source: IEA, 2006.

FIGURE 11 ELECTRIFICATION RATE IN THE ARAB COUNTRIES



Source: IEA, 2006.

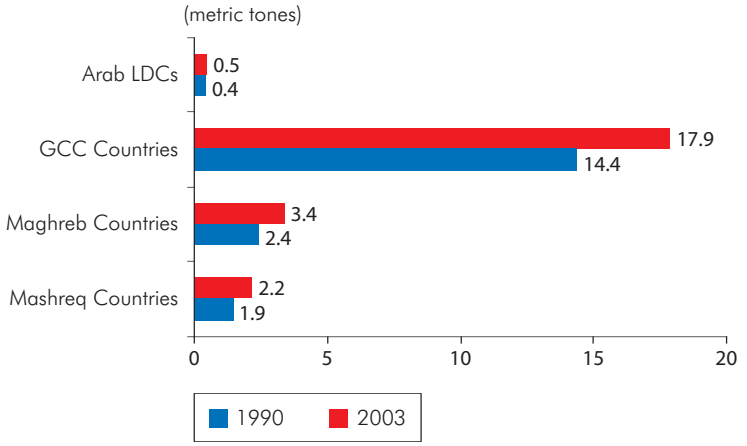
major cities of some Mashreq countries and in Yemen. In the last decade, the number of people living in slum conditions has almost doubled in Yemen, and has increased by about 30, 15, 20, and 25 percent in Lebanon, Jordan, Iraq and Syria, respectively (UN-HABITAT, 2003).

The conflicts in Palestine and in Iraq have also augmented slum areas. Today there are 400,582 Palestinian refugees in Lebanon, 426,650 in Syria and 1,780,701 in Jordan. In Occupied Palestinian Territories, there are 1,649,187 registered refugees, or almost one third of the total population (UNRWA, 2005). In Iraq, stringent economic sanctions in the past and the continued conflicts have led to substantive increases in urban poverty; 32 percent of people in Iraqi cities are living under or near the poverty line while a large number live in refugee camps on the borders with Syria and Iran.

III. HUMAN DEVELOPMENT

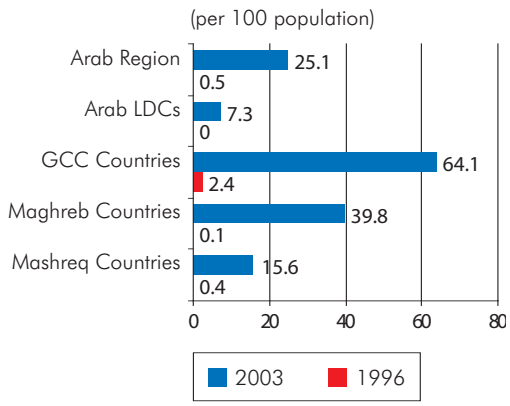
In terms of the Human Development Index (HDI), there is considerable variation within the region (Table 1). In terms of the sub-regions, it is clear that, except for Saudi Arabia, the Gulf region, which is characterized by a relatively small population and a high concentration of natural resource wealth, retains a significantly higher HDI rating than the Mashreq and

FIGURE 12 CO_2 EMISSIONS PER CAPITA



Source: UNDP, 2003.

FIGURE 13 CELLULAR PHONE SUBSCRIPTIONS



Source: UNDP, 2003.

Maghreb regions. Kuwait is the highest-ranking Arab country on the Global HDI, and Mauritania has the lowest HDI value in the Arab region (UNDP, 2006).

IV. MILLENNIUM DEVELOPMENT GOALS (MDGs)

The prospects of the Arab region as a whole for achieving the MDGs are encouraging; however, wide gaps and significant disparities in progress, both among and within Arab sub-regions, remain. Although the region will probably continue to make progress in reducing income poverty, Iraq, Palestine, and the Least Developed Countries (LDCs) will likely fail to meet the poverty related targets by 2015 without drastic improvements in their economic and political situations (Figure 5). Disparities between rural and urban populations in terms of poverty levels are evident in Algeria, Mauritania, Morocco, Tunisia, and Yemen (Figure 6).

Today, the Arab states face significant development challenges. About ten million children still do not go to school. Even though women's access to education has tripled since 1970, gender disparities persist. Over half of women remain illiterate, and women occupy less than five per cent of the seats in Arab legislatures.

Over the last few decades, the Arab countries have made progress towards many of the MDGs. Literacy rates for the 15-24 year old range steadily increased from 35 per cent in 1970 around to 83 per cent in 2006 (Figure 7). Life expectancy soared from 51 to 68 years between 1970 and 2001. New infrastructure extended access to safe water to 83 per cent of the population, while sanitation networks spread to 87 per cent of the urban population (Figure 8).

Target 9 of the MDGs calls for integrating the principles of sustainable development into country policies and programmes as well as reversing the loss of environmental resources. The percentage of land area covered by forest in the Arab region decreased from 7.4% to 6.7% between 1990 and 2004. This implies that the Arab region as a whole is not on track to meet the set target despite reforestation efforts in many Arab countries to increase green areas. Some of the challenges facing the region include high population density, deforestation due to high demand for energy resources, especially in the Arab LDCs, lack of institutional capacity, and lack of legislation and incentives encouraging reforestation.

However, despite the deficiencies in institutional capacity, legislation, and incentives, the Arab region has witnessed a significant increase in protected areas since 1990. The proportion of protected areas in the region increased from 2.4% to 3.9% between 1990 and 2004. However, the protected area average in the Arab region remains about three times lower than the world average of 13% in 2004. The increase is mainly due to efforts in the GCC sub-region where the size of

protected areas has more than quadrupled since 1990. This is partly attributed to the protection of 64 million hectares as a wildlife management area in Saudi Arabia, the largest protected area in the world, in 1994. The lowest proportion of protected areas compared to surface area is in the Arab LDCs, which have the highest levels of biological diversity in the region and which have not witnessed any successful efforts in expanding protected areas in the past 15 years.

Dry lands account for over 50% of total area in the Arab world. These are characterized by harsh environments, fragile ecosystems, limited water resources and non-arable lands. Land degradation in the Arab region is widespread, due primarily to misuse, and is proceeding at an accelerating rate. A growing population and changing patterns of consumption have resulted in increasing food demand, hastening land degradation in this arid environment. Wind erosion, salinity and water erosion constitute the major threats. Failures of resource management policies are aggravated by overgrazing, overexploitation of water and land resources, over-cultivation of marginal lands, deforestation, and the use of inappropriate technologies. Despite government efforts to prevent and reduce land degradation at the national and regional levels, only limited success has been achieved, mostly due to the severity of the problems.

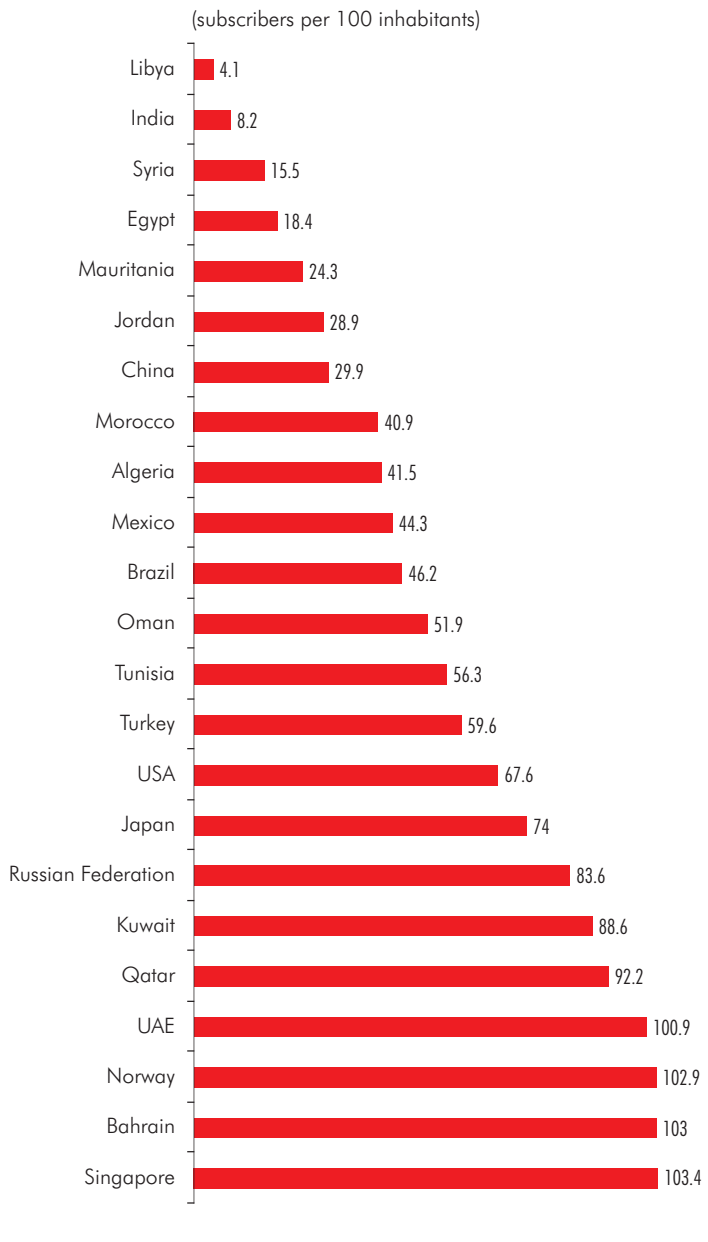
V. PRODUCTION AND CONSUMPTION PATTERNS

According to the World Bank, while only 2.4% of the Middle East and North Africa (MENA) region's population lives in absolute poverty under an income of $1 a day, this figure jumps to a more realistic 23% for incomes of only $2 a day. Worryingly, the reduction in the absolute numbers of poor that was achieved in the 1980s was reversed during the 1990s despite the fact that economic growth was relatively higher for the region.

Rapidly expanding populations, rural-urban migration, and widespread subsidies have contributed to a rising demand for energy in the Arab world since 1990. On average, energy consumption per $1,000 GDP increased by 10% between 1990 and 2003. While the Mashreq and the Arab LDCs witnessed decreases of 5% and 22%, respectively, energy consumption per $1,000 GDP in the GCC countries rose by 23%. The Maghreb maintained a constant average level over the same period (Figure 9). Of course, there are disparities among Arab countries on levels of energy intensity; seven countries have energy intensity above the world average (Figure 10).

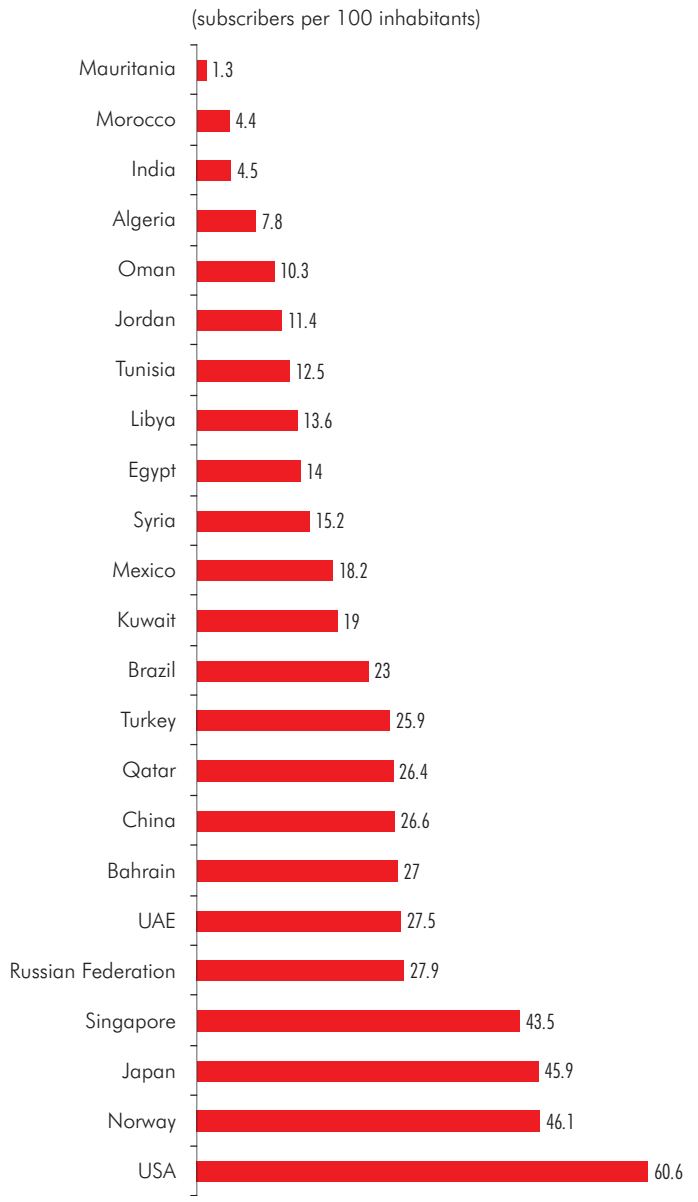
In per capita terms, a large discrepancy in energy use persists between the GCC countries and

FIGURE 14 MOBILE PHONE PER CAPITA



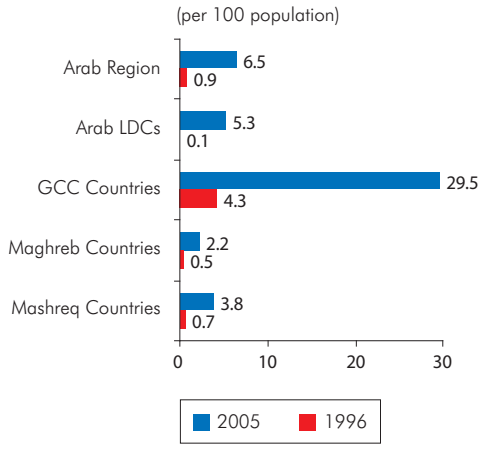
Source: ITU, 2006.

FIGURE 15 MAIN TELEPHONE LINES PER CAPITA



Source: ITU, 2006.

FIGURE 16 PERSONAL COMPUTERS BY REGION



Source: UNESCWA, LAS, 2007.

all other Arab countries. Per capita energy consumption in all the GCC is higher than the world average. Per capita electricity consumption in the GCC remains among the highest in the world as well.

Electrification rates also varied widely among Arab countries, averaging 80% in 2005. While Kuwait boasted a 100% electrification rate, some Arab LDCs have limited electricity coverage. Across the region, about 63 million people, almost 20% of the Arab population, had no access to electricity in 2005, and one fifth relied on non-commercial fuels. Another 20% of people living in poor urban and rural areas had limited and unreliable access to energy (Figure 11).

The regional level of per capita CO2 emissions rose by 28% between 1990 and 2003 from 3.1 to 3.9 metric tons. Mashreq and Maghreb countries and the Arab LDCs saw total emissions of CO2 rise by 66%, 80% and 57%, respectively. The Mashreq and the Arab LDCs maintained relatively stable levels of per capita emissions, while those in the Maghreb rose by 42%. The GCC remains the sub-region with both the highest total and per capita emissions; the former increased by 86% between 1990 and 2003 (Figure 12; see also chapter 4).

Arab countries have expended serious efforts in implementing the Montreal Protocol. Legislation and programmes have been developed to reduce, control and monitor the consumption of ozone-depleting substances (ODS), especially chlorofluorocarbons (CFCs). By 2004, the region had succeeded in decreasing the level of consumption of ODS by 31%. In fact, since 2000, all sub-regions have witnessed drops in total ODS consumption, the most significant of which being the Mashreq (40%). CFCs accounted for 64% of total ODS in the region (UNESCWA and LAS, 2007).

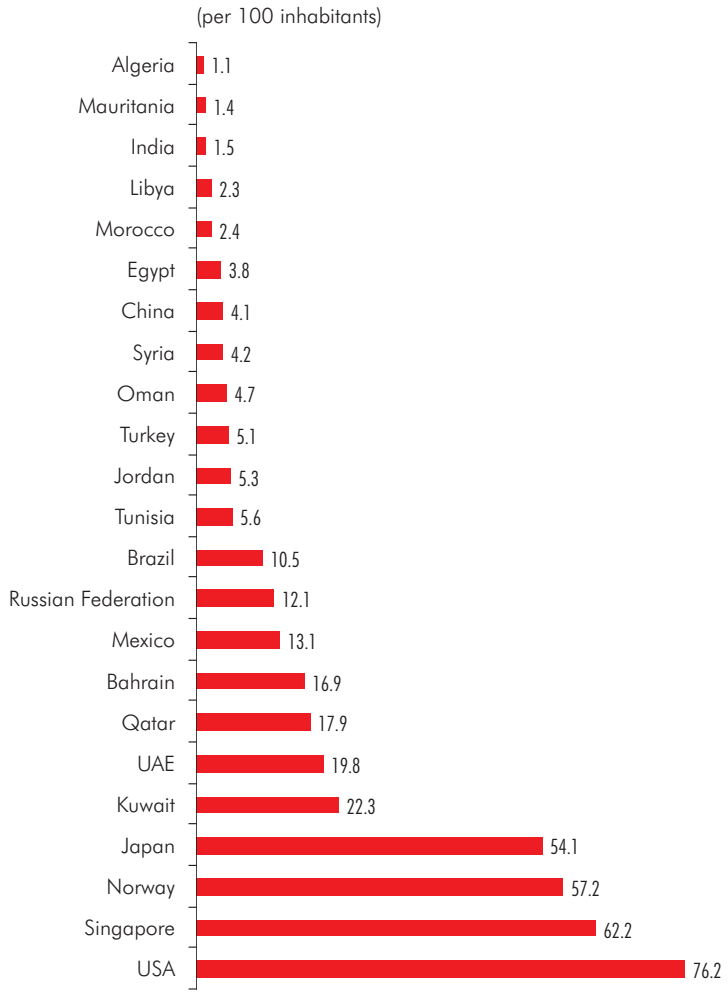
Target 18 of the MDGs stipulates that governments, in cooperation with the private sector, must endeavour to make available the benefits of new technologies, especially in the areas of information and communications. With very few exceptions, access to information and communication technologies (ICT) in the twenty-two Arab countries increased steadily over the last decade and a half. However, despite this progress, the region as a whole lags considerably behind the world average in terms of fixed telephone lines, personal computers, and internet users. Moreover, disparities between Arab countries remain very high. The digital divide is most noticeable when comparing the advanced countries of the GCC with many poorer Arab countries.

The mobile sector in the Arab world has grown very rapidly during the past decade. Between 1996 and 2005, the number of cellular subscribers has increased by a factor of 50 and, today, there are on average more than 25 subscriptions per 100 people. It is the only indicator of target 18 of MDG Goal 8 (regarding making widely available the benefits of new technologies in information and communications) for which the average of the Arab countries comes close to the world average. However, in Libya, there are still less than 5 cellular subscriptions per 100 people (Figure 13).

In contrast to the mobile sector, the number of fixed telephone lines in the Arab region has grown at a slow pace since the early 1990s. By 2005, the average number of fixed lines in operation per 100 people had reached only 9.5, around half of the world average. While fixed telephone markets in some of the GCC countries, namely Kuwait, Saudi Arabia, and the UAE are showing signs of saturation, the penetration rate remains below 4% in all six Arab LDC countries and Morocco (Figures 14, 15).

While still less than half the world's average (6.5% as opposed to 13.4%), the number of personal computers (PCs) in Arab countries has increased substantially since the mid 1990s. The average number of PCs in the four Arab subregions clearly illustrates the digital divide that separates the GCC countries from the rest of the region. Excluding Lebanon, all Mashreq and Maghreb countries and the Arab LDCs have rates below 10%. The relatively high average number of PCs in the Arab LDCs in 2005 is primarily due to a significant increase in PC usage in Sudan (Figures 16, 17).

FIGURE 17 PERSONAL COMPUTERS BY COUNTRIES



Source: ITU, 2006.

Access to and use of the internet in Arab countries have grown at a very fast pace over the past few years. In 2005, 7.2% of the Arab population was using the internet, compared to only 1% in 2000. However, the average number of internet connections in the Arab countries is still well below the world average of 15.2 per 100. Internet use is particularly limited in Iraq, Mauritania, and Yemen, where less than 1% of the population use the internet. This may be in part attributed to the low number of websites available in Arabic (World Economic Forum website).

As a result of the abundance of hydrocarbon resources and the heavily subsidized energy prices, energy intensive industries such as aluminium, cement, petrochemicals, and the like have been widely attracted to the region. These industries exert heavy burdens on natural resources and the environment. Within the current global climate policies, hosting of these industries could be looked at as carbon leakage from industrialized countries to developing countries where no commitments to reduce carbon emissions have been made. Additionally, and due to scarcity of water resources in the region, especially in the GCC sub-region, those countries rely heavily on sea water desalination to meet growing water demand. The widely penetrated desalination technologies in the region have been those fuelled by oil and gas, exacerbating their environmental impacts and carbon emissions. Accordingly, this has led to increasing the energy and CO2 emissions per capita in the GCC countries.

Cleaner production (CP) concepts and tools have been introduced in some Arab countries within the gradual evolution of the environmental management at the national levels. One regional centre promoting pollution prevention and cleaner production in the Mediterranean Arab countries has been the Regional Activity Center for Cleaner Production (RAC/CP) established under the Mediterranean Action Plan (MAP) in Barcelona, Spain. The RAC/CP's objective is to provide technical support to its 21 member countries of the Mediterranean and the European Community, specifically through giving support to businesses wishing to promote less polluting and more eco-efficient techniques and practices in their activities. Since the mid-nineties, the Arab countries have been much more involved in CP and have progressively adopted measures fostering, directly or indirectly, CP implementation. National CP centres have been created, or are in the process of starting up, in most countries. Tunisia was the first country in the region to operate a centre entrusted to introduce Cleaner Production in industry in 1996, followed by Morocco and Egypt. At present, most of the Arab countries have considered or are in the process of setting up CP centres, in many cases with support from international development organizations such as UNIDO (UNEP/ROWA, 2007).

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Integrating Environment in Development Planning

Mostafa Kamal Tolba

I. INTRODUCTION

Integrating environment in development planning is what we now call sustainable development with its three dimensions: economic growth, social development and environmental protection.

The concept of sustainable development did not come up overnight. It is based on tenets expressed more than three decades ago. At the beginning of the 1970s, the Club of Rome released its famous report "Limits to Growth," warning that the planet's ability to sustain us, our industries, and our agriculture was being jeopardized, and that what, for a relatively small human population, had seemed infinite was actually alarmingly finite.

In Stockholm at the 1972 UN Conference on the Human Environment, the governments of the world agreed on the urgent need to respond to the problem of environmental deterioration. The Stockholm Conference clarified the link between development and the environment and suggested an approach that would recognize the socioeconomic factors behind many environmental problems and cure the effects by treating the causes.

The conference defined environment as the dynamic stock of physical and social resources available at any given time for the satisfaction of human needs, and development as a process by which these resources are used for increasing and maintaining human well-being. It became evident that environmental and development objectives are complementary.

With this understanding a search began for a new, more rounded concept of development related to the limits of the natural-resource base in which environmental considerations play a central role while still allowing opportunities for human activities. Current patterns of production and consumption, based on waste, extravagance, and planned obsolescence, would have to be replaced by those based on the conservation and reuse of resources.

In 1974 the Cocoyoc Declaration adopted by the United Nations stressed that:

1- Economic and social factors were often the root cause of environmental degradation.

2- Different nations placed widely differing demands on the biosphere, with the rich preempting and wasting many cheap natural resources, whereas the poor were often left with no option except to destroy them (this is now reflected in the concept of ecological footprint).

3- The principal means of achieving both environmental and developmental goals is to find alternative patterns of lifestyle and development.

4- This generation must not jeopardize the well-being of future generations by squandering the planet's resources.

Note that principles 1, 3, and 4 above have since become integral parts of the concept of sustainable development.

Concerns voiced at Stockholm, Cocoyoc and several subsequent international conferences have led to the evolution of the theory and practice now known as sustainable development. In 1987, the UN World Commission on Environment and Development elaborated the concept of sustainable development in its report "Our Common Future." In 1992, at the Rio United Nations Conference on Environment and Development (The Earth Summit), the leaders of the world agreed that the protection of the environment and social and economic development are prerequisites for sustainable development.

Since Rio, the world's nations have met in several major international conferences, which defined

a comprehensive vision for the future of humanity. The 20th century culminated with the UN Summit in 2000 which adopted the eight Millennium Development Goals; goal 7 was "Ensure environmental sustainability."

At the Johannesburg Summit on Sustainable Development in 2002, leaders of the World at Heads of State and Government Level declared:

> *1- We, the representatives of the peoples of the world, reaffirm our commitment to sustainable development.*
>
> *And 2- We commit ourselves to building a humane, equitable and caring global society, cognizant of the need for human dignity for all.*

Most, if not all, the Arab states participated in the adoption of all these declarations. Therefore they have a moral obligation to achieve the Millennium Development Goals.

Our concern in this chapter is goal number 7 – ensuring environmental sustainability – through integrating environment into development plans at every level.

Of course there are serious challenges that face anyone trying to achieve such integration. These challenges include: poverty eradication, changing consumption and production patterns, protecting and managing the natural resources base and encouraging popular participation and effective support to education, scientific research and public information. Achieving all of this, however, is easier said than done because of the ills that governments themselves recognized at Johannesburg six years ago: particularly foreign occupation, armed conflicts, corruption, and modest efforts by the rich countries to help the poor ones. Globalization, has added a new dimension to these challenges.

The Arab states are fully aware of the challenges they face. In fact, they addressed most of them in the Abu Dhabi Declaration on the Future of Environmental Action in the Arab World, which was issued on the 3rd of February 2001, more than seven years ago.

In this declaration, the Arab ministers responsible for environmental affairs declared – inter alia – :

1- We note that despite the fact that we have today the benefit of a considerable amount of experience and expertise in dealing with the various environmental problems that face us, the reality is that those involved in environmental action in the Arab world are still far fewer in number and far less experienced than the situation requires and that institutions for environmental protection in the Arab world are of recent creation, have limited expertise and face difficult and complex challenges.

2- The priority environmental problems facing the Arab world at the beginning of the twenty-first century are:
   - The acute shortage and deteriorating quality of sources of water;
   - The paucity and deteriorating quality of exploitable land;
   - The imprudent consumption of natural resources;
   - Urban sprawl and its associated problems;
   - The degradation of marine and coastal areas.

3- We will apply new environmental accounting methods; adopt "cleaner production" strategy in its widest sense; adopt measures to ensure effective Arab participation in achievements in the field of advanced technology for the improvement of the Arab environment.

4- We will:
   - Pay greater attention to human development and capacity building at all levels of action and in all environmental specializations;
   - Develop curricula at all educational levels so that the environment becomes a basic component thereof;
   - Provide incentives to the Arab information media to take more focused and clearer interest in informing Arab citizens of environmental problems.
   - Encourage civil society to participate actively in decision – making on matters of environmental protection;
   - Achieve a qualitative leap in the efforts of scientific research and technological development institutions;
   - Emphasize the local absorption of water desalination techniques.

TABLE 1 **ESI INDICATORS IN THE ARAB REGION**

Indicator	Average Arab League Member Score	Average Rest of the World Score
Air Quality	-0.28	0.04
Water Quality	-0.54	0.07
Water Quantity	-0.58	0.07
Biodiversity	-0.12	0.01
Terrestrial Systems	0.54	-0.07
Reducing Air pollution	-0.14	0.02
Reducing Water Stress	-0.76	0.12
Reducing ecosystem Stress	-0.54	-0.07
Reducing Water & consumption pressures	-0.14	0.14
Reducing population growth	-0.63	0.08
Basic human sustenance	0.22	-0.03
Environmental Health	-0.06	0.01
Science and technology	-0.23	-0.19
Capacity for debate	-0.43	0.05
Environmental governance	-0.61	-0.02
Private Sector Responsiveness	-0.28	-0.12
Eco- efficiency	-0.52	0.07
Participation in international cooperative efforts	-0.33	0.02
Reducing Greenhouse Gas Emissions	-0.44	0.06
Reducing Transboundary Environmental Pressures	0.03	0.04

Source: Environmental Sustainability Index (ESI) 2005

5- We affirm the need for permanent resources to be secured for the funding of programs to address current and future environmental problems in the region by devising an inter-Arab mechanism to finance environmental investments at the national and regional levels.

II. THE ABU DHABI DECLARATION: SEVEN YEARS LATER

Let us now examine where we stand in 2008 with the implementation of the Abu Dhabi Declaration and responding to the rest of the challenges mentioned above.

It is important to keep in mind here that the purpose of this report in quantifying environmental sustainability in the Arab world is to facilitate more effective decision- making. Assigning blame or praise is not the goal.

Alarming figures on the environmental status of Arab countries appeared in the Environmental Sustainability Index (ESI) which was prepared for the World Economic Forum by researchers at Yale and Columbia universities, in 2002 and 2005. These ESIs rank the average Arab country more than 10 points below other countries.

Because Arab states lie predominantly in extremely arid regions, and because water is such a fundamental aspect to environmental sustainability, it is logical to suspect that the low sustainability scores found in Arab states are primarily a function of location. However, when this measure of aridness is included as a control in the ESI analysis, scores of Arab states remain significantly below other states.

Geography, therefore, appears to matter, but not enough to account for the systematic under-performance observed among Arab states.

What does this data show

The Environmental Sustainability Indexes (ESIs) of 2002 and 2005 covered 142 and 146 countries, respectively, including 16 of the 22 Arab League member countries. They were based on official publications by UNESCO, FAO, WHO, World Bank, Federal Environment Agency of Germany, World

Economic Forum and National Reports prepared by the World Economic Forum and Yale and Columbia universities.

It should be noted that Bahrain, Comoros, Djibouti, Qatar, Palestine, and Somalia were omitted for various technical reasons.

To start with, we have to admit that there is a paucity of environmental data, and huge gaps exist in the data that is available. All this data, with few exceptions, dates back to late nineties of the past century to 2003 and only few from 2004.

Arab countries score above average when it comes to preserving land from human influence and in reducing human vulnerability to environmental harms. The above average performance in reducing human vulnerability is especially notable. Arab countries, however, score below average on seventeen of the ESI's twenty indicators, as summarized in Table 1:

The Arab states score, in general, far below average in, for example, air and water quality and in measures of social and institutional capacity and global stewardship.

Population growth and urbanization

The Arab rate of population growth is still among the highest in the world in spite of all the efforts exerted by the governments of the region to implement family planning policies. The population of the Arab world was around 72 million people in 1950, increasing to nearly 300 million in 2000, and is expected to reach 466 by 2025.

Table 2 shows the population indicators of all members of the Arab League as they were calculated in 2002/2003.

This very high rate of population growth puts a heavy burden on natural resources and social services and heightens the need for employment opportunities growth as youths seek to enter the work force. High rates of population growth significantly dampen prospects for lasting economic development.

Rapid urbanization is also endemic throughout the region. The United Nations Population Division reports that on average, urban areas in the Arab world are growing a percentage point faster than in the rest of the world. Some of the poorest countries, such as Comoros, Mauritania, and Somalia, have rates of urbanization in excess of 4 percent per year, which puts tremendous strains on urban water supplies and sanitation infrastructure. Cairo, the largest Arab city with a population of 10.6 million, has significant air quality and sanitation problems. Casablanca, a city of 3.3 million, properly disposes of only 10 percent of household waste through sanitary landfills and incineration. Sana'a (Yemen), with 1.2 million people, effectively has no sanitary waste disposal facilities. The proportion of household waste that is processed ranges from only 3 percent in Damascus to 83 percent in Tunisia.

Table 3 shows the waste recycling rates recorded in the ESI tables. With very few exceptions, the 16 Arab countries reported score very low on waste recycling indices.

TABLE 2 **POPULATION INDICATOR OF THE ARAB COUNTRIES**

Country	Total Fertility Rate	Projected Change in Population by 2050 (%)
Algeria	3.1	66.2
Bahrain	2.8	300.4
Comoros	6.8	207.9
Djibouti	6.1	67.1
Egypt	3.5	64.3
Iraq	5.3	127.1
Jordan	3.6	128.5
Kuwait	4.2	180.7
Lebanon	2.5	35.4
Libya	3.9	106.4
Mauritania	6.0	207.9
Morocco	3.4	66.0
Oman	6.1	218.0
Qatar	3.9	45.3
Saudi Arabia	5.7	185.4
Somalia	7.3	240.5
Sudan	4.9	99.9
Syrian AR	4.1	105.9
Tunisia	2.3	46.5
U.A.E.	3.5	53.6
West Bank and Gaza	5.9	239.4
Yemen	7.2	295.0
Arab country average	4.6	140.3
World average	3.4	66.2

Source: Environmental Sustainability Index (ESI), 2002

TABLE 3 **PERCENTAGE OF WASTE RECYCLING**

Max	91
Min	0
Albania	0.00
Algeria	..
Angola	..
Argentina	0.30
Armenia	0.00
Australia	47.00
Austria	84.00
Azerbaijan	..
Bangladesh	35.00
Belarus	0.00
Belgium	87.00
Benin	25.00
Bhutan	..
Bolivia	2.00
Bosnia and Herz.	..
Botswana	1.00
Brazil	22.00
Bulgaria	22.80
Burkina Faso	12.00
Burundi	0.00
Cambodia	15.00
Cameroon	8.00
Canada	54.00
Central Afr. Rep.	0.00
Chad	0.00
Chile	8.00
China	..
Colombia	11.50
Congo	26.20
Costa Rica	..
Côte d'Ivoire	3.00
Croatia	13.00
Cuba	0.00
Czech Rep.	42.00
Dem. Rep. Congo	4.90
Denmark	65.00
Dominican Rep.	..
Ecuador	20.00
Egypt	0.00
El Salvador	0.00
Estonia	0.00
Ethiopia	0.00
Finland	89.00
France	55.00
Gabon	0.00
Gambia	0.00
Georgia	..
Germany	83.00
Ghana	0.00
Greece	35.00
Guatemala	5.00
Guinea	5.00
Guinea-Bissau	..
Guyana	..
Haiti	..
Honduras	..
Hungary	38.00
Iceland	..
India	14.50
Indonesia	30.00
Iran	..
Iraq	..
Ireland	35.00
Israel	..
Italy	40.00
Jamaica	..
Japan	78.00
Jordan	0.00
Kazakhstan	..
Kenya	1.00
Kuwait	0.00
Kyrgyzstan	0.00
Laos	..
Latvia	0.00
Lebanon	6.00
Liberia	0.00
Libya	20.00
Lithuania	..
Macedonia	..
Madagascar	..
Malawi	..
Malaysia	10.00
Mali	0.00
Mauritania	1.00
Mexico	13.00
Moldova	..
Mongolia	0.00
Morocco	0.00
Mozambique	0.00
Myanmar	14.00
Namibia	4.50
Nepal	15.90
Netherlands	78.00
New Zealand	65.00
Nicaragua	..
Niger	..
Nigeria	..
North Korea	..
Norway	85.00
Oman	..
P. N. Guinea	..
Pakistan	12.00
Panama	0.00
Paraguay	4.00
Peru	7.00
Philippines	0.00
Poland	17.20
Portugal	40.00
Romania	..
Russia	13.90
Rwanda	0.00
Saudi Arabia	..
Senegal	0.00
Serbia and Mont.	0.70
Sierra Leone	..
Slovakia	40.00
Slovenia	8.00
South Africa	0.00
South Korea	67.00
Spain	54.00
Sri Lanka	0.00
Sudan	..
Sweden	86.00
Switzerland	91.00
Syria	21.00
Taiwan	14.60
Tajikistan	..
Tanzania	..
Thailand	0.00
Togo	0.00
Trin. and Tob.	..
Tunisia	5.00
Turkey	40.00
Turkmenistan	..
Uganda	2.50
Ukraine	..
United Arab. Em.	..
United Kingdom	41.00
United States	42.00
Uruguay	0.00
Uzbekistan	..
Venezuela	..
Viet Nam	15.00
Yemen	5.00
Zambia	..
Zimbabwe	16.00

Source: Environmental Sustainability Index (ESI). 2005
Note: ".." means the data point is missing.

TABLE 4 **PERCENTAGE OF POPULATION WITH ACCESS TO IMPROVED DRINKING WATER SOURCE**

Max	100
Min	13
Albania	97.00
Algeria	87.00
Angola	50.00
Argentina	[88.93]
Armenia	92.00
Australia	100.00
Austria	100.00
Azerbaijan	77.00
Bangladesh	75.00
Belarus	100.00
Belgium	96.45
Benin	68.00
Bhutan	62.00
Bolivia	85.00
Bosnia and Herz.	98.00
Botswana	95.00
Brazil	89.00
Bulgaria	100.00
Burkina Faso	51.00
Burundi	79.00
Cambodia	34.00
Cameroon	63.00
Canada	100.00
Central Afr. Rep.	75.00
Chad	34.00
Chile	95.00
China	77.00
Colombia	92.00
Congo	46.00
Costa Rica	97.00
Côte d'Ivoire	84.00
Croatia	[95.48]
Cuba	91.00
Czech Rep.	[96.86]
Dem. Rep. Congo	46.00
Denmark	100.00
Dominican Rep.	93.00
Ecuador	86.00
Egypt	98.00
El Salvador	82.00
Estonia	[101.83]
Ethiopia	22.00
Finland	100.00
France	[101.75]
Gabon	87.00
Gambia	82.00
Georgia	76.00
Germany	100.00
Ghana	79.00
Greece	[102.16]
Guatemala	95.00
Guinea	51.00
Guinea-Bissau	59.00
Guyana	83.00
Haiti	71.00
Honduras	90.00
Hungary	99.00
Iceland	100.00
India	86.00
Indonesia	78.00
Iran	93.00
Iraq	81.00
Ireland	100.00
Israel	100.00
Italy	94.10
Jamaica	93.00
Japan	100.00
Jordan	91.00
Kazakhstan	86.00
Kenya	62.00
Kuwait	[98.75]
Kyrgyzstan	76.00
Laos	43.00
Latvia	[98.73]
Lebanon	100.00
Liberia	62.00
Libya	72.00
Lithuania	[98.01]
Macedonia	[86.05]
Madagascar	45.00
Malawi	67.00
Malaysia	95.00
Mali	48.00
Mauritania	56.00
Mexico	91.00
Moldova	92.00
Mongolia	62.00
Morocco	80.00
Mozambique	42.00
Myanmar	80.00
Namibia	80.00
Nepal	84.00
Netherlands	100.00
New Zealand	[97.7]
Nicaragua	81.00
Niger	46.00
Nigeria	60.00
North Korea	100.00
Norway	100.00
Oman	79.00
P. N. Guinea	39.00
Pakistan	90.00
Panama	91.00
Paraguay	83.00
Peru	81.00
Philippines	85.00
Poland	[102.2]
Portugal	[98.51]
Romania	57.00
Russia	96.00
Rwanda	73.00
Saudi Arabia	[87.55]
Senegal	72.00
Serbia and Mont.	93.00
Sierra Leone	57.00
Slovakia	100.00
Slovenia	[103.1]
South Africa	87.00
South Korea	92.00
Spain	[99.85]
Sri Lanka	78.00
Sudan	69.00
Sweden	100.00
Switzerland	100.00
Syria	79.00
Taiwan	100.00
Tajikistan	58.00
Tanzania	73.00
Thailand	85.00
Togo	51.00
Trin. and Tob.	91.00
Tunisia	82.00
Turkey	93.00
Turkmenistan	71.00
Uganda	56.00
Ukraine	98.00
United Arab. Em.	98.00
United Kingdom	[100.1]
United States	100.00
Uruguay	98.00
Uzbekistan	89.00
Venezuela	83.00
Viet Nam	73.00
Yemen	69.00
Zambia	55.00
Zimbabwe	83.00

Source: Environmental Sustainability Index (ESI). 2005
Note: Data in "[ ]" indicates imputed values; ".." means the data point is missing.

TABLE 5 **ESI WATER INDICATORS IN ARAB STATES**

Country	Water Quantity	Water Quality	Reducing Water Stress
Algeria	-1.04	-0.18	-0.18
Egypt	-0.27	-0.55	-0.82
Iraq	-0.08	-0.66	-0.47
Jordan	-0.70	-0.53	-0.45
Kuwait	-1.09	-1.10	-2.79
Lebanon	-1.07	-0.79	-1.48
Libya	-0.66	-0.75	-0.61
Mauritania	0.14	-0.53	0.59
Morocco	-1.07	-0.69	-0.27
Oman	-1.06	-0.05	-1.54
Saudi	-1.08	-0.56	-0.59
Somalia	-0.08	-0.25	0.26
Sudan	-0.01	-0.75	0.45
Syrian AR	-0.18	-0.40	-0.76
Tunisia	-0.64	0.05	-0.62
U.A.E.	-0.36	-0.92	-2.87
Arab average	-0.58	-0.54	-0.76
World average	0.00	0.00	0.11

Source: Environmental Sustainability Index (ESI). 2002

Note that the following variables are taken into account for the relevant indicators presented in table 5:

- Water Quantity: (i) freshwater available per capita and (ii) internal groundwater availability per capita.
- Water Quality: (i) dissolved oxygen concentration; (ii) electrical conductivity; (iii) phosphorus concentration; and (iv) suspended solids.
- Reducing Water Stress: (i) Industrial organic water pollutant (BOD) emissions per available freshwater; (ii) fertilizer consumption per hectare of available land; (iii) pesticide consumption per hectare of available land; and (iv) percentage of country under severe water stress.

On the other hand, the Arab states fare relatively well when it comes to percentages of population with access to improved drinking water source (Table 4).

The fact that 70% of the region is arid certainly has a major influence in shaping environmental and sustainability issues in the Arab region (see Chapter 7).

Freshwater resources

Freshwater resources in the Arab world represent only 1.2% of global water reserves although the region accounts for about 3% of the world's population and 10% of world land. Average per capita renewable water resources in the Arab region are far below 1,000 cubic meters per year, considered the world's water poverty line. Note that the world average is 7,000 cubic meters.

Under these circumstances, non-conventional resources provide an invaluable escape. These include: (i) rain water; (ii) desalination; (iii) cloud seeding; (iv) towing icebergs; and (v) reusing and treating wastewater.

Most of these forms are used or have been tried to various degrees and with various levels of success in a number of Arab countries.

Among the listed options, desalination is considered to be the best alternative. In the Arab region, desalination is heavily used especially in the Arab Peninsula. While desalinated water represents less than 1% of total fresh water in the Arab region as a whole, it represents 12% of that in the Arab Peninsula. The "production" of desalinated water in the Arab region constitutes about 60% of total world production. In the Gulf, one desalination plant produces 7.6% of the world's production (1 million cubic meters/day). Ten years ago, Saudi Arabia alone produced 27% (14mcm/day) of the

TABLE 6 **INTERNAL GROUNDWATER AVAILABILITY PER CAPITA (MEASURED PER THOUSAND CUBIC METERS)**

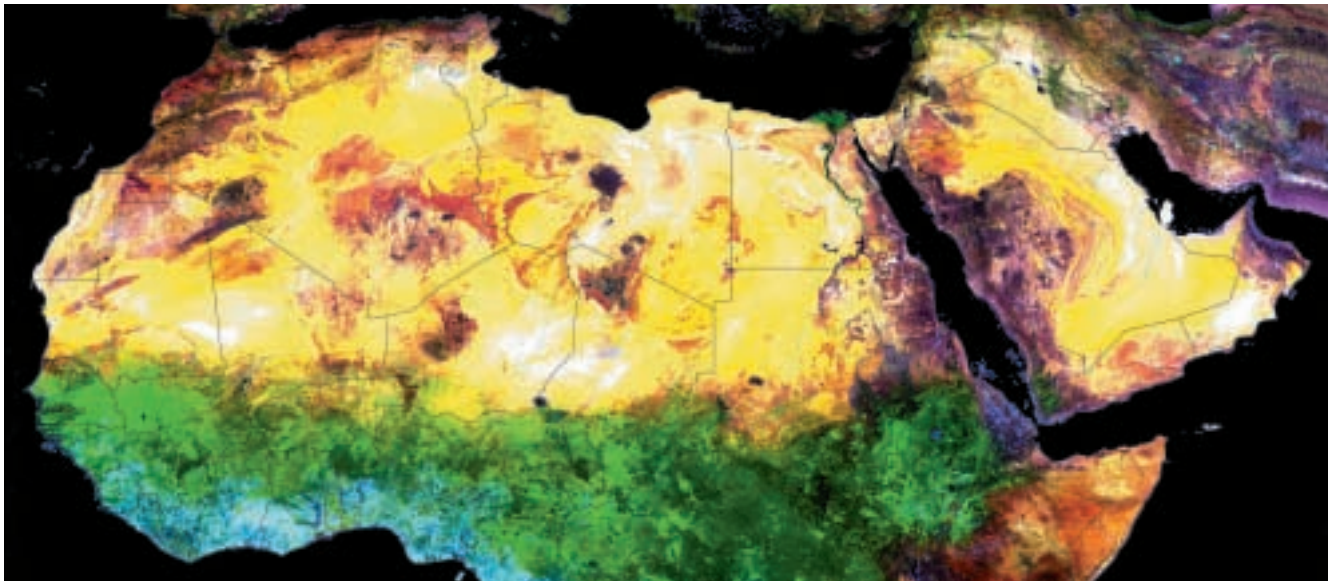
Max	110.27
Min	0.00
Albania	1.92
Algeria	0.05
Angola	5.42
Argentina	3.38
Armenia	1.31
Australia	3.58
Austria	0.74
Azerbaijan	0.78
Bangladesh	0.15
Belarus	1.84
Belgium	0.09
Benin	0.25
Bhutan	..
Bolivia	14.83
Bosnia and Herz.	..
Botswana	1.01
Brazil	10.46
Bulgaria	0.82
Burkina Faso	..
Burundi	0.34
Cambodia	1.34
Cameroon	6.23
Canada	11.60
Central Afr. Rep.	14.97
Chad	1.21
Chile	8.76
China	0.64
Colombia	11.25
Congo	110.27
Costa Rica	8.84
Côte d'Ivoire	2.23
Croatia	2.48
Cuba	0.58
Czech Rep.	0.14
Dem. Rep. Congo	0.23
Denmark	0.80
Dominican Rep.	1.33
Ecuador	10.00
Egypt	0.02
El Salvador	0.92
Estonia	2.97
Ethiopia	0.55
Finland	0.42
France	1.67
Gabon	45.89
Gambia	0.32
Georgia	0.01
Germany	0.21
Ghana	2.14
Greece	0.94
Guatemala	2.66
Guinea	4.11
Guinea-Bissau	9.10
Guyana	..
Haiti	0.27
Honduras	5.55
Hungary	0.60
Iceland	82.19
India	0.39
Indonesia	2.08
Iran	0.73
Iraq	0.05
Ireland	2.66
Israel	0.07
Italy	0.74
Jamaica	1.47
Japan	0.21
Jordan	0.09
Kazakhstan	0.41
Kenya	0.09
Kuwait	0.00
Kyrgyzstan	2.69
Laos	6.55
Latvia	0.95
Lebanon	0.71
Liberia	17.21
Libya	0.09
Lithuania	0.35
Macedonia	..
Madagascar	3.14
Malawi	0.12
Malaysia	2.50
Mali	1.49
Mauritania	0.10
Mexico	1.31
Moldova	0.10
Mongolia	2.42
Morocco	0.33
Mozambique	0.89
Myanmar	3.11
Namibia	1.10
Nepal	0.81
Netherlands	0.28
New Zealand	..
Nicaragua	10.49
Niger	0.20
Nigeria	0.63
North Korea	0.57
Norway	20.92
Oman	0.36
P. N. Guinea	..
Pakistan	0.35
Panama	6.62
Paraguay	6.81
Peru	11.00
Philippines	2.15
Poland	0.33
Portugal	0.38
Romania	0.38
Russia	5.47
Rwanda	0.43
Saudi Arabia	0.09
Senegal	0.70
Serbia and Mont.	..
Sierra Leone	9.67
Slovakia	0.32
Slovenia	6.76
South Africa	0.10
South Korea	..
Spain	0.70
Sri Lanka	0.40
Sudan	0.18
Sweden	2.22
Switzerland	0.34
Syria	0.23
Taiwan	..
Tajikistan	0.91
Tanzania	0.83
Thailand	0.66
Togo	1.03
Trin. and Tob.	..
Tunisia	0.14
Turkey	0.97
Turkmenistan	0.06
Uganda	1.11
Ukraine	0.42
United Arab. Em.	0.03
United Kingdom	0.16
United States	4.43
Uruguay	6.77
Uzbekistan	0.33
Venezuela	8.67
Viet Nam	0.59
Yemen	0.07
Zambia	4.30
Zimbabwe	0.39

Source: Environmental Sustainability Index (ESI). 2005
Note: ".." indicates that the data point is missing.

TABLE 7 **NUMBER OF ISO 14001 CERTIFIED PER BILLION DOLLARS GDP (PPP)**

Max	41.51
Min	0.00
Albania	0.00
Algeria	0.02
Angola	0.00
Argentina	41.51
Armenia	0.00
Australia	1.50
Austria	2.13
Azerbaijan	0.19
Bangladesh	0.02
Belarus	0.04
Belgium	1.06
Benin	0.00
Bhutan	0.00
Bolivia	0.23
Bosnia and Herz.	..
Botswana	0.14
Brazil	0.74
Bulgaria	0.30
Burkina Faso	0.00
Burundi	0.00
Cambodia	0.04
Cameroon	0.06
Canada	1.34
Central Afr. Rep.	0.00
Chad	0.00
Chile	0.52
China	0.86
Colombia	0.32
Congo	0.00
Costa Rica	1.15
Côte d'Ivoire	0.00
Croatia	1.14
Cuba	0.00
Czech Rep.	3.76
Dem. Rep. Congo	0.00
Denmark	4.28
Dominican Rep.	0.02
Ecuador	0.04
Egypt	0.77
El Salvador	0.00
Estonia	4.45
Ethiopia	0.00
Finland	7.78
France	1.46
Gabon	0.00
Gambia	0.00
Georgia	0.00
Germany	1.86
Ghana	0.02
Greece	0.45
Guatemala	0.04
Guinea	0.00
Guinea-Bissau	0.00
Guyana	0.92
Haiti	0.00
Honduras	0.11
Hungary	4.68
Iceland	0.36
India	0.22
Indonesia	0.36
Iran	0.22
Iraq	0.00
Ireland	0.75
Israel	0.87
Italy	2.05
Jamaica	0.10
Japan	4.03
Jordan	0.73
Kazakhstan	0.05
Kenya	0.03
Kuwait	0.08
Kyrgyzstan	0.00
Laos	0.00
Latvia	0.93
Lebanon	0.26
Liberia	0.00
Libya	0.00
Lithuania	2.01
Macedonia	0.08
Madagascar	0.00
Malawi	0.48
Malaysia	1.66
Mali	0.00
Mauritania	0.00
Mexico	0.45
Moldova	0.00
Mongolia	0.00
Morocco	0.10
Mozambique	0.05
Myanmar	0.03
Namibia	0.32
Nepal	0.03
Netherlands	2.47
New Zealand	1.17
Nicaragua	0.00
Niger	0.11
Nigeria	0.09
North Korea	0.00
Norway	2.11
Oman	0.18
P. N. Guinea	0.00
Pakistan	0.09
Panama	0.06
Paraguay	0.00
Peru	0.23
Philippines	0.50
Poland	1.06
Portugal	1.33
Romania	0.66
Russia	0.04
Rwanda	0.00
Saudi Arabia	0.03
Senegal	0.13
Serbia and Mont.	..
Sierra Leone	0.00
Slovakia	1.06
Slovenia	5.63
South Africa	0.58
South Korea	1.85
Spain	5.54
Sri Lanka	0.19
Sudan	0.02
Sweden	9.94
Switzerland	5.28
Syria	0.55
Taiwan	..
Tajikistan	0.00
Tanzania	0.05
Thailand	1.70
Togo	0.00
Trin. and Tob.	0.57
Tunisia	0.27
Turkey	0.30
Turkmenistan	..
Uganda	0.09
Ukraine	0.02
United Arab. Em.	1.71
United Kingdom	1.88
United States	0.34
Uruguay	1.22
Uzbekistan	0.00
Venezuela	0.13
Viet Nam	0.30
Yemen	0.00
Zambia	0.23
Zimbabwe	..

Source: Environmental Sustainability Index (ESI). 2005



world's capacity. Still, what happens in the Arab region in the area of desalination is buying turn key technologies. We are far from successfully implementing the commitment of the Arab Ministers of Environment in 2001 to ensure the local absorption of these technologies. There are separate efforts in some Arab countries such as Egypt, Jordan, Oman and Saudi Arabia, but what is certainly needed is meaningful regional co-operation in this very important area.

The measure of water stress used in the ESI was the percentage of territory in which water consumption exceeded availability by 40 percent or more. The average Arab state had in this index a value of 71 percent as compared to 20 percent for other states. African members of the Arab League countries fare better on water issues than do the West Asian countries.

For a number of Arab countries water inflows and groundwater resources are far below levels needed to support basic human needs and economic growth. More troubling is the acknowledged failure to integrate planning for meeting water needs with other aspects of social and resource planning. The 2002 United Nations Development Programme (UNDP) Arab Development Report draws attention to the weak conservation and reuse programs; the failure to come to grips with tradeoffs among agricultural, industrial, and human water needs; and the lackluster attention paid to the challenges of managing transboundary freshwater resources. Regional assessments increasingly raise concerns about the ability of the region to meet its freshwater needs over the coming decades in the absence of effective integrated planning. Among Arab League members, Iraq, Libya, and the Syrian Arab Republic have especially worrisome prospects.

"Surface water is an important part of the picture of a country's water resources. The more groundwater is available per capita, the higher the probability that a country can sustainably manage its groundwater resources, e.g. for agricultural production" (ESI 2005, Methodology Appendix). Table 6 gives the values of Internal Groundwater availability per capita as reported in the ESI 2005.

The UAE has unveiled a three-year environmental plan focused on the rational use of the country's natural resources, aimed in particular at reducing the use of groundwater and other natural reserves over the next three years in a bid to shift focus to alternative sources such as desalination. In July 2007 Abu Dhabi invited offers from at least 20 international firms to build a water desalination and power plant in the country. The move also involves creating awareness among UAE nationals about rational water use.

Tables 7 and 8 show that Arab countries reported on in the ESI publications score very low with respect to the number of nationally active ISO 14001 ISO (environmentally sound) companies and most of them likewise fare badly in measures of the number of researchers.

TABLE 8 **NUMBER OF RESEARCHERS PER MILLION INHABITANTS**

Max	7110.45
Min	1.82
Albania	[451.31]
Algeria	[-4.23]
Angola	[-354.55]
Argentina	684.38
Armenia	1534.00
Australia	3438.51
Austria	2313.29
Azerbaijan	2798.58
Bangladesh	[-163.45
Belarus	[1004.23]
Belgium	2953.26
Benin	[-405.16]
Bhutan	[147.9]
Bolivia	123.31
Bosnia and Herz.	[1136.14]
Botswana	[1051.19]
Brazil	323.36
Bulgaria	1166.65
Burkina Faso	16.00
Burundi	[-713.55]
Cambodia	[166.95]
Cameroon	[-111.32]
Canada	2978.16
Central Afr. Rep.	[184.72]
Chad	[29.32]
Chile	418.58
China	583.93
Colombia	100.70
Congo	[197.44]
Costa Rica	[1014.64]
Côte d'Ivoire	[-631.24]
Croatia	1186.95
Cuba	489.40
Czech Rep.	1465.87
Dem. Rep. Congo	[-962.82]
Denmark	3475.75
Dominican Rep.	[-339.29]
Ecuador	83.29
Egypt	[1321.94]
El Salvador	46.67
Estonia	1946.70
Ethiopia	[-544.65]
Finland	7110.45
France	2717.85
Gabon	[433.96]
Gambia	[545.27]
Georgia	2420.78
Germany	3153.01
Ghana	[557.12]
Greece	1400.06
Guatemala	[-183.78]
Guinea	[-975.42]
Guinea-Bissau	[-194.44]
Guyana	[607.39]
Haiti	[-1027.86]
Honduras	[-631.7]
Hungary	1439.68
Iceland	6639.29
India	[285.91]
Indonesia	[218.59]
Iran	[-14.32]
Iraq	[257.49]
Ireland	2190.03
Israel	1563.29
Italy	1127.85
Jamaica	[762.49]
Japan	5320.77
Jordan	1948.37
Kazakhstan	715.80
Kenya	[-47.48]
Kuwait	212.08
Kyrgyzstan	581.27
Laos	[116.56]
Latvia	1078.24
Lebanon	[2005.59]
Liberia	[-977.07]
Libya	[1644.9]
Lithuania	2303.2
Macedonia	[641.0]
Madagascar	15.03
Malawi	[-971.19]
Malaysia	159.93
Mali	[-252.28]
Mauritania	[671.54]
Mexico	224.73
Moldova	329.49
Mongolia	[1365.79]
Morocco	[257.41]
Mozambique	[37.06]
Myanmar	[280.15]
Namibia	[1086.91]
Nepal	[56.42]
Netherlands	2572.2
New Zealand	2197.1
Nicaragua	72.67
Niger	[143.07]
Nigeria	[-851.62]
Norway	4376.6
North Korea	[1516.76]
Oman	[761.3]
P. N. Guinea	[100.9]
Pakistan	[86.7]
Panama	95.27
Paraguay	166.03
Peru	228.83
Philippines	[-391.16]
Poland	1473.0
Portugal	1754.1
Romania	879.25
Russia	3494.1
Rwanda	[-238.34]
Saudi Arabia	[969.33]
Senegal	1.82
Serbia and Mont.	[915.0]
Sierra Leone	[-623.94]
Slovakia	1773.6
Slovenia	2258.0
South Africa	[826.3]
South Korea	2879.7
Spain	1947.6
Sri Lanka	190.54
Sudan	[-991.66]
Sweden	5186.0
Switzerland	3591.8
Syria	29.44
Taiwan	1258.4
Tajikistan	[965.55]
Tanzania	[174.8]
Thailand	73.81
Togo	[-670.92]
Trin. and Tob.	455.82
Tunisia	336.41
Turkey	305.52
Turkmenistan	[116.29]
Uganda	23.56
Ukraine	2117.6
United Arab. Em.	[2327.82]
United Kingdom	2666.4
United States	4099.3
Uruguay	276.29
Uzbekistan	[1261.55]
Venezuela	193.08
Viet Nam	[525.62]
Yemen	[1.13]
Zambia	[283.39]
Zimbabwe	[295.33]

Source: Environmental Sustainability Index (ESI). 2005
Note: data in "[ ]" indicates imputed values.

The Arab region contains 53% of the world's known oil reserves and 26% of natural gas reserves. But energy needs and costs are fast escalating. Investments of $100 billion are reportedly needed in the next 10 years across the Gulf Cooperation Council (GCC) to double power generation as populations grow and industrialize.

Biodiversity

Most of the Arab states established and are continuing to establish and maintain protected areas on land and in the sea. But the Arab region has one painfully negative record. For the first time in its history, the UNESCO World Heritage Programme had to take the hard decision of removing one site from its glamorous list of global natural wonders, the site in question being an Arabian Oryx sanctuary in Oman. The Omani government itself had requested removal of the site from the list and both UNESCO and the International Union for Conservation of Nature (IUCN) reluctantly complied. IUCN had identified serious threats to the natural values of the site for a number of years. These were discussed several times by the World Heritage Committee, which called for urgent action to address the threats. The population of Arabian Oryx has significantly declined from 450 in 1996 to the current situation where there remains only one breeding herd of four females and four males. The capacity of the Arabian Oryx Sanctuary to maintain a viable free-ranging population of this endangered species has been extremely reduced. This unprecedented episode constituted a particularly big loss since, among the Arab countries, Oman has a very impressive record of environmental awareness and effective policies.

The great importance assigned to wildlife conservation by Arab leaders could be seen, however, as out of sync with the region's priorities as identified by environmental ministers.

SHINING EXAMPLES OF ENVIRONMENTALLY SOUND BUSINESS IN THE FIELD OF ENERGY MANAGEMENT IN VARIOUS ARAB COUNTRIES

Abu Dhabi has launched an innovative clean energy initiative, Masdar, promising to invest $15 billion into it. This includes building a city powered entirely by renewable energy. Masdar announced that it will invest in clean technology companies, a sustainability research centre and major green power projects.

A Jordanian company established in 1991 received the Special Recognition Award at the 16th World Energy Congress in the U.S. Today, it is considered to be the leading energy service company in the Middle East, providing its services to over 500 large corporations and government institutions in the region.

More developers and companies in the Middle East are working towards achieving LEED (Leadership in Energy and Environmental Design) certification, an official recognition that was developed by the U.S. Green Building Council. The Gulf states are taking the lead in this area.

Energy City Qatar (ECQ), a $2.6 billion project, is the Middle East's first hydrocarbon industry business centre. Experts are predicting that ECQ will become one of the region's most viable environmentally sound business centres.

The Commercial Bank of Dubai's head office reported a 15% reduction in its annual energy expenditure over a period of 10 months and one of the buildings in Dubai witnessed a 50% saving.

The Arab Forum for Environment and Development (AFED) convened a Business Summit on Corporate Environmental Responsibility in the Arab World in Abu Dhabi in November 2007. In their declaration, the Chief Executive Officers (CEOs) present committed themselves to cut down the use of water and energy in their products and services by 20% by the year 2012 from the base year 2002 levels.

Work on the Arab region's first "bio-refinery," which will produce ethanol mainly from date palms for use in motor vechicles as a substitute for petrol and diesel, is due to start in Oman's Batinah region town of Sohar soon. The 11 million riyal ($28.5 million) plant, to be imported from Brazil, is expected to create 4,000 jobs for nationals, in addition to turning in a profit of $225 million in its very first year of operation.

Wildlife and habitat protection receive almost as much attention in the press of a number of Arab countries as freshwater issues, and almost ten times as much as either air pollution or climate change, this may reflect an imbalance in priorities.

Arab countries – with the exception of Jordan and Palestine – do not publish specific reports on environment statistics. A number of them publish State of the Environment Reports.

Particularly significant data gaps exist in the Arab region in a number of key areas:

- *Land:* land use (agricultural and cultivatable land) and land degradation; there is no usage of the Land Degradation Assessment Drylands (LADA) method for classification.
- *Biodiversity:* threatened species, protected areas, and forest cover.
- *Coastal ecosystems:* marine pollution, urban development in coastal areas, and destruction of marine habitats.

Application and enforcement

It is not clear from the available information how far countries in the Arab region apply the tools of environmental economics and environmental accounting in development planning.

Arab countries are tackling environment enforcement issues and preparing environment action plans. Chapter 13 of this report deals specifically with environmental legislation in the Arab region. It identifies that its weak enforcement is a major obstacle to improving the state of the environment in the region. The first Arab Regional Conference on the Inspection and Enforcement of Environmental Regulations was held in Jordan in May 2007 with the aim of increasing cooperation on these key issues. The conference was organized by the International Network for Environmental Compliance and Enforcement (INECE) with the participation of experts from Algeria, Jordan, Morocco, Oman, Qatar, Saudi Arabia and Yemen.

Environmental Awareness in the Arab World

This subject is covered in detail in Chapter 14 by Najib Saab which shows that media on environment in Arab countries, with few exceptions, are restricted to fragmented national and international news items spread over any pages in Arabic newspapers. Both radio and TV programs are largely devoid of environmental coverage except in few cases.

III. WHAT NEEDS TO BE DONE

Progress has been made in countries of the region in addressing the challenges of environmental sustainability.

A number of political forums have been established at the regional level to improve governance, define goals and priority action areas, and adopt an integrated approach to sustainable development. Examples are the Arab Initiative of Sustainable Development in 2002, and the Abu Ahabi Declaration on Environment and Energy in 2003.

There have been noticeable improvements in water policies and water-related governance issues, which have been reflected in better coordination and integration of efforts among various institutions and stakeholders, including partnerships between public and private sector organizations.

However, achieving environmental sustainability requires more concrete efforts to protect and conserve natural resources, particularly energy, water and soil resources, to improve efficiency in the use of non-renewable energy and water resources and to correct market failures and distortions by taking into consideration the environment in national accounts. Some of the concrete actions needed are:

Data collection and dissemination

First and foremost there is an urgent need to deal seriously with the issue of reliable environmental data which is not readily available in the region. This is due to:

- A lack of suitable infrastructure for environmental statistics.
- Several departments collect data on environment and the different departments do not follow the same methodology and appropriate cooperation networks are virtually absent.
- Inadequate monitoring of the state of the environment.

TABLE 9 ESI INDICATORS FOR HABITAT AND BIODIVERSITY CONSERVATION IN ARAB COUNTRIES

Country	Percentage of mammals endangered	Percentage of birds endangered	Percentage of territory with very low human influence	Percentage of territory with very high human influence	Percentage of cities* reporting requirements met	Percentage of territory protected
Algeria	14.1	3.1	80.4	0.5	60.0	2.4
Egypt	12.2	4.6	70.1	2.4	19.0	0.1
Iraq	12.3	6.4	3.7	1.2	0.0	0.0
Jordan	11.3	5.7	2.1	1.0	35.0	3.1
Kuwait	4.8	35.0	0.1	7.0	0.0	1.0
Lebanon	10.5	4.5	0.0	14.5	0.0	0.5
Libya	11.8	1.1	80.4	0.1	0.0	0.1
Mauritania	16.4	0.7	79.5	0.0	0.0	0.5
Morocco	15.2	4.3	17.5	1.5	60.9	0.7
Oman	16.1	9.3	54.0	0.8	0.0	12.5
Saudi Arabia	9.1	9.7	44.3	0.4	0.0	34.2
Somalia	11.1	2.4	17.7	0.1	7.7	0.3
Sudan	9.0	0.9	41.4	0.2	56.3	4.9
Syrian AR	6.3	3.9	0.1	2.0	0.0	0.0
Tunisia	14.1	2.9	26.2	4.3	100.0	0.3
U.A.E.	12.0	11.9	0.2	2.6	66.7	0.0
Arab average	11.7	6.2	32.3	2.4	25.4	3.5
World average	13.0	4.2	18.6	7.1	57.0	8.4

*Convention on International Trade in Endangered Species. Source: Environmental Sustainability Index (ESI) 2002

Only about 50% of states in the Arab world carry out regular environmental data collection. While waste and water are mostly covered, internationally agreed-upon statistical methodologies for the collection of environmental statistics are not followed, and countries do not apply the same concepts and definitions.

To address these problems of reliability of environmental data the Arab states need, among other things, to:

- Invest in environmental data collection (financial, technical, human resources).
- Set up environmental monitoring systems to compile comprehensive data based on systematic measurements.
- Ensure quality assurance and quality control practices (QA / QC) according to international guidelines.
- Increase temporal and spatial coverage to generate time-series data to be used for monitoring environmental trends across the country.
- Disseminate quality environmental data regularly.
- Enhance regional cooperation in the field of environmental monitoring and data collection.

Integration, globalization and standardization

The Arab world needs to respond effectively to globalization challenges and benefit from the opportunities it offers. This will require action to:

- Strongly – in co-operation with other developing countries – defend the need for open, equitable, rule-based, predictable and non-discriminatory multilateral trading and financial systems.
- Enhance our capacities to develop local technologies that can compete in the fast-growing environmental technologies market.
- Ensure corporate environmental responsibility and accountability.

Achieving environmental sustainability

No Arab state can achieve environmental sustainability (integrating environment in development planning) without:

- Evaluating the resources available to it - natural, human and financial - and then evaluating the realistic options available to the country.

- Decision makers moving from *react-and-cure* to anticipatory and preventive policies through applying the whole series of strategic and cumulative environmental assessments and project impact statements. This needs reliable time-series data and information.
- Applying the new environmental economic tools: cost / benefit analysis, risk analysis, environmental accounting, natural resources accounting, ecological accounting, life cycle analysis and finally the latest tool, the ecological footprint. Wackernagel and Rees (1996) define the *ecological footprint* as "The area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever, on Earth that land /water is located."
- Ensuring public participation in the decision-making process and in the implementation of development strategies.
- Achieving a number of critical transitions: an energy transition to an era in which energy is produced and used at high efficiency without aggravating the environment; a demographic transition to a stable population; and a resource transition to reliance on nature's income and not depletion of its "capital."

The role of the media in the Arab world

Upgrading the professionalism and effectiveness of environmental media in Arab countries requires a complete shift of media mentality towards a better understanding and appreciation of the importance of environmental issues. Special training initiatives must be conducted to raise the professionalism of environmental journalists and provide some career incentives. The most important awareness targets should be editors in chief, who must take into consideration the importance of providing a continuous, high level environmental media service for their readers. It is not a luxury nor over-optimism to ask that a fixed environmental page or section be established in every newspaper and magazine, and a weekly radio and TV programs be produced in the mainstream channels, as well as dedicated internet sites.

The role of NGOs

At the top of all this there must be genuine effort of governments in the Arab countries to empower NGOs to take major responsibility for upgrading the environmental media sector in Arab countries and environmental public awareness in general.

Closing thoughts

Is all this possible? I believe it is. But it requires strengthening the institutional framework at both local and regional levels.

At the regional level we need the provision of adequate financing for the implementation of regionally agreed upon good environmental resource management programmes and projects. Fortunately this is in the process of being established in the form of an Arab Environment Facility along the lines of the Global Environment Facility (GEF) but not as a replacement to it. At the national level, each country must accept the fact that it has primary responsibility for integrating environment in its development plans. It must arrange its government offices and responsibilities accordingly.

ABU DHABI DECLARATION ON CORPORATE ENVIRONMENTAL RESPONSIBILITY AND CLEANER PRODUCTION

Business leaders, meeting at the Arab Corporate Responsibility Summit in Abu Dhabi on 29 November 2007, at the invitation of the Arab Forum for Environment and Development (AFED), hosted by Environment Agency under the patronage of HH Sheikh Mohammad Bin Zayed, Crown Prince of Abu Dhabi;

Being aware of the magnitude of environmental challenges facing the Arab region and the world;

Realizing that low-carbon technology will be the driver of economic change; Recognizing that taking the environment fully into account is key to achieving sustainable development and regarding it as a fundamental prerequisite for sound business management;

Further recognizing that achieving sustainable development is a collective responsibility of government, business and the civil society;

Believing that environmental responsibility should be a corporate commitment and an integral part of our pursuit of good corporate citizenship;

Declare:

1- Eco-efficiency, Cleaner Production and Green Production methods will be our preferred options, as they are fundamental to our competitiveness locally, regionally and internationally.

2- We commit ourselves to integrating environmental considerations in our internal and external operations and adopt preventive environmental strategies at all levels of business.

3- We are committed to adopting innovative solutions that shift the priority from end-of-pipe to preventive strategies and supporting the provision of products and services that meet environmental and health standards.

4- We commit our selves to setting a target of 20% reduction in the use of energy and water in the production of our products per unit by the year 2012 from base year 2002, and strive to compete actively in the growing global environmental industries.

5- We are also committed to complying with national and international environmental regulations applicable to our operations and business. Beyond compliance, we shall strive to develop and adopt voluntary targets and encourage our clients, partners and suppliers to do likewise.

6- We will conduct internal environmental reviews, and periodically report on the results.

7- We recommend that all corporations in the Arab World develop and publish statements of their environmental policies and the steps they have taken to promote the integration of environmental considerations into their operations.

8- We request the United Nations Environment Programme (UNEP), the World Business Council for Sustainable Development (WBCSD) and the Arab Forum for Environment and Development (AFED) to assist corporations operating in the Arab region to further the principles and goals of this declaration, through providing technical assistance, training and relevant information relating to best practices in achieving corporate environmental responsibility.

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Urbanization

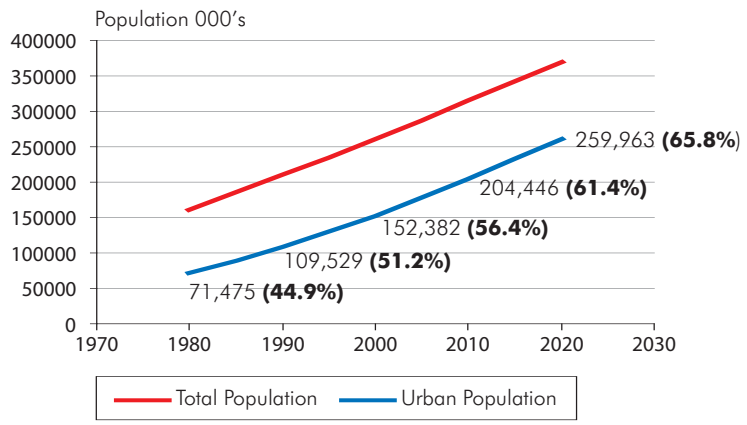
Manal El-Batran

I. INTRODUCTION

The population of the Arab region is around 320 million people, living in 22 countries stretching from Morocco and Algeria in the west to Yemen and Oman in the east. The region is characterized by a wide diversity, not just in political, ethnic, social, cultural, and economic terms, but also in terms of the progress that individual states have made in terms of development. In terms of sub-regional divisions, we consider four main groupings, bearing in mind that some LDC group members tend to also belong to another group: Arab Least Developed Countries (LDCs), the Mashreq and the Maghreb regions, and the Gulf Cooperation Council (GCC).[1] Taken together, the Arab countries offer examples of conflict and post-conflict situations; range from very open economies to economic isolation; and display highly urbanized to predominantly rural populations.

Urbanization in the Arab region has been fuelled by high fertility rates, substantial rural-urban migration, international labour migration and the concentration of economic activity in urban areas. Housing policies have also contributed to urban growth. Infrastructure development has not kept pace with this growth (UNFPA, 1996). Rural development activities often intended to counter urbanization trends, have received low priority policy attention. The states in the GCC have some of the world's highest rates of labour immigration. Migrants are concentrated in the Gulf cities, contributing to this sub-region's high urbanization levels.

FIGURE 1 ARAB STATES REGION- POPULATION 1980- 2015



Source: UN, World Urbanization Prospects, 1999.

Over the last few decades, infrastructure improvements in the Arab region brought drinking water to 82 percent of the population, and sanitation to most of those living in urban areas. However, progress slowed in the 1990s and in some countries has reversed. Since 1990 the percentage of people living below $1 per day has not improved, and the percentage living below $2 per day has increased from 21 to 23 percent of the population. According to World Bank estimates, adopting the income poverty line $1/day per person does not reflect reality in the Arab region: some countries, namely in the GCC, are classified as high income, while many of those in the Mashreq and Maghreb are considered middle income (ESCWA, 2005).

The region once had the highest population growth rates in the world. Fertility declined significantly in the 1990s, but the growth rate is still high – about 2 percent compared to 1.4 percent for the less-developed world as a whole. In addition, the region's relatively high proportion of youths means that the population is expected to grow strongly in the future. UN-Habitat projects that the region will be home to some 395 million people by 2020 (compared to about 303.9 million in 2003, and 144.6 million in 1975). It will be a challenge for the countries of the region to ensure that population growth is matched by corresponding social and economic development. (Figure 1 shows the total population of the Arab region between 1980-2015).

II. URBANISATION TRENDS IN THE ARAB STATES

The Arab region is marked by the widespread and very swift expansion of cities, with this high level of urbanization bringing about a range of social, economic, and demographic changes. Today, urban areas account for 56 percent of the total population of 320 million; this figure is projected to increase to 66% by 2020. The "urban explosion" witnessed in the Arab world has not just been evident in the massive growth of the region's major cities, but small- and medium-sized towns have also shown high and speedy levels of urbanization and development.

Rapid population growth remains a major challenge. Some countries have annual population

growth rates between 3 and 5.5 percent, while some urban growth rates are even higher: 6.4 percent (Iraq), 5.9 percent (United Arab Emirates), and 4.1 percent (Oman and Bahrain). Urban growth rates will remain higher than total population growth rates for the foreseeable future. Although these changes show a sustained increase in the Arab states, they give rise to a process of urbanisation that is far from uniform. The diversity of national situations and the existence of distinct urban traditions in each country explain the heterogeneity of the urban contexts (Kharoufi, 1996).

In the region's more diversified economies, urban growth has been the result of rural-to-urban migration as well as high fertility and declining rates of mortality. In some countries, however, high rates of urbanization have been stimulated by transnational migration as well as natural increase (UN-Habitat, 2001).

Urban population is greatest in the smaller states (Kuwait 97 percent, the Gaza Strip 95 percent, and Bahrain and Qatar 92 percent). Saudi Arabia, one of the largest Arab states, is 86 percent urban and this figure is projected to rise to 89 percent by 2010. Egypt is 45 percent urban and Sudan 36 percent. Both countries will remain among the region's least-urbanized in the years to come. Table 1 shows Size and Growth of Urban and Rural Populations, Urbanization Trends.

At present, there are 19 mega-cities in the world (i.e. with populations exceeding 10 million), with a total population of over 275 million and 8.8% of the world's urban population, four of which are from developed parts of the world. The other 15 mega-cities are from the developing world. Cairo is the only mega-city in the Arab region with 11.1 million inhabitants.

In the Arab states, the urban framework often appears to be in a state of disequilibrium due to geographical constraints. This common feature does not apply a similar pattern of development. Apart from the "City States" of the Gulf Cooperation Council, where the presence of one metropolis dominates the whole urban system, varying degrees of unbalance can be noted in the other countries (Kharoufi, 1996).

In the case of the Maghreb, (Algeria, Libyan Arab Jamahiriya, Morocco, Tunisia), despite initial restoration of the balance of regional disparities with regard to the concentration of city dwellers, the coastal regions still display the highest degree

TABLE 1 SIZE AND GROWTH OF URBAN AND RURAL POPULATIONS, URBANIZATION TRENDS

	Level of Urbanization (%)			Urban Population Estimates & Projections (thousands)		
	2000	2015	2030	2000	2015	2030
WORLD	**47.0**	**53.4**	**60.3**	**2,845,049**	**3,817,292**	**4,889,393**
More developed regions	76.0	79.7	83.5	902,993	968,223	1,009,808
Less developed regions	39.9	48.0	56.2	1,942,056	2,849,069	3,879,585
AFRICA	**37.9**	**46.5**	**54.5**	**297,139**	**501,015**	**765,709**
Algeria	60.3	68.5	74.4	18,969	28,214	36,721
Comoros	33.2	42.6	52.2	231	425	656
Djibouti	83.3	86.3	88.8	531	747	975
Egypt	45.2	51.2	59.9	30,954	43,641	60,115
Libya	87.6	90.3	92.0	4,911	6,841	8,465
Mauritania	57.7	68.6	74.4	1,541	2,665	3,856
Morocco	56.1	65.6	72.0	15,902	22,829	29,139
Somalia	27.5	35.9	45.8	2,776	5,869	10,846
Sudan	36.1	48.7	57.7	10,652	19,381	28,237
Tunisia	65.5	73.5	78.4	6,281	8,528	10,491
ASIA	**36.7**	**44.7**	**53.4**	**1,351,806**	**1943245**	**2,604,757**
Bahrain	92.2	95.0	95.8	569	724	858
Palestine (Gaza Strip)**	94.6	95.5	96.2	1,060	1,897	3,095
Iraq	76.8	81.6	85.0	17,756	27,804	37,326
Jordan	74.2	79.8	83.5	4,948	7,906	10,869
Kuwait	97.6	98.2	98.5	1,924	2,574	3,067
Lebanon	89.7	92.6	93.9	2,945	3,651	4,324
Oman	84.0	92.8	94.0	2,135	3,805	5,636
Qatar	92.5	94.2	95.2	554	690	755
Saudi Arabia	85.7	89.7	91.5	18,526	29,259	39,331
Syria	54.5	62.1	69.1	8,783	14,063	19,409
UAE	85.9	88.8	90.8	2,097	2,688	3,065
Yemen	24.7	31.2	41.0	4,476	9,221	17,943
EUROPE	**74.8**	**78.6**	**82.6**	**544,848**	**565,599**	**570,612**
LATIN AMERICA	**75.3**	**79.9**	**83.2**	**390,868**	**504,184**	**604,002**
NORTHERN AMERICA	**77.2**	**80.9**	**84.4**	**239,049**	**277,563**	**313,663**
OCEANIA	**70.2**	**71.2**	**74.4**	**21,338**	**25,688**	**30,650**

Source: - United Nations Centre for Human Settlements (Habitat), The State of the World's Cities 2006/7:
The Millennium Development Goals and Urban Sustainability - Thirty years of Shaping the Habitat Agenda., UN Habitat –Earth scan, 2006.
** the available data only cover Gaza strip, and there is no available date about the rest of Palestine.

of urbanization. As for the "urban explosion" prevalent on the outskirts of big centres (Casablanca, Algiers, Tunis), a significant observation has been the intensification of relations between these centres and their outskirts (Kharoufi, 1996).

The region's considerable internal disparities are reflected in the conditions in its cities and have resulted in widely varying domestic needs and priorities: rehabilitation and reconstruction (Iraq, Lebanon, Palestine and Somalia); poverty alleviation (Egypt, Jordan, Syria, Morocco and Yemen); urban management and housing needs (Egypt, Jordan and Algeria); and capacity building (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Libyan Arab Jamahiriya) (UN-Habitat, 2001).

Water and sanitation

Access to acceptable drinking water sources remains a problem in the Arab region. Between 1990 and 2004, the proportion of the population using such water sources was constant at around 82%. Regional disparities exist: there were

Annual Growth Rate (%)		Rural Population Estimates & Projections (thousands)			Annual Growth Rate (%)	
2000-2015	2015-2030	2000	2015	2030	2000-2015	2015-2030
2.0	**1.7**	**3,210,000**	**3,337,074**	**3,222,587**	**0.3**	**-0.2**
0.5	0.3	284,987	246,171	199,699	-1.0	-1.4
2.6	2.1	2,925,013	3,090,903	3,022,888	0.4	-0.2
3.5	**2.8**	**487,306**	**576,781**	**640,216**	**1.1**	**0.7**
2.7	1.8	12,502	12,985	12,661	0.3	-0.2
4.1	2.9	464	573	601	1.4	0.3
2.3	1.8	106	118	124	0.7	0.3
2.3	2.1	37,515	41,583	40,256	0.7	-0.2
2.2	1.4	693	732	735	0.4	0.0
3.7	2.5	1,128	1,221	1,324	0.5	0.5
2.4	1.6	12,448	11,955	11,312	-0.3	-0.4
5.0	4.1	7,321	10,481	12,838	2.4	1.4
4.0	2.5	18,838	20,430	20,723	0.5	0.1
2.0	1.4	3,305	3,079	2,890	-0.5	-0.4
2.4	**2.0**	**2,330,744**	**2,403,649**	**2,271,823**	**0.2**	**-0.4**
1.6	1.1	48	38	38	-1.6	-
3.9	3.3	61	90	121	2.6	2.0
3.0	2.0	5,359	6,259	6,603	1.0	0.4
3.1	2.1	1,721	2,003	2,150	1.0	0.5
1.9	1.2	47	48	48	0.1	-
1.4	1.1	337	291	282	-1.0	-0.2
3.9	2.6	407	297	360	-2.1	1.3
1.5	0.6	45	42	38	-0.5	-0.7
3.1	2.0	3,081	3,364	3,660	0.6	0.6
3.1	2.2	7,342	8,583	8,669	1.0	0.1
1.7	0.9	344	339	311	-0.1	-0.6
4.8	4.4	13,636	20,374	25,791	2.7	1.6
0.3	**0.1**	**184,039**	**153,709**	**120,364**	**-1.2**	**-1.6**
1.7	**1.2**	**128,275**	**126,931**	**121,534**	**-0.1**	**-0.3**
1.0	**0.8**	**70,582**	**65,602**	**58,112**	**-0.5**	**-0.8**
1.2	**1.2**	**9,055**	**10,401**	**10,538**	**0.9**	**0.1**

improvements in the GCC, Mashreq, and Maghreb, raising the percentages there to 100%, 94%, and 86%, respectively, but the percentage for the Arab LDCs fell from 68% to 63%. It is clear, therefore, that more efforts still need to be made in order to improve the situation for the people still without adequate access to drinking water (ESCWA/LAS, 2007).

There still exist wide discrepancies between rural and urban populations when it comes to access to improved water sources; in 2004, the proportion of the population with such access in rural areas was 13% less than that in urban areas. This big difference can primarily be explained by the considerable divide between urban and rural populations in the Maghreb; 56% of the Maghreb population live in Morocco, where the percentages for urban and rural are 99% and 56%, respectively. For Arab LDCs, the situation is equally grim: almost half the rural population has no access to improved water sources. It is clear that national development strategies in the region need to take this problem into account and close the rural-urban gap (El-Habr, 2007).

TABLE 2 URBAN AGGLOMERATIONS POPULATION SIZE AND GROWTH RATE

		Estimates and Projections (thousands)						
		1985	1990	1995	2000	2005	2010	2015
AFRICA								
Algeria	**Algiers**	1,480	1,561	1,687	1,885	2,142	2,407	2,622
Algeria	**Oran**	604	679	774	895	1,034	1,171	1,282
Egypt	**Alexandria**	2,835	3,212	3,648	4,113	4,586	5,051	5,525
Egypt	**Cairo**	7,691	8,572	9,533	10,552	11,605	12,664	13,751
Egypt	**Shubra El-Khemia**	661	789	906	1,033	1,163	1,294	1,430
Libya	**Benghazi**	508	634	752	871	987	1,087	1,171
Libya	**Tripoli**	1,040	1,318	1,573	1,822	2,056	2,253	2,413
Mali	**Bamako**	599	738	912	1,131	1,404	1,738	2,130
Morocco	**Casablanca**	2,387	2,721	3,101	3,541	4,019	4,477	4,862
Morocco	**Rabat**	967	1,118	1,293	1,496	1,716	1,926	2,105
Somalia	**Mogadishu**	548	779	965	1,219	1,552	1,955	2,443
Sudan	**Khartoum**	1,485	1,828	2,249	2,731	3,299	3,950	4,615
Tunisia	**Tunis**	1,428	1,568	1,722	1,897	2,087	2,279	2,454
ASIA								
Gaza Strip	**Gaza Strip (Urban)**	486	601	853	1,060	1,299	1,575	1,897
Iraq	**Arbil**	691	1,157	1,743	2,369	2,925	3,380	3,768
Iraq	**Baghdad**	3,681	4,039	4,336	4,797	5,438	6,155	6,833
Iraq	**Mosul**	603	744	879	1,034	1,210	1,390	1,560
Jordan	**Amman**	782	955	1,179	1,430	1,700	1,965	2,212
Kuwait	**Kuwait City**	942	1,090	1,090	1,190	1,313	1,418	1,513
Lebanon	**Beirut**	1,385	1,582	1,826	2,055	2,238	2,366	2,468
Saudi Arabia	**Jeddah**	952	1,216	1,492	1,810	2,139	2,460	2,753
Saudi Arabia	**Mecca**	550	663	777	919	1,079	1,244	1,399
Saudi Arabia	**Riyadh**	1,401	1,975	2,619	3,324	3,990	4,587	5,111
Syria	**Aleppo**	1,288	1,543	1,840	2,173	2,536	2,923	3,305
Syria	**Damascus**	1,585	1,790	2,036	2,335	2,694	3,096	3,500
UAE	**Abu Dhabi**	415	624	799	927	1,022	1,093	1,153
Yemen	**Sana'a**	402	678	965	1,303	1,697	2,157	2,709

Source : - United Nations Centre for Human Settlements (Habitat),
The State of the World's Cities 2006/7: The Millennium Development Goals and Urban Sustainability - Thirty years of Shaping the Habitat Agenda., UN Habitat –Earth scan, 2006.

Figure 2 indicates the proportion of the population using improved drinking water sources, 2004 (%).

As for access to sanitation facilities, we can observe slow improvement in the Arab sub-regions during the last 15 years. In 2004, the proportion of the population in Arab LDCs with access to improved sanitation facilities was only 42% compared to 99% in the GCC, 87% in the Maghreb, and 84% in the Mashreq. Nonetheless, at this pace, an estimated 124 million people in the Arab region will remain without access to sanitation facilities by 2015, and 50% of these people will be living in the Arab LDCs (ESCWA/LAS, 2007).

Figure 3 indicates the proportion of population using improved sanitation facilities, 2004 (%).

As with access to clean water, access to sanitation facilities varies widely between urban and rural areas; the difference is particularly striking in the Arab LDCs, where the figure stands at 26% and 60% for rural and urban areas, respectively. Nonetheless, the aforementioned improvements of the last 15 years have mostly been due to improved access in rural areas in the region. In fact, it is interesting to note that the proportion of rural populations with access to clean sanitation facilities improved by 13%, 14%, and 8% in the GCC, Mashreq, and Maghreb regions, respectively, rising

Annual Growth Rate (%)			Share in Country's Urban Population %		
1985-1995	1995-2005	2005-2015	1985	2000	2015
AFRICA					
1.3	2.4	2.0	14.1	9.9	9.3
2.5	2.9	2.2	5.8	4.7	4.5
2.5	2.3	1.9	13.0	13.3	12.7
2.2	2.0	1.7	35.2	34.1	31.5
3.2	2.5	2.1	3.0	3.3	3.3
3.9	2.7	1.7	17.5	17.7	17.1
4.1	2.7	1.6	35.9	37.1	35.3
4.2	4.3	4.2	36.0	33.5	31.9
2.6	2.6	1.9	24.7	22.3	21.3
2.9	2.8	2.0	10.0	9.4	9.2
5.7	4.8	4.5	36.1	43.9	41.6
4.2	3.8	3.4	30.9	25.6	23.8
1.9	1.9	1.6	36.2	30.2	28.8
ASIA					
5.6	4.2	3.8	…	…	…
9.3	5.2	2.5	6.6	13.3	13.6
1.6	2.3	2.3	35.0	27.0	24.6
3.8	3.2	2.5	5.7	5.8	5.6
4.1	3.7	2.6	29.6	28.9	28.0
1.5	1.9	1.4	58.4	61.8	58.8
2.8	2.0	1.0	65.4	69.8	67.6
4.5	3.6	2.5	10.4	9.8	9.4
3.5	3.3	2.6	6.0	5.0	4.8
6.3	4.2	2.5	15.2	17.9	17.5
3.6	3.2	2.7	25.6	24.7	23.5
2.5	2.8	2.6	31.5	26.6	24.9
6.6	2.5	1.2	34.8	44.2	42.9
8.8	6.5	4.7	18.8	29.1	29.4

from 54% to 59% in rural areas in the Arab region as a whole. At the same time, the percentage fell in urban areas from 87% to 85%, though this fall can partly be attributed to the increased pressures on urban infrastructures through rural-urban migration (ESCWA/LAS, 2007).

III. IMPACTS OF NEW MIGRATION PATTERNS

Changes in migration patterns and types of population mobility can be observed in the past four decades; while in the 1960s the big cities of the Arab region could still accommodate high inflows of migrants, this rural exodus has slowed today as the absorptive capacity of these cities has lessened considerably. In fact, as indicated above, urban conditions may actually have worsened in some cases due to increased strains on existing infrastructure, such as sanitation.

In the specific case of the oil-producing Arab countries, and particularly in the GCC region, urban expansion has been strongly fuelled by international migration. In the UAE and Saudi Arabia, for example, the high urban growth rate can be attributed to the immigration of foreign workers from both Arab countries (such as Palestine, Egypt, Yemen, and Syria) and Asian

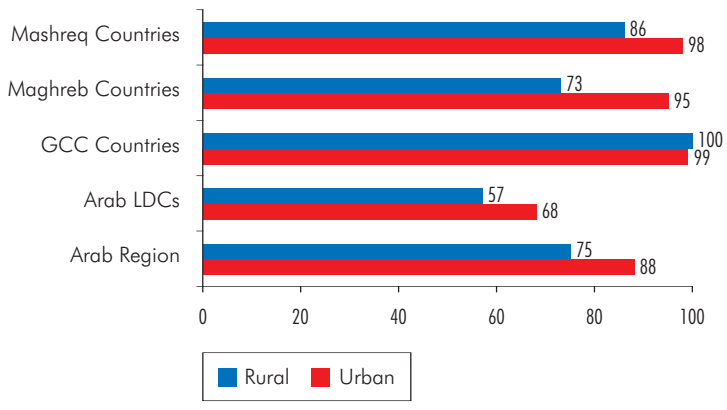
countries (such as Bangladesh, India, Pakistan, the Philippines, the Republic of Korea, Sri Lanka, and Thailand (Kharoufi, 1996).

Turning to the examples of Algeria, Morocco, Tunisia, and Egypt we find another pattern, namely that of large, medium, and even small-sized towns increasingly becoming urbanized. In Egypt, we even observe villages around towns urbanizing in this manner. Nonetheless, more research needs to be done to explore more clearly the role of small and medium-sized towns in the changing urbanization patterns in the Arab region, and the ensuing redistributive spatial dispositions. It will be interesting to study the impacts of better transportation links between rural and urban areas, on the migratory patterns between them (Kharoufi, 1996).

With their increasing urbanization, small towns in the Arab region are increasing in functional importance and capacity, for example developing service activities which include administration, education and health. Through decentralization and the downward migration of civil servants and managerial personnel, they have acquired the position of administrative, commercial and even manufacturing centres (Kharoufi, 1996).

Although the predominant pattern in the region is one of a decline of rural populations, an already-observed pattern in the 1990-2000 period, and also for the current decade, six countries in the region face both urban growth rates and

FIGURE 2 **PROPORTION OF POPULATION USING IMPROVED DRINKING WATER SOURCES, 2004 (%)**



Source: The Millennium Development Goals in the Arab Region, ESCWA- 2007

rapidly expanding rural populations. These are Yemen, the Gaza Strip, Syria, Iraq, Jordan, and Egypt (UN-Habitat, 2001).

For many countries, urban growth is still much higher than rural, and urban centres continue to hold large portions of the population. In Tunisia, for example, the Tunis district holds around one-fifth of the country's population and is exhibiting a strong population growth rate. In Algeria, 95% of the population lives in a 1200 by 100 km territory by the sea. And in Egypt, the region around Cairo and by the Nile holds a considerable proportion of the country's population.

For many of the region's major cities, existing infrastructure, such as educational facilities, work as a force attracting rural to urban migration, and cities such as Damascus, Cairo, Alexandria, and Amman can expect – and need to prepare for – strong rural to urban migration. This truly places great strains on the resources of these states and cities, dealing as they have to with dwindling resources, high demand on existing facilities, increasing poverty, and the serious environmental consequences of such highly concentrated urban populations.

Historically, there have also been instances in the Arab world of forced migrations to urban centres. Demographic changes such as these have been observed in Sudan, in 1983-1984, when about 5 million people forcibly changed their place of resident; in Mauritania, in 1989, during the conflict with Senegal; and in Iraq in 2003. "Following the invasion of Kuwait by Iraq in 1991, the Near

East saw the biggest forced migration of populations of these last decades: 4 or 5 million people had to leave the Gulf region. The vastness of this migration has shattered the migratory patterns in the Near East putting the countries which furnish labour in a difficult economic and social situation" (Kharoufi, 1996). Naturally, such overwhelming population movements cause considerable difficulties for the authorities when it comes to the management of urban centres as well as the controlled expansion thereof.

Although chapter 12 deals with this issue in greater detail, it must be mentioned that political upheavals, instability, and armed conflicts have become added complications in the Arab region's attempts at development and poverty reduction. The examples of Iraq, the Palestinian-Israeli conflict, the civil strife in Sudan and Somalia, and the summer 2006 conflict in Lebanon and Israel are notable examples of such highly problematic conflicts. The destruction of housing and urban infrastructure, such as in Lebanon, for example, caused migratory movements, mainly to urban centres, placing greater pressures on the already-limited infrastructure facilities thereof. In addition, terrorist acts in countries such as Algeria, Egypt, Jordan, and Saudi Arabia contributed to economic insecurity and population displacement. Many conflicts such as those mentioned above have partially eroded earlier progress in development.

IV. SLUMS IN THE ARAB STATES

In the Arab region, Egypt and Tunisia are considered among the "on track" countries when it comes to reducing the numbers of slum dwellers and slum expansion.

Tunisia has succeeded in more than halving the number of slum dwellers to approximately 190,000. Egypt succeeded in reducing the number of slum dwellers by 3 million from 1990 to 2005.

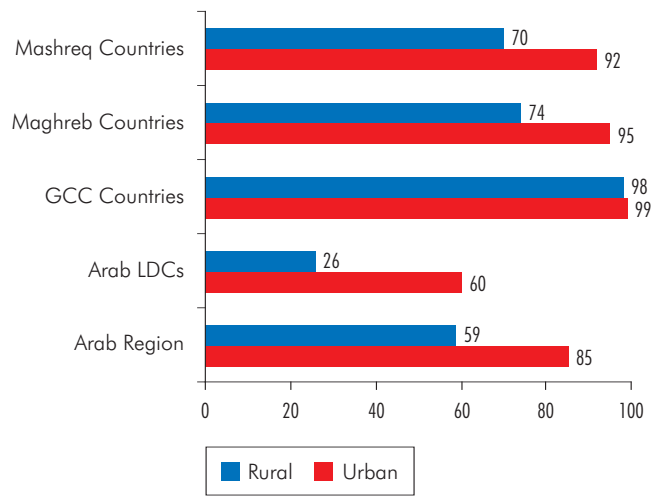
On the other hand, in Sudan, one of the off-track group, the numbers of slum dwellers grew considerably during the same period. Although Morocco is doing slightly better than the off-track group when it comes to managing slum growth rates, it still has a relatively proportion of people living in slum conditions (30%). Swift action is needed in order to reverse the process of slum formation and improve living conditions for slum dwellers.

For the Arab region as a whole, we can note that most of the Arab states still need to review and improve existing housing policies and improve performance. Table 3 shows the Population of Slum Areas at Mid- Year by Region and Country; 1990, 2001 and Slum Annual Growth Rate.

V. THE CHANGING CHARACTER OF THE ARAB CITY

A study published by ESCWA in 2005, entitled "Urbanization and the Changing Character of the Arab City" examines the role of development in shaping the character of Arab cities. The study focuses on three cities: Amman, Jordan; Dubai, UAE; and Beirut, Lebanon, considering their characteristics generalizable to other cities in the region as a whole. In particular, the study examined the effects on these cities of dynamics and processes such as rural-urban migration, population growth, and socio-economic developments, while taking into consideration the particular historical and social background of the cities (ESCWA, 2006).

FIGURE 3 **PROPORTION OF POPULATION USING IMPROVED SANITATION FACILITIES, 2004 (%)**



Source: The Millennium Development Goals in the Arab Region, ESCWA- 2007

TABLE 3 **POPULATION OF SLUM AREAS AT MID- YEAR BY REGION AND COUNTRY; 1990, 2001**

	1990				
	Total Population (thousands)	Urban Population (thousands)	Percentage Urban	Percentage Slum	Slum Population (thousands)
WORLD	**5,254,807**	**2,285,693**	**43.5**	**31.3**	**714,972**
Developed regions	933,494	694,260	74.4	6.0	41,750
Developing regions	4,039,703	1,407,172	34.8	46.5	654,294
AFRICA					
Algeria	24,855	12,776	51.4	11.8	1,508
Comoros	527	147	27.9	61.7	91
Djibouti	504	408	81.0		
Egypt	56,223	24,499	43.6	57.5	14,087
Libya	4,311	3,528	81.8	35.2	1,242
Mauritania	1,992	877	44.0	94.3	
Morocco	24,624	11,917	48.4	37.4	4,457
Somalia	7,163	1,734	24.2	96.3	1,670
Sudan	24,818	6,606	26.6	86.4	5,708
Tunisia	8,156	4,726	57.9	9.0	425
ASIA					
Bahrain	490	429	87.9	0.0	
Palestine (Gaza Strip) **	2,154	1,379	64.0		
Iraq	17,271	12,027	69.6	56.7	6,825
Jordan	3,254	2,350	72.2	16.5	388
Kuwait	2,143	2,034	94.9	3.0	60
Lebanon	2,713	2,284	84.2	50.0	1,142
Oman	1,785	1,109	62.1	60.5	671
Qatar	453	407	89.8	2.0	8
Saudi Arabia	15,400	12,046	78.2	19.8	2,385
Syria	12,386	6,061	48.9	10.4	629
UAE	2,014	1,615	80.2	2.0	32
Yemen	11,590	2,648	22.8	67.5	1,787
EUROPE	**214,807**	**152,222**	**70.9**	**6.0**	**9,208**
LATIN AMERICA	**440,419**	**312,995**	**71.1**	**35.4**	**110,837**
NORTHERN AMERICA					
OCEANIA	**6,066**	**1,430**	**23.6**	**24.5**	**350**

Source: United Nations, World Urbanization Prospects: The 1999 Revision. Source : - United Nations Centre for Human Settlements (Habitat), The State of the World's Cities 2006/7: The Millennium Development Goals and Urban Sustainability - Thirty years of Shaping the Habitat Agenda., UN Habitat –Earth scan, 2006.
** the available data only cover Gaza strip, and there is no available date about the rest of Palestine.

While it is undeniable that the three cities differ in terms of urban history, archeological identity, bureaucracy, economic and tourism activities, they do share common characteristics, such as comparable populations, a growing mall culture, and the role of foreign capital in their development. Also, like many cities in the region, they were in some way influenced by regional conflicts. Beirut, suffering major destruction and devastation during the 15-year civil war, and again during the 2006 summer war, has been the site of much reconstruction during the past years. Amman struggled to deal with signification population inflows, while Dubai, geographically further from conflict zones, has exhibited incredible urban and economic development as a result of its high economic growth and ambitious policies aimed at making it a globally significant economic and financial centre.

"The resultant diversity and difference provided a cosmopolitan life of various intensities in the three cities. Among the three cities, Amman is the city that has undergone the most qualitative changes; Beirut is the oldest continuously inhabited; and Dubai is the most economically vibrant" (ESCWA, 2005).

AND SLUM ANNUAL GROWTH RATE

		2001			
Total Population (thousands)	Urban Population (thousands)	Percentage Urban	Percentage Slum	Slum Population (thousands)	Slum Annual Growth Rate (%)
6,134,124	**2,923,184**	**47.7**	**31.2**	**912,918**	**2.22**
985,592	753,909	76.5	6.0	45,191	0.72
4,865,893	1,988,093	40.9	42.7	849,013	2.37
30,841	17,801	57.7	11.8	2,101	3.02
727	246	33.8	61.2	151	4.61
644	542	84.2			
69,080	29,475	42.7	39.9	11,762	-1.64
5,408	4,757	88.0	35.2	1,674	2.72
2,747	1,624	59.1	94.3	1,531	5.60
30,430	17,082	56.1	32.7	5,579	2.04
9,157	2,557	27.9	97.1	2,482	3.60
31,809	11,790	37.1	85.7	10,107	5.19
9,562	6,329	66.2	3.7	234	-5,43
652	603	92.5	2.0	12	
3,311	2,222	67.1	60.0	1,333	
23,584	15,907	67.4	56.7	9,026	2.54
5,051	3,979	78.7	15.7	623	4.32
1,971	1,894	96.1	3.0	56	-0.65
3,556	3,203	90.1	50.0	1,602	3.07
2,622	2,006	76.5	60.5	1,214	5.39
575	534	92.9	2.0	11	2.47
21,028	18,229	86.7	19.8	3,609	3.77
16,610	8,596	51.8	10.4	892	3.18
2,654	2,314	87.2	2.0	46	3.27
19,114	4,778	25.0	65.1	3,110	5.03
208,208	**147,673**	**70.9**	**6.0**	**8,878**	**-0.33**
526,594	**399,322**	**75.8**	**31.9**	**127,566**	**1.28**
7,755	**2,072**	**26.7**	**24.1**	**499**	**3.24**

One feature shared by all three cities is that of some kind of demographic stratification; that is, different neighborhoods accommodating different sections of the population. In Beirut, these are the poor southern suburbs; in Amman, the affluent western suburbs; and in Dubai, the evident residential stratification by which nationals and foreign expatriates are accommodated. This feature can be seen in many other Arab cities, for example Cairo and Baghdad.

The study also revealed that the development of cities is driven by various factors, including the following: (a) strengthening and sustaining institutions, in the case of Amman; (b) political will, which, in the case of Beirut, was promoted by the Lebanese Company for the Development and Reconstruction of Beirut Central District (SOLIDERE); and (c) economic growth as in Dubai. However, in general terms the visible development of cities is one of the most tangible manifestations of positive national development, whereby advancement in the quality of life can be observed and gauged.

Architecturally, the three cities face similar challenges, balanced as they are between traditional



urban designs and modern, distinctive development. The two have not synthesized, but rather cause what the study deems a kind of "identify crisis in architectural forms" (ESCWA, 2005).

Then there is the big change in commercial spaces vis-à-vis the traditional *souks* that has been brought about by the mall culture. In particular, malls tend to be isolated from the neighbourhoods in which they are situated by large parking lots, and constituting mini-cities in and of themselves. Unlike the *souks*, such malls do not perform a social function within their areas (ESCWA, 2005).

Dubai is a fascinating case, in that it represents at once a city trying to escape from the stereotypical representations of the Arab city, but at the same time sometimes lavishly displaying waste and opulence. It is yet to be seen if, through planned and sustainable development, it can avoid the latter; plans such as the "Green Building Codes" are promising initiatives, though most buildings in Dubai still follow the glass screen design with few energy-saving features. Still, Dubai is developing economically less reliant on oil, and may therefore well move towards durable economic success as a regional economic powerhouse.

In terms of the environment, however, it remains to be seen whether the extraordinarily rapid urban developments in Dubai, Bahrain, and Qatar, and elsewhere in the Arab region, aimed at economically diversifying away from oil revenues, and attracting investors and business, can come to terms with the long-term environmental impacts of their ventures. Some argue, for example, that projects such as those of the artificial islands for luxury developments have not been preceded by satisfactory amounts of research into the environmental impacts of such coastal structures.

Further research is needed into the role of rapidly-growing urban centres, fuelled by massive foreign immigration and high natural growth rates, especially as this pattern of development is projected to continue in the future.

VI. CONCLUDING REMARKS

The main growth in the Arab region has been in urban centres, and on the whole, it can be observed that the population growth and inflow into these centres has generally outpaced their ability to adequately develop. Huge strains have ensued on water, sanitation, public transport, sewage networks, waste management, education, and other services. In turn, this has caused strains on the environment.

The Arab states need to revise their urbanization policies to deal seriously with their problems of imbalances in infrastructure, slums and the changing face of their cities.

GREEN BUILDINGS IN DUBAI

From an article in Gulf News, Dubai, By Emmanuelle Landais, published on 24 October 2007.

All buildings in Dubai will have to be constructed as per environment-friendly "green building", Sheikh Mohammad Bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE, has instructed in his capacity as the Ruler of Dubai.

Owners of residential, commercial and other buildings will have to implement the decision according to the highest international standards that are suitable for Dubai, to maintain a healthy city that follows the global benchmarks in sustainable development and clean environment.

Mohammad Al Gergawi, Minister of State for Cabinet Affairs, said the decision enhances Dubai's keen efforts towards contribution in international efforts to combat environmental challenges, such as the global initiative to control climate change and heat retention. The decision makes Dubai the first city in the Middle East to implement this method.

Environmentalists lauded the decision as a major boost to environmentally-conscious construction. Dr Sadek Owainati, co-founder of the Emirates Green Building Council, said the decision will favourably impact the construction industry to go sustainable and will enforce the "expectation we have of construction in this part of the world." He said the principle for older buildings has not been laid out yet, but the council is encouraging the reviewing of energy consumption in older buildings. "You cannot change the orientation of a building but you can remove hazardous materials."

A green building is environment-friendly by abiding international standards to reduce its impact on the environment. It achieves this by increasing its efficiency and use of energy, water, and materials, and reducing impacts on human health and the environment, through better design, construction, operation and maintenance.

According to the US Green Buildings Council, a green building on average saves 70 per cent of electricity, 50 to 60 per cent of water and 36 per cent of energy than standard buildings.

Based on a point system for every level of efficiency there are about 16,000 green buildings in the United States. There are 16 Platinum green buildings in the world, which is the highest level of eco-friendliness for a structure. By using solar panels and wind turbines to water efficient faucets, buildings can make a difference to how they impact the environment.

READERS' COMMENTS

On 25 October, the following comments from readers appeared on Gulf News website:

Shame it has taken so long. By the time this comes into effect think of all the hundreds of towers and thousands of villas that have missed out. The energy usage from those buildings that have already gone up is huge - how can that be rectified?
Jayne, *Dubai,UAE*

I hope the construction phase where many toxic materials are generated is also considered. What about the community's carbon footprints after the building is built? There is a long way to go one step at a time!
Sherry, *Dubai,UAE*

FROM *ARCHITECTURAL RECORD*

5 December 2007

"The U.A.E. is picking up on messages from around the world, and one of those is sustainability, and they have the ability to implement it," says Chris Johnson, a Gensler managing principal.

But to do so, the country should pay heed to its own vernacular forms—large tents, for example, cooled by breezes and not air conditioning—and not rush to re-create a Manhattan-style skyline, contends Robert Fox, a partner in Cook + Fox. In 1995, he helped design Four Times Square, in New York City, which is often cited as one of the earliest green skyscrapers in the U.S. Fox worries that a U.A.E.-specific LEED ratings system could allow developers to score extra points for, say, photovoltaic panels while neglecting fundamental design issues. "What are the lessons they could learn from their forefathers?" he wonders. "I don't think that any of the forefathers thought that skiing in the middle of the desert would have been a good idea."

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NOTE

1 Note that these three groupings comprise the following countries: Mashreq: Egypt, Iraq, Jordan, Lebanon, Palestine, Syrian Arab Republic; Maghreb: Algeria, Libyan Arab Jamahiriya, Morocco, Tunisia; and Gulf Cooperation Council (GCC): Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates; Least Developed Countries (LDCs): Comoros, Djibouti, Mauritania, Somalia, Sudan, Yemen.

Air Quality

FARID B. CHAABAN

I. INTRODUCTION

In recent years, worldwide public concern over deteriorating air quality and the associated local and global impacts has grown significantly. The impacts on human health could be the most drastic since human lungs, containing very sensitive tissues, receive daily around 15Kg of air compared to 2.5Kg of water and 1.5Kg of food. Moreover, polluted air spreads over long distances and can practically not be avoided. Also, the global impact of pollution-related phenomena such as global warming has been proven to have alarming consequences. This has led governments and local authorities, mainly in industrialized countries, into taking these issues more seriously and hence establishing various emissions limits and standards and implementing mitigation measures to reduce the pollution of the air down to bearable levels.

Concerns related to air quality degradation arise in several quite distinct contexts, often requiring separate legal and other policy responses and actions. By far the most important problem is ambient air – the air people breathe outside buildings and, more broadly, the air in the tropospheric layer. Next are the two global concerns related to the stratosphere: climate change caused by excessive green house gases emissions; and the depletion of the ozone layer protecting life from UV radiation reaching the earth from the sun. Finally, there is the problem of indoor air pollution and odour that may impose a lethal health risk which is sometimes neglected by environ-

TABLE 1 **RECENT STATISTICS FROM THE ARAB COUNTRIES (FOR YEARS 2002-2004)**

Country	Population in 2007 [1]	Number of Vehicles per 1000 inhabitants [2]	Capital	Capital Population	Number of Vehicles in the Capital [3,4]
Algeria	33,857,913	87	**Algiers**	1,980,000	600,000
Bahrain	752,647	322	**Manama**	162,000	280,000
Egypt	75,497,914	30	**Cairo**	9,600,000	2,000,000
Iraq	28,993,376	50	**Baghdad**	5,750,000	1,000,000
Jordan	5,924,247	47	**Amman**	1,147,447	471500
Kuwait	2,851,144	357	**Kuwait**	32,400	900,000
Lebanon	4,099,114	434	**Beirut**	2,012,000	300,000
Libya	6,160,481	234	**Tripoli**	1,150,000	1,243,418
Morocco	31,224,136	53	**Rabat**	1,620,000	254,674
Oman	2,595,132	150	**Muscat**	24,769	316,786
Qatar	840,634	378	**Doha**	340,000	252,959
Saudi Arabia	24,734,532	336	**Riyadh**	4,087,152	985,000
Syria	19,928,518	50	**Damascus**	1,614,500	250,000
Tunisia	10,327,285	71	**Tunis**	728,453	550,000
UAE	4,380,439	193	**Abu Dhabi**	552,000	212,686
Yemen	22,389,172	47	**Sana'a**	1,747,627	823556

Sources: 1. Abdalla, 2006 ; 2. United Nations, 2007 ; 3. NationMaster, 2008 ; 4. PCBS

mentalists as it does not affect nature. Recent studies conducted by national and international organizations, including the World Bank, have indicated that the annual cost of all aspects of air quality degradation is substantial and could constitute up to around 2% of GDP in developed countries and more than 5% in developing countries. These costs include mortality, chronic illness, hospital admissions, lower worker and agricultural productivity, IQ loss, and reduction of visibility. Up to 800,000 premature deaths, and up to 1 million pre-natal deaths have been estimated as one consequence of air pollution globally (Abdalla, 2006).

Table 1 presents a list of Arab countries with statistics about the population densities of each country, the number of vehicles allocated for every 1,000 inhabitants, i.e. the car ownership rate. According to these two sets of statistics, the total number of vehicles in a country is estimated. The population of the capital city for each country is also presented, together with the number of vehicles in each capital.

The car ownership rate indicates the reliance of each Arab state on the transport sector, and is to a certain extent related to the economic standing of the country. Table 2 correlates energy consumption with the national GDP. Here also the recorded figures are much related to the levels of urbanization and economic development in individual countries. Energy consumption per GDP in developing countries, in general, is higher than that of more advanced nations, and this is interpreted sometimes as indicating the inefficient use of energy through the reliance on old technologies for energy conversion, including the transport sector. This gap, however, has been narrowed as indicated in table 2. It is also worth highlighting that some Arab countries have witnessed a drop in relative consumption between 1990 and 2003.

TABLE 2 **ENERGY CONSUMPTION PER GDP IN TONES OF OIL EQUIVALENT (toe) PER MILLION CONSTANT 2000 INTERNATIONAL $**

Country	1990	2000	2003
Algeria	174.2	177.2	176.8
Bahrain	666.8	582.5	559.4
Egypt	197.8	189.3	201.4
Jordan	286.1	276	253.1
Kuwait	..	566	481
Lebanon	366.8	339.1	327
Morocco	84.0	101.1	96.4
Oman	233.3	311.1	361.6
Saudi Arabia	353.1	426	448
Sudan	364.3	244.2	266.7
Syrian Arab Rep	350.8	322.2	294.3
Tunisia	149.5	126.9	123.3
United Arab Emirates	530.9	535	481.3
Yemen	332.6	345	335.9
Developed Countries	*219.1*	*221.1*	*211.8*
Developing Countries	*300.0*	*230.1*	*224.3*

Source: EarthTrends

II. EMISSIONS IN THE ARAB WORLD

Most countries in the region, and in particular the capitals and other major cities, suffer from different degrees of air pollution. About 90 percent of total emissions of carbon monoxide (CO) in Arab countries is due to transportation activities. It is estimated that Arab countries emit collectively about 16 million tons/year of CO (El Raey, 2006). The Arab vehicle fleets emit 1.1 million tons/year of nitrogen oxides (NO_X). Between 70 and 80 percent of total hydrocarbon (HC) emissions originate from the transportation sector, and play an important role in the formation of photochemical oxidants. Lead, used as an additive in petrol, still accounts for more than half of total lead atmospheric emission in the Arab countries and almost 100 percent in urban areas. Diesel engines also emit sulphur dioxides (SO_2) and fine particulate. Stationary sources, such as thermal power plants, refineries, smelters, fertilizers plants, cement manufacturing, and water desalination plants also significantly contribute to air quality deterioration. Industrial compounds and manufacturing facilities emit gases such as CO_2, methane, Volatile Organic Compounds (VOCs) and nitrogen oxide (NO_X). In the Gulf Cooperation Council (GCC) countries total atmospheric emission loads are about 3.85 million tones per year, made of 28% CO, 27% SO_2 and 23% particulates (UNEP, 1999).

Recent studies have indicated that the Gulf countries emit about 50% of the total of Arab countries' (254 million metric tons of carbon) emissions of CO_2. A summary of various regional emissions is presented in Table 3.

TABLE 3 **ARAB COUNTRIES ANNUAL EMISSIONS (1000 TONS) FROM THE TRANSPORT SECTOR, AND THE PERCENTAGE THIS REPRESENTS OF TOTAL EMISSIONS**

	SO_2	NO_x	TSP	CO	HC
Road Transport	200 (5%)	1,100 (37%)	120 (10%)	16,000 (<90 %)	3,000 (<80 %)

Source: El Raey, 2006

Recent reports have included several Arab countries amongst the top 50 countries with highest CO2-emitting power sectors (Center for Global Development, 2007). These are Saudi Arabia (75,900,000 tons and ranked 22nd), Egypt (45,000,000 tons, and ranked 30), Kuwait (19,000,000 tons and ranked 48th), and Algeria (17,700,000 tons and ranked 49th).

Table 4 shows the changes in the carbon dioxide per capita emissions over the past 3 decades. In most listed countries a substantial increase has been recorded between 1980 and 2003. These figures are also compared to the Middle East and World averages. These figures clearly indicate the wide variations amongst regional nations in energy consumption intensities and patterns. In general, GCC and other oil-exporting nations have emissions rates higher than the world average.

TABLE 4 **THE ARAB REGION'S NATIONAL PER CAPITA CO_2 EMISSIONS FROM THE CONSUMPTION AND FLARING OF FOSSIL FUELS**

Region/Country	1980	1990	2000	2003
Algeria	0.94	0.90	0.75	0.70
Bahrain	6.11	7.68	8.66	9.13
Egypt	0.27	0.44	0.46	0.53
Iraq	1.04	1.03	0.88	0.78
Jordan	0.67	0.85	0.84	0.85
Kuwait	6.12	3.48	8.15	8.16
Lebanon	0.58	0.40	1.24	1.17
Libya	2.83	2.74	2.21	2.77
Mauritania	0.10	0.13	0.33	0.29
Morocco	0.21	0.24	0.28	0.29
Oman	0.88	1.90	2.33	2.17
Qatar	16.37	10.54	12.64	10.78
Saudi Arabia	4.79	3.53	3.39	3.74
Somalia	0.05	0.04	0.03	0.02
Sudan	0.05	0.04	0.05	0.07
Syria	0.52	0.81	0.86	0.80
Tunisia	0.36	0.43	0.56	0.57
United Arab Emirates	8.09	10.99	12.61	14.45
Yemen	0.21	0.25	0.15	0.14
Middle East Average	*1.43*	*1.48*	*1.76*	*1.89*
World Average	*1.12*	*1.11*	*1.07*	*1.11*

Source: EIA World Carbon Dioxide Emissions from the Use of Fossil Fuels

Table 5 shows the net thermal electric power (in kilowatt hours - kWh) generated from thermal power plants in the Arab region. The presented figures show that the increase in demand for electricity in some countries has been higher than the world average. It should also be noted that the vast majority of the operating power plants are thermal, and mostly driven by fuel oil derivatives.

Recently, several electric utilities in the region have begun to use natural gas for thermal power generation. The amounts of emissions associated with generated power could be deduced from the emission rates from typical power plants as shown in Table 6.

The electric power sector in the region has the following common characteristics:

- Typical energy conversion efficiencies in the range of 30-35%.
- In most countries, the power sector is entrusted to a state-controlled monopoly for the generation, transmission, and distribution of electricity. This trend has been recently changed in some countries.
- Consequently, the limited available state financial resources, the future size of investments, and uncertainty about the future become major obstacles in any technology updating process.
- Fuel used for electricity generation is mostly being subsidized by the governments, and this leads to a significant undervaluation of electricity prices, causing misleading and distorted market signals provided to producers and consumers alike.
- Traditional electricity planning in these countries has focused on expanding supply resources to meet anticipated demand growth.

TABLE 5 NET THERMAL POWER PRODUCTION [BILLION kWh]

Region/Country	1980	1990	2000	2003
Algeria	6.44	15.01	23.84	27.55
Bahrain	1.55	3.28	5.92	7.30
Egypt	8.56	31.53	57.97	73.99
Iraq	10.05	20.12	29.41	26.23
Jordan	1.00	3.41	6.90	7.47
Kuwait	8.82	19.37	30.88	37.41
Lebanon	1.78	2.13	6.95	8.63
Libya	4.53	15.79	14.57	17.81
Mauritania	0.06	0.11	0.12	0.13
Morocco	3.43	7.90	12.16	15.46
Oman	0.90	5.02	8.56	13.74
Qatar	2.28	4.53	8.59	11.29
Saudi Arabia	20.45	64.90	118.62	143.82
Somalia	0.11	0.25	0.27	0.27
Sudan	0.47	0.52	1.19	2.06
Syria	1.20	5.61	20.67	25.14
Tunisia	2.60	5.16	9.88	11.48
United Arab Emirates	5.90	16.06	37.55	46.57
Yemen	0.47	1.56	3.21	3.85
World Total	**5,588.54**	**7,137.85**	**9,255.70**	**10,438.90**

Source: EIA World Carbon Dioxide Emissions from the Use of Fossil Fuels

In general, no account has been given to global initiatives related to the sustainability of the sector.

- Subsequently, insufficient investments have been made into critical areas such as energy conservation and load management, system optimization and loss reduction, renewable energy, and fuel substitution, and others.

III. POLLUTION LEVELS IN SOME ARAB COUNTRIES

According to the 2006 Yearbook of the UNEP Global Environmental Outlook (GEO), the urban growth rates in the region were very rapid; the urban population increased from 38% of the total in 1970, to 63% by 2005. In the same period, the urban share in the Mashreq sub-region (Iraq, Jordan, Lebanon, the Occupied Palestinian Territories and Syria) increased from 52% to 65%. By 2030, the urban population in West Asia is projected to reach 143 million. The concentration of population in urban areas has resulted, among other problems, in increased air pollution.

According to the yearbook, cities such as Sana'a, Damascus, Cairo, Baghdad and Manama among other major cities in the region suffer air pollution levels that sometimes exceed WHO guidelines. Although few countries monitor air pollution levels systematically, available data and reports indicate that the main sources include industrial processes, inappropriate disposal of solid and hazardous waste, vehicle emissions and the burning of oil in electric power generation.

TABLE 6 TYPICAL EMISSION FROM POWER PLANTS [g/kWh]

Fuel type	CO	CO_2	SO_2	NO_x	VOC
Natural gas	0.2	490	0.004	1.5	0.025
Fuel oil	0.19	781	5.1	1.5	0.05
Coal	0.11	1,060	5.5	2.4	0.01

Source: EPRI

TABLE 7 **AIR POLLUTION IN CAIRO**

Pollutant	Standard (ug/m³)	Peak values
PM_{10}	70 (annual)	300
SO_2	150 (24 hour)	351
NO_2	150 (24 hour)	164
Ozone	120 (8 hour)	380
CO	10mg/m³ (8-hour)	34
Pb	1 (annual)	1.6

Source: EIA World Carbon Dioxide Emissions from the Use of Fossil Fuels

In what follows, a brief statistical overview is offered about pollutants concentration in major cities and urbanized regions in the Arab world.

Egypt

It has been estimated that Egypt's emissions of greenhouse gases (GHG) figure is around 0.6% of estimated total world emissions. Measurements inside urban areas and close to industrial complexes have sometimes recorded pollution levels higher (sometimes 6 to 8 times) than the limits set by Environmental Law 4 (ratified in 1994). Egypt has an average concentration of SO_2 of around 69µg/m³ of (compared to the WHO standard of 50µg/m³) (Anderson, Loeb, Nasralla, 2001; El Raey, 2006). The peak levels recorded, however, are much higher than recorded averages. High particulates concentrations are generally caused by the climatic conditions and winds blown from the desert. Measurements, however, also showed that smaller particulates that cause major health problems are generated from industrial complexes and power plants. These particle levels are also accompanied by high sulphur concentrations, an indication of the burning of fossil fuels in these complexes. Levels of PM_{10} have reached 580µg/m³ in Cairo and 450µg/m³ in Alexandria. A sample of recorded concentration levels of various major air pollutants in comparison to national standards is shown in Table 7.

Syria

The transport sector in Syria causes around 70% of urban air pollution. The concentration of PM_{10} in Damascus is estimated at 749µg/m³ in highly congested traffic areas and 333µg/m³ in residential zones (El Raey, 2006). This is due to the fossil fuel combustion in industrial complexes in and around the city, and is also attributed to the generally old and poorly- maintained vehicles fleet, quality of transport fuel, and high reliance of diesel- driven microbuses for public transport in major cities (Haffar, 2004).

Diesel stoves are the second biggest polluters (Kurze 2004). They also strongly contaminate the air with sulphur dioxide. There is hardly a private household in Damascus that does not use diesel (*Mazut*), for heating in the cold months from November to March. The stoves, which do not cost more than 25 Euro, can be bought everywhere in town, and *Mazut* is cheap.

Lebanon

The power sector in Lebanon relies almost completely on imported fuel oil to operate its thermal power plants. These plants are regarded as the main source of air pollution in nearby areas, and this has been confirmed by series of measurements conducted mainly by academic institutions and NGOs. Levels of particulates and oxides of sulphur were found to be several times higher than international standards.

Air pollution from the industrial sector is recorded in the vicinity of major cement factories along the Lebanese coast. Particulates and dust are the main effluents from these factories.

The transport sector is the major source of GHG emissions in the country. The motor vehicles fleet of Lebanon constitutes over 1.4 million registered vehicles, 55% of which are more than 15 years old (Chaaban and Chedid 2003). CO_2 emissions in 1999 totaled 4,585 Gg (gigagram) compared to around 3,957 Gg in 1994, an increase of around 16% (see table 8). Currently, emissions have topped the 5,000 Gg level.

Lead concentrations in Beirut varied by the end of the 20th century from 0.17 to 4.64µg/m³ with an average value of 1.86µg/m³, and the total TSP concentrations is 166µg/m³. Levels of ozone and smog measured in Beirut were several times higher than the world norms. This has been partially mitigated by the enforcement of law 341 in 2003 that has banned the use of industrial diesel for transport, and also banned leaded fuel.

Bahrain

The transport sector is the main source of pollution in Bahrain, according to air quality tests (Sami and Khonji, 2006). In one such air quality test, air monitoring equipment was set up in each of Bahrain's five governorates; the results revealed a significant increase in pollutants associated with vehicle emissions over the past 10 years – particularly nitrogen oxides and ozone gas. These increases were attributed primarily to vehicle exhaust and industrial emissions, petrol vapours and chemical solvents – as well as natural sources – emitting NO_X and volatile organic compounds, which form ozone.

Levels of sulphur dioxide (SO_2), which is pumped into the atmosphere by industries such as petroleum refineries, cement manufacturers and metal processing facilities, have been relatively stable in Bahrain at under 5ppb (parts per billion) over the last 10 years. There were spikes upwards to 10ppb in 1998 and 9ppb in 2002, but the figure currently stands at 7ppb. SO_2 also contributes to respiratory illness and acid rain. However, Bahrain's air quality tests showed that certain parts of the country are more polluted than others.

The amount of low-level O_3 in Bahrain is 51ppb, whereas NO_X concentration has risen from 15ppb 10 years ago, reaching a peak of 30ppb in late 2002. CO_2 emissions from the transportation sector represent only 5.6 percent of the total CO_2 emissions in Bahrain (Sami and Khonji 2006).

Algeria

Urban air pollution in Algeria is caused by the transport sector in the large cities of Algiers, Oran and Constantine; by burning municipal

waste; and by heavy industries in Annaba, Skikda, and Gazaouet. Such pollution has triggered on a yearly basis 353,000 cases of bronchitis, 544,000 asthma attacks and could be a cause behind 1,500 cases of lung cancer. Morbidity and mortality were evaluated in terms of DALYs (Disability Adjusted Life Years). It was estimated that 157,000 DALYs a year are lost because of outdoor air pollution and 88,820 are lost annually due to indoor air pollution (METAP, 2003). The environmental cost mounts to around 0.9% of national GDP.

The annual concentration of PM_{10} in Algiers is about 50µg/m^3 (SMAP RMSU 2004), and the ozone concentration is 180µg/m^3. SO_2 concentration is 360µg/m^3, and NO_X is 400µg/m^3,

TABLE 8 **MAJOR GREENHOUSE GAS EMISSIONS FROM THE TRANSPORT SECTOR IN LEBANON, IN Gg**

GH Gas Source	CO_2	NO_X	CO	NMVOC	SO_2
Civil aviation	6.02853	0.0255	0.00851	0.00425	0.001872
Road transportation	3,949.839	34.824	447.193	83.8708	2.67669
Navigation	1.2564	0.02734	0.0182	0.00364	0
Total Transport (1994)	3,957.124	34.877	447.220	83.879	2.679

Source: Lebanon Ministry of Environment 2001 (State of the Environment Report)

TABLE 9 EMISSIONS FROM THE TRANSPORT SECTOR IN TETUAN IN TONS/YEAR

NVOC	CH_4	CO	CO_2	NO_x	SO_x	N_2O	PM_{10}
503.09	19.26	4,681.4	286,634	489.93	1,656.6	2.96	31.06

Sources: World Bank 2003; National Environment Observatory of Morocco 2001

whereas CO concentration is 10,000µg/m³. A quantity of 180 tons lead/year is emitted in the streets of the capital. Other cities also suffer from air quality degradation but at smaller scale.

Jordan

A recent study has been conducted to assess vehicular emissions of carbon monoxide and hydrocarbons for gasoline-driven motor vehicles in the Greater Amman Area in order to provide the government with the basic information necessary for updating and developing new vehicular exhaust emissions standards. It was found that the incompliance rates of CO and HC to limits specified in Traffic Law no. 14/1984 were 40% and 25% respectively. Motor vehicles age was found to be the most important factor affecting vehicular emission levels. Old motor vehicles were found to emit double the CO amount and triple the HC amount emitted by new automobiles. Additionally, public transport vehicles were found to contribute to higher CO and HC emission levels than those of private cars. The total CO_2 emissions in the country were estimated at around 5.18 million tons, 2.3% of which were attributed to the power sector (UNESCWA, 2001).

Zarqa is home to 52% of the country's industries. Phosphate accumulation and emissions from local refineries are among the governorate's major environmental problems. The area also is affected by emissions from the nearby thermal power plant, industrial wastewater, and the dust from brick and stone quarries.

Saudi Arabia

The air pollution problem in the Riyadh region is mainly attributed to the nearby refineries, power plants, and to transport. Sulphur dioxide is the main air pollutant emitted from the refining processes. The main source of sulphur dioxide emission is the hydrogen sulphide incinerator. There are no apparent serious environmental problems with any other air effluents. In Riyadh the following concentrations were reported: SO_2 concentration is 23.8µg/m³ (Spektor, 1998), whereas the concentration of ozone is 53.4µg/m³. Average interior CO concentrations (inside vehicles) during non-peak traffic times ranged from 10 to 25 parts per million (ppm). Also, lead concentrations have exceeded international norms.

Morocco

Sources of air pollution are the industrial and mining, transport, and agriculture sectors. In Rabat, fine particulates (less than 3µm in diameter) have an annual average of 243µg/m³ (World Bank 2003; National Environment Observatory of Morocco 2001). PM_{10} levels ranges between 70 and 123µg/m³, CO_2 concentrations reach 144µg/m³, SO_2 concentrations vary between 8 and 144µg/m³ depending on the region inside the city. Data from Tetuan city is also summarized in Table 9.

A correlation has been found between air pollution and health needs in a number of cities. Mortality, for example, has increased by 2% due to the increase of PM_{10} concentrations by 22µg/m³.

Palestine

Although air pollution may not be as severe an environmental issue as the pressures on water and land resources, it still poses a threat to the local community. The main problem is the lack of monitoring stations and therefore reliable data, and the institutional capacity to interpret data and take appropriate action. Air quality in the region is generally on the decline, largely due to lack of relevant regulations, proper solid waste disposal and the lack of control over industrial and transport-related emissions. Another important factor is the growing population, using an expanding fleet of vehicles running on diesel and leaded fuel (El Raey, 2006). Some parts of the West Bank are downwind from industrial zones, and these further reduce ambient air quality.

UAE

Air pollution exists in the UAE in the larger cities such as Abu Dhabi, Dubai and Sharjah. One source is wind-blown sand; the incidence and scale of this problem varies according to the time of year. The anthropogenic sources of air-pollution in the UAE, and mainly in Dubai, are mostly the construction sector, which kicks up a lot of dust, and the ever increasing traffic. According to the State of the Environment report, the CO_2 emissions rate in the UAE has increased from around 80.8 million tons in 1990 up to over 94 million tons in 2002.

In Abu Dhabi, NO_2 concentrations are between 250-270µg/m^3 (Abu Dhabi Environment Ministry), SO_2 concentrations are between 100-150µg/m^3. In the Al Ain region, NO_2 concentrations inside the city reach 230µg/m^3, while SO_2 concentrations reach its maximum in Al Ain Centre around 60µg/m^3. Typical concentration levels in Mussafah and Ruwais are shown in Table 10.

Yemen

The capital city of Sana'a, located at an altitude of around 2300m, suffers from extensive air pollution emitted mainly from the transport, electric power, and energy-intensive industries located in and around the city. The transport sector has witnessed a large growth. According to a recent UN study (Chaaban, 2004), the transport sector in Sana'a constitutes over 100,000 personal vehicles, added to it around 40,000 small taxis, and 70,000 minibuses. There is a heavy reliance on diesel for transport because its cost is almost 50% that of petrol. The fleet is very old and poorly maintained. The pollutant concentrations are estimated to be several times higher than the levels set by norms and standards.

Tunisia

In Tunisia, the electric power and transport sectors are the major contributors to air pollution, at 31% and 30%, respectively. Samples of pollutant concentrations in Ben Arous (Tunis) in the year 2000 are shown in the Table 11.

IV. INITIATIVES TO REDUCE AIR POLLUTION

There exists a wide scope of mitigation options and strategies for air pollution abatement. The feasibility of these options varies from one country to another depending on the social and economic welfare of each nation. However, options like setting air quality standards, establishing air monitoring networks, increasing awareness among citizens as well as decision makers, and allocating sufficient funding could be adopted in most Arab countries. Each country has conducted steps and set regulations aiming at solving the air quality problem. In what follows is a brief overview of selected countries.

Lebanon

A technology needs assessment has been conducted for all economic sectors for GHG mitigation (Chaaban and Chedid, 2002). The transport sector was analyzed under six options. These are the promotion of mass transport, improving the

TABLE 10 **CONCENTRATIONS IN MUSSAFAH AND RUWAIS (UAE)**

Pollutant	Mean concentrations in Mussafah (µg/m^3)	Mean concentrations in Ruwais (µg/m^3)
NO_x	83.7	28.9
NO	20.2	4.8
NO_2	52.8	21.7
SO_2	14.7	17.2
H_2S	9.7	4.1
CO	0.6	0.3
O_3	41.4	90.8
PM_{10}	135.0	28.9

Source: Abu Dhabi Environment Ministry

TABLE 11 **AIR POLLUTION CONCENTRATIONS IN BEN AROUS, TUNISIA**

Pollutant	Concentration in µg/m^3
SO_2	104
O_3	86
NO_2	178
CO	3143
H_2S	77
PM_{10}	226

Source: Japan International Cooperation Agency

TABLE 12 **SUMMARY OF TECHNOLOGY OPTIONS RANKING IN THE TRANSPORT SECTOR**

Option	Overall Score
Promoting mass transport	78.20
Improving technical status of the fleet	76.50
Switching to alternative fuels (NG)	73.75
Improving traffic management	69.30
Environmental standards and regulations	68.50
Urban planning and land use	62.50

Source: Chaaban and Chedid 2002

TABLE 13 **SUMMARY OF TECHNOLOGY OPTIONS RANKING IN THE POWER SECTOR**

Option	Overall Score
Electric Interconnection	82.10
Deployment of Combined Cycles	80.30
Switching to Natural Gas	77.40
Partially Switching to Renewable Energy	77.00
Recycling/phasing out Subsidies	75.30
Reduction of Transmission losses	71.10
Demand-Side Management	70.95
Technology upgrading	70.55

Source: Chaaban and Chedid 2002

TABLE 14 **SUMMARY OF TECHNOLOGY OPTIONS RANKING IN THE INDUSTRY SECTOR**

Option	Overall Score
Switching to Natural Gas	80.75
Boiler Improvement	80.30
Energy Efficient Systems	78.80
Cogeneration	71.15
Efficient Motors	70.00

Source: Chaaban and Chedid 2002

technical status of the fleet, switching to alternative fuels, improving traffic management, updating and enforcing environmental standards and regulations and finally improving urban planning and land use. The results shown in Table 12 reflect the ranking of these technologies, as obtained from a nation-wide consultation process that included decision makers, experts, NGOs, and others. The scores are also listed to show the margins between individual options.

There is a need to consolidate and enforce programs and policies associated with Law 341/2001 on reducing air pollution from the transport sector. Specifically, in designing and implementing a fuel quality improvement program, and supporting a vehicle inspection and maintenance program. A national strategy for the improvement of fuel quality has targeted a complete lead phase-out in gasoline and the reduction of diesel sulphur content, also banning the use of industrial diesel for small and medium vehicles.

In the power sector, eight options have been found suitable to reduce emissions, mainly GHG gases. Based on the comparative analysis made possible by the ranking tables designed for that purpose, it was found that electricity interconnection is the most important option, followed by combined cycle technology, switching to natural gas and then partial switching to renewable energy.

In the industrial sector, five options were identified. The natural gas option has the highest priority followed by boiler improvement, energy efficient systems, co-generation and finally energy-efficient motors.

Egypt

Initiatives and activities are carried out on both the strategic and operational levels.

On a strategic level, the preparation of an Air Quality Management Strategy is underway, primarily addressing air pollution resulting from the mismanagement of solid waste, as well as pollution abatement from mobile sources. Moreover, an emissions inventory in Greater Cairo including all sources of air pollution, industrial and non-industrial, is to be carried out (EEAA).

On an operational level, a number of activities and initiatives were carried out during 2000/2001 with a particular focus on the Greater Cairo area, where the highest levels of air pollution occur:

1. *Monitoring of Ambient Air Quality:* A comprehensive national air quality monitoring system has been established as part of the Environmental Information and Monitoring Program of the Egyptian Environmental Affairs Agency (EEAA). The

monitoring system measures concentrations of common air pollutants.

2. *Reduction of Vehicle Emissions in Greater Cairo:*
   On-road testing of vehicles with mobile emission analyzers has been enforced in partnership with the Ministry of Interior. Moreover, a network of stationary facilities for emissions testing, operated through the Traffic Department has been identified as the most feasible option for systematic testing of vehicles in the long term. With the objective of demonstrating the feasibility of replacing diesel-fuelled city public transport buses with compressed natural gas (CNG), the introduction of CNG buses into the fleets of the public bus companies of Greater Cairo is currently taking place.

3. *Conversion to the Use of Natural Gas:*
   The conversion of the power plants in the Greater Cairo region from the use of fossil fuels to that of natural gas, was successfully carried out, thereby reducing ambient concentrations of sulphur dioxide.

Jordan

"Horizon 2020" has set the following framework for the country to mitigate air quality degradation:

Initiative 1:
Legal framework
The primary piece of environmental legislation is Law No. 1 of 2003, which has substituted the Environmental Protection Law of 1995. As a result, many regulations are issued by the government; among them is "The Air Protection Regulation". Clean Draft Act (2000) sets out the responsibilities for determining maximum allowable concentrations.

Initiative 2:
Develop and implement action plans
Consolidate the institutional set-up for environmental management, particularly on pollution management (monitoring and enforcement). In the same context, enhanced communication and coordination between the involved entities is needed. In addition, the preparation of an inspection program, as well as the mechanism to

monitor the environmental mitigation plans proposed for various industrial units (industrial emissions) and the enforcement of the related articles of the environment law is a priority.

Initiative 3:
Technical capacity
The capacity to manage integrated environmental management systems and technologies in Jordan is weak, and Jordanian experience with some of the modern systems and technologies used in environmental management programs is limited in the field of air pollution. The improvement of Jordan's technical capacity in this field is thus a key objective.

UAE

The UAE's ban on leaded fuel, which came into force on 1 January 2003, has favorably impacted air quality in the country. These changes began when the Gulf Cooperation Council (GCC) asserted in December 1998 the need for a regional transition towards unleaded fuel. Four years later the UAE phased out leaded gasoline entirely and replaced it with unleaded gasoline (ERWDA- Abu Dhabi Research and Wildlife Management Agency 2005).

In response to the rising concern over the preservation of air quality, ERWDA (now Environmental Agency Abu Dhabi - EAD) embarked on an ambitious air quality management project aimed at monitoring air quality. By the end of 2003, ERWDA conducted an 18 month air quality monitoring and management study for Abu Dhabi. As part of the air quality management effort, 15 fixed and 2 mobile stations were acquired to monitor air quality and pollution.

EAD has completed the second stage of the project, bringing to a close the baseline data collection and assessment process, as well as the analysis of emissions and dispersion of flue gases from industrial stacks and vehicular traffic. The third stage will involve the creation of a full fledged Central Network System and an Air Quality Management System, to operate and continually enhance the equipment to achieve maximum efficient utilization of resources.

Another planned measure is to draw up an action plan to introduce natural gas as a substitute for petrol, especially for specific vehicular categories that are high fuel consumers. Indeed, according to the Environment Agency Abu Dhabi (EAD) report, 20 percent of government-owned vehicles and taxis in the emirate will be converted to run on CNG, which EAD also calls Clean Natural Gas, by 2012. All government diesel vehicles will also be converted to run on Ultra Low Sulphur Fuel (ULSF) with at least Euro III emission limits or equivalent by 2012.

Saudi Arabia

Air quality management in Saudi Arabia is currently concerned with establishing air quality standards for limits on sulphur dioxide, particulates, ozone, nitrogen oxides, carbon monoxide and hydrogen sulphide, and other pollutants (Abu Dhabi Research and Wildlife Management Agency, 2005).

The Kingdom's Meteorology and Environmental Protection Administration (MEPA) has undertaken studies on the hazards of pollution, inventory of pollutants, development of necessary environmental standards and measures to protect air quality. Collaborating with MEPA, Saudi Aramco, the country's largest petroleum entity, also conducts its own air quality monitoring program.

Aramco operates ten Air Quality Monitoring and Meteorology Network stations and fifteen meteorology-only stations throughout the Kingdom. These stations ensure facilities meet national and company air quality standards for limits on major air pollutants.

On the other hand, Saudi air quality has been improved by the introduction of unleaded gasoline in the country in January 2001. Currently, service stations in Saudi Arabia sell lead-free gasoline with the octane boosting additive MTBE (methyl tertiary butyl ether). Leaded gasoline has now been almost eliminated.

Bahrain

The most important legislation was set forth as Amiri Decree No. 7 in August 1980, which formed the Environmental Protection Committee (EPC) and the Environmental Protection Technical Secretariat (EPTS). An Amiri decree-law No. 21 (1996) was enacted with the establishment of an Environmental Affairs agency (EA), an agency under the Ministry of Housing, Municipalities and Environment.

Continuous monitoring of atmospheric pollutants at four geographical locations began in August 1993 (United Nations, 1997). Major pollutants such as SO_2, NO_2, NO, O_3, CO, H_2S, HC, and PM_{10} are monitored. Recorded data at each station is transmitted via modems to a central computer system. Various mean values are automatically calculated and compared to acceptable ambient air quality standards. All measured values are available for statistical evaluation. Daily, weekly, monthly and annual reports are utilized in the decision-making process.

There is a joint effort within the GCC to implement an action plan to reduce car emissions and introduce unleaded petrol. A program called "Fume watch", which was introduced in Bahrain in 1994, aimed to report vehicles visibly emitting smoke, followed by an immediate approach to rectify these situations. This program yielded a noticeable improvement.

Recent studies have also suggested that removing subsidies and internationalizing the external costs of electricity generation could lead to resources

use optimization, and would also enhance the stability of the sector (Al-Hesabi, 2004). Electricity tariffs should, according to these studies, reflect the cost of the environmental and health impacts of emissions.

Qatar

The State of Qatar has established guidelines to reduce air pollution in urbanized regions. These are based on the following initiatives:

Initiative 1:
Control of air pollution
The Supreme Council for Environment and Natural Reserves has developed a network of fixed and mobile air quality monitoring stations in many industrial cities to conduct air quality monitoring activities. These stations provide valuable data related to the major pollutants.

Initiative 2:
Legislation
By publishing the executive regulations of Law Number 30 of 2002 related to the environmental protection in the country, the norms and standards related to gas emissions became legally binding. Equally, any development projects including industrial projects became subject to environmental impact approval. According to this law, all industrial plants are obliged to monitor their emissions according to norms, standards and conditions agreed upon in advance and subject to a quarterly report.

Initiative 3:
General policies to improve fuel quality
All transport vehicles use unleaded gasoline. It has also been planned to start in 2005 to produce green diesel produced through converting Natural Gas to Liquefied fuels. This is yet to be fully implemented. A nationwide energy audit is being conducted for the residential sector.

Initiative 4:
Capacity building, information research and development
Particular efforts are made in Qatar towards building and strengthening national institutional and legal capacities to preserve good air quality. In addition, the importance of creating public awareness of these issues is recognized by parties involved in the dissemination of relevant publications and the implementation of specific programs at the school level throughout the country.

Tunisia

In the Tunisian capital, Tunis, motor vehicles and motorcycles are the main causes of air pollu-

tion. A national control and monitoring program is conducted by the Environment and Management body of the Territory Ministry with the National Environment Protection Agency and CITET ("Centre International des Technologies de l'Environnement de Tunis" – Tunis International Centre for Environmental Technologies) (Japan International Cooperation Agency, 2002). The objective of this program is the preservation of air quality by identification, characterization and reduction of origin of the fixed (industrial emissions) or mobile pollutions.

Five continuous monitoring stations form a first group of national monitoring network that is currently extended to 25 fixed monitoring stations.

Syria

Syria has enacted a multifaceted national action plan for controlling air emissions from various sectors (Kayyal, 2005). The proposed goals include:

1. Phase out leaded gasoline from use by vehicular traffic, and provide incentives for minibuses operating in Tartous, Lattakia and Jableh to also run in rural areas.
2. Enforce vehicular emissions standards and controls, control technical performance of vehicles, and develop appropriate rules and regulations in accordance with international standards for imports with the aim of preventing pollution.
3. Shift towards natural gas as a main fuel for the power sector and for major industrial complexes.
4. Deployment of modern heating systems to replace the old diesel stoves in residential sector.
5. Adhere to a regular and annual vehicles inspection system for monitoring exhaust gas emissions, and provide the necessary technologies for this task.
6. Reduce demand on vehicular transport, adjust peak periods, and substitute the individual vehicular traffic with an integrated modern public transport system.

Yemen

Mitigation strategies sought for the transport sector are classified as:

1. To establish a sampling/monitoring network to assess air quality in Sana'a, in collaboration with UNEP and experts from academic research units.
2. To further rely on cleaner fuel for electricity generation.
3. On the technical side, to improve the technical status of the fleet through regular inspection and maintenance programs, phasing out leaded fuel, adopting cleaner fuels and dual fuels systems using LPG, diesel, and gasoline.
4. On the planning and regulatory sides, to establish modern and reliable mass transport systems, to provide incentives to shift towards unleaded and other cleaner fuels, and to upgrade traffic management systems in major cities.
5. To adopt local and international standards on emissions from industries and ambient air quality and to have these standards enforced.
6. On the awareness side, to publicize the economic cost and health impacts of air quality degradation, to highlight technical and economic benefits of cleaner fuels and technologies, and to conduct public awareness campaigns in collaboration with local media and NGOs.

To conclude, Table 15 shows the current status of diesel fuel in a number of Arab countries and a brief of future plans.

V. STRATEGIES FOR A MORE EFFICIENT ENERGY SECTOR AND EMISSIONS REDUCTION

Electric power sector

Feasible options include:

1. Reducing the role of governments to achieve sector reform and the elimination/reduction of bills and fuel subsidies to reduce consumption and emissions;
2. Introduction of appropriate tariff structures to encourage consumers to shift their demand off peak intervals, thus reducing the total installed capacities;
3. Improvement of the thermal efficiency through the adoption of new and advanced technologies like combined cycle units;
4. Full utilization of hydropower resources tak-

TABLE 15 **ARAB WORLD'S DIESEL SULPHUR MATRIX**

COUNTRY	CURRENT STATUS Diesel Sulphur Content (ppm)	COMMENT
Algeria	900	No plans to process crude further
Bahrain	5,000 (500)	To be reduced to further by 2007, some low sulfur available
Egypt	5,000	No Plans to reduce levels, Standard 10,000 ppm
Iraq	10,000	Actual Standards 25,000 ppm
Jordan	9,000	Actual Standards 12,000 ppm
Kuwait	3,500	Actual Standards 5,000 ppm
Lebanon	6,500 (350)	Shift towards green diesel
Libya	1,000	Standards are about 1,500 ppm
Morocco	10,000 (350)	Introduction of 350 ppm sulfur diesel on a very limited basis
Oman	5,500	Actual Standards 10,000 ppm
Palestine	10,000	Gets fuel from Jordan which is at 10,000 ppm
Qatar	5,000	Shift towards lower sulfur diesel
Saudi Arabia	5,000	Current Standards 10,000 ppm. Plans to go to 500 ppm by 2007 and 50 ppm in future
Syria	6,500	Actual Standards 7,000 ppm
Tunisia	10,000	Actual Standards 10,000 ppm. Change in 2011
UAE	5,000	Plans to go to 2,500 ppm in late 2005 and 50 ppm by 2010
Yemen	10,000	No current Standards. Improvements planned for 2010

Source: UNEP 2006

ing into account various relevant environmental and social issues;
5. Deployment of other renewable energy technologies, especially for water heating, on a scale wide enough to impact the national energy situation;
6. Upgrading of the power transmission and distribution networks to minimize losses; and
7. Shifting to less polluting fuels, namely natural gas.

Industrial sector

Options in this category include:
1. Establishment of mandatory building codes that account for energy-efficient designs and operation of commercial buildings;
2. Minimization of heat and power losses and the expanded use of waste heat recovery technologies and automated process controls; especially in energy- intensive industries such as cement, steel, and glass factories.
3. Greater exploitation of cogeneration potential; and
4. Establishment of mandatory standards and evaluation of optimum operating conditions for motor-driven systems.

Transport sector

Options in this category include:
1. Promotion of more efficient vehicle technologies; examples include electric and hybrid electric vehicles;
2. Traffic management in urbanized regions leading to a drop in trip duration and hence reduction in fuel consumption;
3. Improving the technical status of the fleet through strict annual checks;
4. Promotion of public/mass transport; and
5. Promotion of cleaner fuels.

It should be noted that implementing the full range of above-listed actions requires national commitment to strengthening existing institutions engaged in energy efficiency activities or to establishing new ones.

Most Arab countries will need, in addition to their own efforts, assistance from more developed nations to achieve these objectives.

Appropriate economic and institutional reforms would be required to encourage private sector involvement that can attract investments in energy efficient technologies.

VI. CFC ABATEMENT

Data on chlorofluorocarbon (CFC) emissions from various economic sectors in the region is not readily available. Many countries have benefited from the multilateral funds made available from the Montreal Protocol to establish offices and units whose main objectives are:

- Dissemination of information on ozone issues.
- Development of policies and legislation to ban CFC substances and hence reduce their emissions.
- Establishing data bank information on ozone depleting substances (ODS).
- Providing assistance to industrial sector to phase out ODS consumption.
- Conducting training and awareness programs and workshops.

VII. NOISE POLLUTION

Noise pollution is not considered as severe as other forms of pollution because it is not as fatal as water pollution or air pollution. Moreover, unlike the other forms of pollution, it can be avoided. The main – and overwhelming – source of noise pollution in urbanized regions is generated by transportation. Governments all over the world have changed their perception of noise pollution over the past 40 years. However, for developing countries including those in the Arab region, this issue remains unaddressed due to political, economic, and technological limitations. In many regional countries, no direct legislative implementations deal with noise pollution, though there are laws and directives aimed at limiting or banning honking during the night hours.

A recent study conducted in Beirut, Lebanon has shown that major roads suffer from periodical high noise pollution levels, reaching up to around 90dB during rush hours. The study also surveyed people living in the vicinities of these roads, and concluded that they generally suffer from problems such as headaches, heart palpitations and learning impairment (Fares, Nehme, Jouni, 2007).

Noise measurements in Amman, Jordan, were carried out at many locations and the results of the investigation showed that the minimum and the maximum noise levels are 46 dBA and 81 dBA during day-time and 58 dBA and 71 dBA during night-time. The measured noise level exceeded the 62 dBA acceptable limit at most of the locations (Jarmah, Al-Omari, Sharabi, 2006).

In Dubai, high traffic generates a high noise level, added to it the amount of noise created at construction sites currently building rail stations, sections of track and depots. Noise pollution is the key focus of an environmental audit launched by the Roads and Transport Authority. Areas being targeted for the audit include the assessment of acceptable operating noise levels (Gulf News, 2006). There will be a focus on efforts to reduce the impact of noise generating equipment used in construction.

Reduction measures generally fall into 3 categories:

(i) Control at the source

These measures can be implemented at the design stage by the manufacturers, and they include fitting sound absorbers in the vehicle to reduce mechanical and engine noises and improving tires design, improving the exhaust noise mufflers especially for trucks and motorcycles, improving the engine design so as to reduce its noise and vibration.

(ii) Control in the transmission path

These measures, usually provided by local authorities, include keeping the noise source (traffic) as far from the residential areas as economically possible, fitting noise barriers (walls) to partially reflect noise waves away from the residents, banning heavy-load trucks (and motorcycles) from operating in residential areas during night hours, and constructing tunnels and underground mass transportation networks.

(iii) Control at the recipient

These measures are in principle similar to those implemented by planners and local authorities; they include building houses away from the traffic and using some insulation systems in the construction such as double-glazing, and building barriers close to the traffic or close to the buildings. Planting trees can also lead to significant noise reduction in addition to the natural beauty they offer. Also, controlling the technical status of personal vehicles could lead to substantial noise reduction.

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Water Resources

Musa N. Nimah

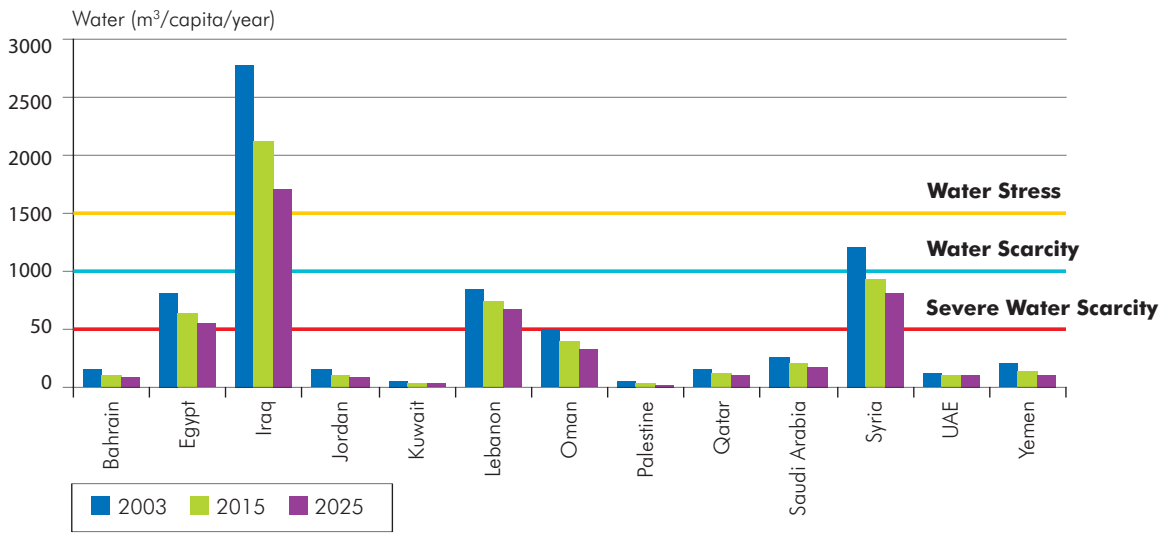
I. INTRODUCTION

At present worldwide freshwater resources are on the decline, with demand far exceeding the available supply. Although the global water supply may be adequate to combat this problem for the time being, it is quickly dwindling, as more and more consumption increases are becoming unsustainable; it is projected that 90% of all available freshwater could be consumed by the year 2025 (Salem, 2003). The potentially adverse impact of climate change on water resources is particularly worrisome for the Arab, Middle East and North African regions since the already meagre water resources of countries in these regions are being stretched thin by rising water demand driven by population growth and rising living standards. Water is considered the single most constraining factor of growth in the Arab countries.

Water resources are unevenly distributed among and within countries, with some presently facing severe drought and water scarcity, especially in the Arab region. In the 2001 benchmark report entitled *The Future of Environmental Action in the Arab World*, M.K. Tolba et al estimated that the average annual available water per capita in the Arab countries was 977 cubic meters in 2001, and that this figure will decrease to 460 cubic meters in the year 2023. The United Nations definition of a nation under water stress is when its available annual water per capita is less than 1,500 cubic meters, under water scarcity if the annual available water is less than 1000 cubic meters, and severe water stress if the available annual water is less than 500 cubic meters; in the year 2025 Iraq will be above the water stress line, Lebanon, Syria and Egypt will be above the severe water stress line, and the rest will be under the severe water stress line. M.E. Osman compiled in 2004 water stress data in some Arab countries, outlining the occurrence of water scarcity in the years 2003, 2015 and 2025 as presented in Figure 1.

The United Nations estimates that globally some 1.1 billion people lack access to clean water and 2.4 billion lack access to proper sanitation (most of these being in developing countries). In addition, a third of the world's population has serious water shortage problems (this number could grow to two thirds by the year 2025 if corrective measures are not taken) (McCarthy, 2003). Exacerbating these problems are accelerated population growth, especially in third world countries, coupled with the concomitant expansion of the agriculture and industrial sectors which increase pollution (higher water usage and untreated wastewater); along with climate changes, these factors combined produce drastic declines in the global water supply (Rosegrant,

FIGURE 1 **WATER STRESS, WATER SCARCITY, AND SEVERE WATER SCARCITY IN THE ARAB COUNTRIES IN THE YEARS 2003, 2015, AND 2025**



Source: Proceedings of the Symposium on challenges facing water resources management in arid and Semi-arid regions. American University of Beirut, Oct 7-9, 2004. (CD Publication).

TABLE 1 **FRESH WATER AVAILABILITY PER CAPITA PER YEAR IN DIFFERENT ARAB COUNTRIES FROM 1955-2050**

	Water availability m^3 / capita / year							
Country	**1955[b]**	**1990[b]**	**2000[a]**	**2003[c]**	**2010[a]**	**2015[c]**	**2025[a]**	**2050[d]**
Algeria	1,770	689					332	300
Bahrain	672	179	170	153	139	120	89	
Egypt	2,561	1,123	800	770	750	600	550	510
Iraq	18,441	6,029	3,100	2,800	2,400	2,100	1,700	
Jordan	906	327	<500	150	<500	130	121	100
Kuwait				<100	<100	<100	<100	
Lebanon	3,088	1,818	900	900	800	800	867	800
Libya	4,105	1,017					359	250
Morocco	2,763	1,117					590	600
Oman	4,240	1,266	500	500	450	450	410	
Qatar	1,427	117	<100	<100	<100	<100	68	
Saudi Arabia	1,266	306	<500	400	320	250	113	
Syria	6,500	2,087	1,250	1,250	900	850	732	600
Tunisia	1,127	540					324	400
United Arab Emirates	6,195	308	<500	<400	<300	<200	176	
West Bank and Gaza	1,229	461	<500		<500		264	
Yemen	1,098	445	<500	300	250	200	152	

Sources:
a- Policies and institutions for coping with environmental aspects of water scarcity in western Asia, by Hosni Khordagui Ph.D., Lebanon http://www.unwater.org/downloads/wwwKhordagui.pdf
b- ITT industries guidebook to global water issues http://itt.com/waterbook/per_cap_country.asp
c- Economic and Social commision for Western Asia, UN, 2003 - http://www.escwa.org.lb/information/publications/edit/upload/sdpd-03-13.pdf
d- Water demand management in the Mediterranean, Hamdy A., http://www.idrc.org.sg/en/ev-42818-201-1-DO_TOPIC.html

1995). Although wide and concrete evidence of this crisis exists there is little or slow progress in bringing about sufficient national, regional and international political commitment and implementation to try and reverse this process.

This situation is very pertinent to the countries of the Arab region: the region accounts for 3% of the world's population, 10% of its land, but only 1.2% of the world's renewable water reserves. Many of the countries in this region are fragile developing countries, struggling with the dual demographic and economic strains of increasing populations and high demand for policies of economic expansion (via industrial and agricultural development), which together lead to even more acute pressure on their already scarce water resources.

II. PRESENT FRESH WATER AVAILABILITY AND USE PER SECTOR IN THE ARAB WORLD

The Arab region is characterized by very low rainfall that is not equally distributed in time and space and is not predictable from year to year. The actual water situation in the region can easily be described as precarious. Within one lifetime, annual average per capita renewable supplies excluding so-called "fossil" aquifers will have fallen by about 80%, from 3,430 cubic meters per capita (in 1960) to 667 cubic meters (in 2025) (World Bank 1994). These levels are far below the levels of other major regions in the world. In several, if not most, Arab countries, renewable water will barely cover the sustainable human needs as defined by the United Nations (as mentioned above). Moreover, more than 10 rivers flowing from outside the region supplying around 35 percent of these renewable water supplies are vulnerable to extraction by upstream riparian countries (Tolba et al., 2001). Table 1 shows the renewable fresh water resources for some Arab counties in annual cubic meters per capita for the years 1955, 1990, 2000, 2010, 2015, 2025, and 2050.

As the above figure makes alarmingly clear, renewable freshwater availability is projected to decrease on per capita basis by a factor of thirty-five in the UAE, a factor of ten in Oman and Iraq, and five in Algeria between the years 1955 and 2025. Only Iraq will remain above the water scarcity line (1,000 cubic meters) by the year 2025.

TABLE 2 **GOVERNMENT EXPENDITURE ON WATER AS PERCENT OF THE GNP IN SOME ARAB COUNTRIES**

	Public expenditure on water as a share of GDP (%)***				Ground water depletion as % of GNP
Country	**2001**	**2002**	**2003**	**2004**	
Algeria	1.3	1.7	1.7	1.5	-
Egypt	-	3.6	3.3	2.4	1.3
Morocco	3.6	3.6	3.6	30.6	0
Saudi Arabia	-	1.7	-	-	-
Tunisia	1.7a	-	-	-	1.2
Yemen	-	-	3.5	-	1.4
Jordan					2.1

a- Average 1997-2001
*** World Bank 2004b, 2005b, 2006g; AWC 2006.

The vital importance of water can hardly be overstated. In arid regions, where most of the Arab counties are located, it largely determines the pattern of settlement and plays a crucial role in human culture and life-style. Health and nutrition depend on the availability of water of acceptable quality, and it is an essential input for most economic activities, especially in rural areas. On the other hand, throughout history the Arab countries have depended on irrigated agriculture, and governments have given irrigation projects priority to feed the growing population. Examples are Egypt, Jordan, Morocco, Saudi Arabia, Tunisia and others. Investment in the water sector has been significant in these countries, typically accounting for 10-20 percent of total public sector investment, and equivalent to perhaps 2 to 4 percent of the GNP as shown in table 2.

By far most of the available water supplies are used for irrigation, accounting for more than 80 percent of total water use in most Arab countries (Table 3). However, with the projected increasing scarcity of fresh water availability, the priority will increasingly be placed on human consumption to meet basic needs. This future shift from irrigation to domestic water use requires careful analysis of the various factors affecting the improvement and development of the water sector – resource management – and the efficient utilization of the water balance – demand management.

Lamentably, as shown in table 3, water use efficiency barely exceeds 40 percent in most of the countries in the Arab world. Strategic planning should therefore stress on water productivity – production of any commodity per unit of water – and focus especially on the agriculture sector, in order to attempt to achieve more value per unit of water.

Annual renewable water supplies in the Arab countries average about 219 BCM (billion cubic metres) as compared to 4,184 BCM in Africa, 10,485 BCM in Asia and 40,673 in the world (World Resources Institute 1992). Of this figure, about 120 BCM are from flowing from outside the region (table 4): 84 BCM by the Nile, 28 BCM by the Euphrates, and 38 BCM by the Tigris and its tributaries. In such situations, countries are more sensitive to exogenous shocks as they do not themselves control the river source. Besides renewable surface water and groundwater, there are substantial non-renewable groundwater resources, and countries in the Arab region have varying access to brackish water and unlimited seawater for future development.

Table 4 compares renewable fresh water resources per capita in the countries with estimates for other regions of the world.

Many Arab countries have been intensively mining their groundwater; this is especially the case in the Gulf States as well as Algeria, Jordan, Lebanon, Palestine and Yemen. Egypt is also mining water from the Nubian Sandstone aquifer. Mining the accessible groundwater resources is often risky since interactions with river flows may affect surface supplies, and the lowering of the water tables can cause no water flow in the river during the summer season and result in saline intrusion from brackish water and/or seawater on the coastal area.

Non-conventional water sources are becoming increasingly important. The region in general, especially the Gulf states, produces more than 60% of the desalinized water in the world. Due

TABLE 3 **RENEWABLE FRESH WATER RESOURCES AND TOTAL WITHDRAWAL AND USE PER SECTOR IN SOME ARAB COUNTRIES IN BILLION CUBIC METERS (BCM)**

Countries	Renewable resources per capita			Total withdrawal		
	1960	1990	2025	BCM	% of Total	% of Total
Algeria	1,704	737	354	3	16	27
Bahrain	na	na	na	0.2	na	
Egypt	2,251	1,112	645	56.4	97	93
Iraq	14,706	5,285	2,000	42.8	43	52
Jordan	529	224	91	0.8	87	77
Lebanon	2,000	1,407	809	0.8	16	24
Libya	538	154	55	2.8	404	854
Morocco	2,560	1,185	651	11	37	35
Oman	4,000	1,333	421	0.4	22	
Qatar	na	na	na	na	174	
Saudi Arabia	537	156	49	2.3	106	643
Syria	1,196	439	161	3.3	61	73
Tunisia	1,036	532	319	2.3	53	54
UAE	3,000	189	113	0.4	140	
Yemen	481	214	72	3.4	136	151
MENA	3,430	1,436	667	177.2	51	
Africa	14,884	6,516	2,620	144	3	
Asia	6,290	3,368	2,134	1,531	15	
World	13,471	7,685	4,783	3,240	8	

Countries	Per sector % of total					
	Domestic	Industry	Agriculture	BCM agric.need	BCM agric. actual	water use efficiency
Algeria	22	4	74	1.45	3.94	37
Bahrain	60	36	4			
Egypt	7	5	88	28.51	54	53
Iraq	3	5	92	11.2	39.38	28
Jordan	29	6	65	0.29	0.68	43
Lebanon	11	4	85	0.42	1.06	40
Libya	15	10	75	2.56	5.13	50
Morocco	6	3	91	4.24	10.18	42
Oman	3	3	94			
Qatar	36	26	38			
Saudi Arabia	45	51	4	6.68	15.42	43
Syria	7	10	83	8.53	18.96	45
Tunisia	13	7	80	1.21	2.43	50
UAE	11	9	80			
Yemen	5	2	93	2.48	6.19	40
MENA	6	7	87			
Africa	7	5	88			
Asia	6	8	86			
World	8	23	69			

Sources: A strategy for Managing water in the MENA 1993
AQUASTAT FAO's information System on Water and Agriculture 2001. www.fao.org/ag/agl/aglw/aquastat/water_res/waterres_tab.htm

to its physical constraints and the relatively high cost of desalinization, this source of water is still confined to industrial and domestic water use.

Water availability depends mainly on seasonal and inter-annual variability; 65 percent of renewable fresh water depends on precipitation, and in

the semi-arid and arid climate prevalent in much of the Arab region precipitation varies from year to year, and from place to place. In many areas rainfall occurs at the wrong time and in the wrong place with the wrong intensity and is confined to a very short period of the year. In the case of Lebanon, there are a maximum of 80 days of rainfall a year, and this is mostly confined to the coastal areas. Annual precipitation varies from negligible amounts in desert areas to about 1,500 mm in mountainous areas with most rain falling in the winter season. Stream flows vary considerably during the year in response to rainfall patterns. Water availability therefore fluctuates markedly about the average in table 4. For example, low flows on the Tigris and Euphrates have been recorded at less than one third of the average annual flows, on the Jordan at less than half, and at the Litani at less than one tenth.

This water supply variability implies three important constraints in water management. First, expensive storage capacity is required to utilize the variability of flows in space and time, subjecting the stored water to evaporation losses. Fourteen percent of the Nile flow at Aswan is lost in evaporation from the reservoir and deep percolation losses. Groundwater recharge and storage can play an important role in minimizing these losses, but this requires expensive geophysical studies to define the underground storage aquifers and their boundaries. Second, it introduces an element of risk, which makes estimation of water's true opportunity cost – its value in the next best economics use – quite difficult. This is relevant, since the cross sectional comparison of water's opportunity cost becomes increasingly important as scarcity increases. And third, this variability requires systematic contingency planning.

The minimum amount of water required to sustain human life is 25 litres per day (about 10 cubic meters per year); a reasonable supply to maintain health may be 100-200 litres per day per capita, although in developed/industrial countries domestic use can exceed 300-400 litres

TABLE 4 **TOTAL ANNUAL INTERNAL RENEWABLE WATER, ANNUAL RIVER FLOWS, AND NET ANNUAL RENEWABLE RESOURCES IN THE ARAB COUNTRIES**

Countries	Total renewable BCM	Total available/ year BCM	Annual river flows From other countries	Annual river flows To other countries	Net annual renewable resources BCM
Algeria	15	11.30	0.2	0.7	18.4
Bahrain	na		na	na	na
Egypt	58	16.00	56.5	**	58.3
Iraq	75		66	na	100
Jordan	1	**	0.16	**	0.86
Lebanon	4	3.90	na	0.86	3.94
Libya	1	-3.00	na	na	0.7
Morocco	29	20.50	na	0.3	29.7
Oman			na	**	2
Qatar			na	**	0
Saudi Arabia	2		na	**	2.2
Syria	26	24.50	27.9	30	5.5
Tunisia	4	1.50	0.6	na	4.35
UAE			na	na	0.3
Yemen	4		na	**	2.5
Arab Countries	219				
Africa	4,184				
Asia	10,485				
World	40,673				

Sources: A strategy for Managing water in the MENA 1993
AQUASTAT FAO's information System on Water and Agriculture 2001
www.fao.org/ag/agl/aglw/aquastat/water_res/waterres_tab.htm
Margat, J., Domitille, V., 1999. Mediterranean Vision on Water, Population and the Environment for the XXIst century.
Contribution to the world water council and the global water partnership prepared by the Blue Plan in the framework of the MEDTAC/GWP.

per day. In some Arab countries, the renewable water supply exceeds basic human requirements, but still remains far less than the minimum amount of water required to sustain good livelihood – food and daily use – which is estimated to be 1,000 cubic meters per year, as defined by the United Nations. Tables 5 and 6 below, abstracted from different sources summarize the withdrawal of water for various sectors, i.e. domestic, industrials and agricultural use.

Water demand is expanding most rapidly in urban areas. Most countries in the region are classified as middle income and the percentage of the urban population that has access to safe drinking water is approaching 100 percent. In contrast, rural areas are much less well served with accessibility to drinking water, with only about 66 percent having safe access. Population growth rates are expected to slow down in the region, reaching around 2.5 percent between 2000 and 2025, which is still high by world standards; the region's population is expected to increase to 466 million in 2025. The urban share of population is also expected to increase from 60 percent to 75 percent, leading to a dramatic increase in domestic water use, which must be met by increasing the efficiency of water used in agriculture so that the saving can be reallocated to different sectors.

Water withdrawal, or use, in most of the Arab countries already exceeds renewable supplies; this is the case in Libya, Saudi Arabia, the Gulf states, and Yemen. Only Iraq and Lebanon have renewable water resources that are adequate and well distributed relative to population. Nonetheless, even for these two countries water conservation projects are necessary.

Reliably modelling a demand-supply strategy is difficult and uncertain, because the data on supply and demand are variable. Each sector can predict its own water demand with a certain degree of accuracy and reasonably estimate the investments needed for meeting these demands, but if investments are faced with financial and/or phys-

TABLE 5 **WATER RESOURCES IN SOME ARAB COUNTRIES FROM CONVENTIONAL RENEWABLE AND NON-CONVENTIONAL WATER RESOURCES, INCLUDING DESALINIZED AND TREATED WASTE WATER (IN MILLION CUBIC METERS (MCM)**

	Conventional water resource (MCM)			Non-conventional water resources (MCM)	
Country	Surface water	Groundwater recharge	Groundwater use	Desalination	Wastewater and drainage reuse
Lebanon	2,500	600	240		2
Oman	918	550	1,644	51	23
West bank and Gaza	30	185	200	0.5	2
Yemen	2,250	1,400	2,200	9	52
Jordan	350	277	486	2.5	61
Bahrain	0.2	100	258	75	17.7 (3)
Saudi Arabia	2,230	3,850	14,430	795	131 (24)
Qatar	1.4	85	185	131	28
United Arab Emirates	185	130	900	455	108
Iraq	70,370	2,000	513	7.4	1,500
Syria	16,375	5,100	3,500	2	1,447
Egypt	55,500	4,100	4,850	6.6	3,800
Kuwait	0.1	160	405	388	30

(values in brackets are drainage water reuse)

'Shared groundwater resources in the ESCWA region: the need, potential benefits and requirements for enhanced cooperation,' paper presented at the Expert Group Meeting on Legal Aspects of the Management of Shared Water Resources, Sharm El-Sheikh, Egypt, 8–11 June 2007 – cited in "Sectoral Water Allocation Policies in Selected ESCWA Countries", Economic and Social Commission for Western Asia of the United Nations. November 2003. 5

ical constraints, then a deficit in demand will occur. Ultimately and with good planning and management supply and demand should balance. The question is at what cost?

Besides its role as a basic need and an economic input into production sectors, water is also one of the three prime natural resources besides land and air. Comprehensive data on water quality is not fully available in most countries. No data is available on the availability and use of saline water. Some data is available on treated waste water and its recycling for use in landscape as presented before. But recent World Bank studies suggest that deteriorating water quality, which adds to fresh water scarcity, is becoming a serious issue in many countries. The principle sources of water pollution include the following:

1. Seepage and runoff of agrochemicals such as nitrogen, and pesticides;
2. Seepage from landfills due to the dumping of the solid wastes;
3. Untreated municipal waste water;
4. Untreated industrial wastes, either discharging in municipal sewer systems or directly in watercourses.

This decline in water quality is adding another dimension to the scarcity thereof, which in the long run will affect the human health, the productivity of water, and the quality of life. Declining water quality, besides being hazardous, increases the purification cost to downstream users and may not be suitable to be used for particular purposes.

VIRTUAL WATER

The concept of virtual water refers to the amount of water *embedded* in certain goods; that is, the amount of water that is required to produce the good. For example, with crops this refers to the amount of water needed to grow a certain quantity of the crop. The implications of the concept of virtual water – a concept developed by Professor John Anthony Allan of King's College London and the School of Oriental and African Studies – for water-scarce countries such as those in the arid regions of the Arab world, are that an awareness of the content of virtual water, when taken into account in the production of goods, can aid a country in using its scarce water resources in a more sustainable manner. Using trade theory, then, it would make sense for water-scarce countries to import goods for whose production water is intensively used, thereby saving the domestically available water supply for other uses.

TABLE 6 **SECTORAL WATER DEMANDS IN SOME ARAB COUNTRIES FOR THE YEARS 2010 AND 2025**

Countries	Sectoral water demand projection									
	Domestic		Agriculture		Industry		Energy		Total	
	2010	2025	2010	2025	2010	2025	2010	2025	2010	2025
Algeria	0.83	0.80	1.90	1.90	0.2	0.3			2.93	3
Bahrain										
Egypt	5.00	6.00	75.00	95.00	10	14			90	115
Jordan	0.43	0.57	1.75	2.40	0.13	0.2			2.31	3.17
Lebanon	0.40	0.52	0.92	1.10	0.1	0.14			1.42	1.76
Libya	1.00	1.76	9.00	11.90	0.24	0.57			10.2	14.2
Morocco	2.80	3.70	1.10	1.40	6	8	10	12	19.9	25.1
Syria	2.10	3.00	17.60	25.20	0.3	0.37	0.1	0.1	20.1	28.7
Tunisia	0.42	0.53	3.37	4.23	0.16	0.26			3.95	5.02

Countries	Sectoral water demand sustainable									
	Domestic		Agriculture		Industry		Energy		Total	
	2010	2025	2010	2025	2010	2025	2010	2025	2010	2025
Algeria	0.50	0.60	1.00	1.30	0.15	0.20	0	0	1.65	2.10
Bahrain										
Egypt	4.00	5.00	60.00	65.00	8.60	11.4	0	0	72.60	81.40
Jordan	0.34	0.50	1.30	2.00	0.12	0.20	0	0	1.76	2.70
Lebanon	0.40	0.48	0.78	0.82	0.10	0.14	0	0	1.28	1.44
Libya	0.90	1.50	5.85	8.70	0.20	0.50	0	0	6.95	10.70
Morocco	1.20	1.80	0.80	0.80	5.00	5.00	8	8	15.00	15.30
Syria	1.00	1.26	17.20	20.70	0.30	0.47	0	0	18.50	22.40
Tunisia	0.40	0.50	2.50	2.05	0.12	0.17	0	0	3.02	2.72

III. CONCLUSIONS AND RECOMMENDATIONS

The water scarcity problem described so far requires an integrated multi-disciplinary and multi-dimensional approach in order to be resolved. The problem no longer requires the sole expertise of water technicians and specialists to be resolved; it should be integrated within national social and economic planning. Economists, policy makers, legislative and executive branches of the government, industrialists, agronomic specialists, public health officials, as well as public administrators need to pool resources and energy together to come out with a plausible and acceptable solution to this water crisis.

Management of the supply side is inadequate without a concomitant management of the demand side; both these areas should be approached in concert (that is, one cannot be dealt with without the other). This is especially true in the Arab region where most of the renewable water resources have already been exploited and new conventional sources of water are scarce. Therefore, the management of the supply side with a broad and comprehensive policy alone is insufficient. The demand side needs also to be strictly managed and accounted for.

On the demand side, the most basic needed step is a long-term plan that is multi-dimensional and incorporates all sides of the equation (both demand and supply sources). To this extent a number of issues should be considered:

Water losses should be reduced. These losses could be due to leakages in closed conduits or seepages from open watercourses. It has been shown that low water costs encourage and lead to increased consumption and waste. Therefore, dealing with water as an economic commodity and placing a price tag to account for the externalities or increasing the water charge would create an environment of conservation and self-management and hence reduce water loss. This has been proven effective in many European nations where water utilization is charged just like electricity; studies have revealed a

TABLE 7 **TOTAL VIRTUAL WATER AND TOTAL AVAILABLE NON-CONVENTIONAL WATER AVAILABLE IN THE REGION IN PERCENTAGE AND MILLION CUBIC METERS (MCM).**

Countries	Virtual water			Treated wastewater	
	Eq. 1,000m^3 of net import	% Pop access to drink	% Pop access to sanit	%Agric.	%Total
Algeria	12.4	94	73		
Bahrain	680			5.9	3.4
Egypt	18.17	95	94	0.4	0.4
Iraq	2.18	85	79		
Jordan	3.467	96	99	6.8	5.1
Lebanon		100	99		
Libya	3.237	72	97	2.5	2.2
Morocco	2.419	82	75		
Oman		39	92	2.3	2.1
Qatar				12	8.8
Saudi Arabia	13.86			1.4	1.3
Syria	1.014	80	90	2.7	2.6
Tunisia				0.7	0.7
UAE	3.362			7.7	5.1
Yemen	3.375	69	45		

Countries	Desalinised water		Non-conventional	Total consumption			
	%Agric.	%Total	Total MCM	Drinking	Agric	Industry	Total
Algeria	3.6	1.422	474.6	2,181	2,543	680	5,404
Bahrain	42.3	18.264	111	107	161	19	287
Egypt	0.3	0.045	4,432	2,700	54,500	5,900	63,100
Iraq			77	1,179	47,584	344	49,107
Jordan	0.8	0.203	61	245	1,088	50	1,383
Lebanon			61	415	750	60	1,225
Libya	11.7	1.522	320	408	4,275	74	4,757
Morocco			3,55.6	543	10,180	322	11,045
Oman	45.3	2.78	60	85	1,150	6	1,241
Qatar	132.7	34.609	229	85	337	17	439
Saudi Arabia	41.8	4.196	1,321	2,387	18,575	193	21,155
Syria			1,643	773	13,618	175	14,566
Tunisia	2.4	0.27	108.7	313	2,518	69	2,900
UAE	55	18.436	489	600	1,539	73	2,212
Yemen			29	470	3,280	69	3,819

Sources:
J.A. Allan, 1999. *"Virtual Water": An essential Element in Stabilizing the Political Economies of the Middle East*. School of oriental & African studies, University of London.
World Health Organization and United Nations Children's Fund, 2000. *Global Water Supply and Sanitation Assessment*. 2000 Report. www.un.org/Depts/unsd/social/watsan.htm
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decrease in water waste and consumption after the implementation of these water taxes or price tags, as well as an improvement of the efficiency and equity among users. This can and should be applied to all sectors. In the industrial sector, industries should be made to implement water usage quality standards; this would force the manufacturing managers to re-circulate their water processes substantially decreasing water demand. Furthermore, water saving technologies should be introduced to the industry and replace the older more water demanding mechanization processes; although more costly in the short term, its return in both water conservation and resource preservation will even out in the long term. Moreover, if environmental laws were also applied, pollution would decline, increasing the availability of freshwater supply and the sustain-

ability of present resources. In the agricultural arena, water losses can be reused via drainage systems or channelled to recharge the underground water, thereby increasing overall basin efficiency. Moreover, farmers should be encouraged to use more effective methods of irrigation like levelling their field for higher yield surface irrigation or using more efficient technologies like sprinkler and trickle irrigation. In the domestic sector, water should be treated like electricity and elevated charges applied, which in turn will induce people to become more thrifty and conscious of water wasting and preservation, hence declining the demand within the domestic sector. This is especially important when we realize that paradoxically per capita consumption for domestic use in some water-poor Arabian Gulf countries, depending entirely on desalinated sea water, exceeds average global levels!

In order to achieve the needed sustainability of the Arab region's scarce water resources a holistic and comprehensive approach should be adopted. The above-mentioned solutions are meaningless without simultaneous capacity building, public and technical education, and increased public awareness.

To sum up, the Arab region countries are faced with many challenges related to the water scarcity problem. In order to alleviate the pressure and develop socio-economically in an adequate and sustainable fashion, they should adopt the following recommendations for long-term strategy planning:

1. Optimization of water allocation among the three domains (agricultural, industrial, domestic).
2. Implementation of an optimal water productivity strategy that leads to the import of water through virtual water.
3. Holistic and integrated approach to water resources supply and demand planning and management.
4. Capacity building and technical upgrading of all stakeholders.
5. Awareness raising at levels, from end users to decision makers.
6. Issuing and implementing of sustainable water policies based on the above points, current and prospective water data and research.

7. Development of water resources management models that will be able to unfold many solution scenarios to select the optimal approach.

Whereas the topic of virtual water may be new to the region many nations worldwide have successfully invested in its development and invested in it to help reduce water shortages and wastes. Therefore it could be of value for water-scarce nations to invest and shift their resources to import water-rich products instead of growing them domestically and loosing the rare available water resources (this shift would create more water for use in other needed sectors). Based on international trade theories, nations should import products in which they have a comparative disadvantage in production (i.e. water-intensive products for water-poor nations) and export those products in which they have a comparable economic advantage.

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Marine Environment

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I. INTRODUCTION

The sustainable use of coastal and ocean resources is linked to public health, food security, and economic and social benefits, including cultural values and traditional livelihoods. More broadly, these elements are understood as decisive elements for the alleviation of poverty. Activities from industrial and agricultural production to daily domestic routines all generate impacts that cumulatively affect the health of these critical marine ecosystems and ultimately their economic development.

The major threats to the health, productivity and biodiversity of the marine environment result from human activities on land and in coastal areas. Most of the pollution load of the oceans, including municipal, industrial and agricultural wastes and run-off, as well as atmospheric deposition, arises from land-based activities (LBA) and affects the most productive areas of the marine and coastal environments.

II. ARAB MARINE ENVIRONMENT: POLLUTION CAUSES AND REMEDIAL ACTIONS

Three of the UNEP Regional Seas Programme regions – the Mediterranean Region (MAP), the Red Sea and Gulf of Aden Region (PERSGA) and the ROPME Sea Area (RSA) – encompass twenty Arab States out of the twenty-two member countries of the Arab League. Some of these countries (Egypt, Morocco, Saudi Arabia) straddle more than a region, for example Egypt's coastlines extend on both the Mediterranean and the Red Sea, and Saudi Arabia's coastlines extend on both the Red Sea and the Gulf.

THE UNEP REGIONAL SEAS PROGRAMME

UNEP Regional Seas Programme has emerged over the last quarter century as an inspiring example of how to craft a regional approach to protecting the environment and managing natural resources. The Regional Seas Conventions and Action Plans cover issues ranging from chemical wastes and coastal development to the conservation of marine animals and ecosystems.

Basic information on the coastal and marine environment of the Arab countries is presented in Table 1.

Arab Environment of the Mediterranean Region

The Mediterranean basin, a semi-enclosed sea, is situated at the centre of a complex mosaic formed by tectonic plates, and is subject to heavy seismic and volcanic activity. With the exception of the southeast and some 3,000 km along the Libyan and Egyptian coasts where the Saharan platform directly meets the sea, there are mountains everywhere (Jeftic *et al*, 1989).

There are a number of large alluvial plains associated with the deltas of major rivers (Ebro, Rhone, Po and Nile) and with those of numerous smaller rivers of the basin, as in Tunisia. These rivers drain soils far removed from the coastline and carry very large volumes of sediment to the sea (Batisse & Grissac, 2003).

Seven Arab countries (Algeria, Egypt, Lebanon, Libya, Morocco, Syria, Tunisia) are Signatory States to the Barcelona Convention (1976), that include 22 Mediterranean counties.

TABLE 1 **BASIC INFORMATION ON THE COASTAL AND MARINE ARAB ENVIRONMENT**

COASTAL & SHELF EXTENSION & AREA

Region	Arab Countries	Coastline km	Cont. shelf km²	Territorial Sea km²
MED Region	**Morocco**	2,008**	70,365	37,481
	Algeria	1,557**	9,688	27,863
	Tunisia	1,927**	65,347	36,773
	Lybia	2,025**	63,595	38,131
	Egypt#	2,450**	(Med+RS) 50,060	(Med+RS) 82,048
	Lebanon	294**	1,169	4,702
	Syria	212**	852	3,866
PERSGA Red Sea & Gulf of Aden Region	**Djibouti**	443***	3,406	4,853
	Egypt	1,800***	X	X
	Jordan	27***	82	87
	Saudi Arabia	1,840***	(RS+RSA) 95,580	(RS+RSA) 95,580
	Somalia	3,898***	40,392	68,849
	Sudan	2,245***	15,861	32,645
	Yemen	3,149***	65,341	82,359
ROPME Sea Area (GULF Region)	**Bahrain**	255#	7,967	4,006
	Iraq	105#	1,034	716
	Kuwait	756#	6,526	5,362
	Oman	3,165#	46,670	51,821
	Qatar	909#	31,156	11,373
	Saudi Arabia	790#	(RS+RSA) 95,580	(RS+RSA) 95,580
	UAE	735#	51,394	30,962
Other Regions	**Mauritania**	1,268	28,370	19,455
	Comoros	469	1,426	12,684

Main source: World resource Institution. Earth trends: The Environmental Information Portal (2006)
** EEAA (2006)
*** PERSGA (1998)
# ROPME (2003)
Med: Mediterranean Sea
RS: Red Sea
ROPME Sea Area: RSA

Around 150 million people (in 2000) are concentrated along the 46,000 km of the Mediterranean coastline, 54 million people of which are from the 7 Mediterranean Arab countries. Some 200 million tourists descend on the Mediterranean region every year, of which 17 million are tourists visiting the Arab countries of the region (Benoit & Comeau, 2005). More than 200 petrochemical and energy installations, chemical industries and chlorine plants are located along the Mediterranean coast. These figures represent the major challenge for the preservation of the environment of the Mediterranean owing to the transboundary nature of the pollution that originates from land-based sources around the whole basin. The Mediterranean countries have been devoting specific attention over the past decades to prevent, halt, reduce and ultimately eliminate the main sources of pollution for the marine environment.

The major sources of pollution in the Mediterranean include:

- Municipal wastewater treatment and disposal;
- Urban solid waste disposal;
- Activities contributing to air pollution from mobile sources;
- Release of harmful concentrations of nutrients into the marine environment;
- Storage, transportation and disposal of radioactive and hazardous waste; and
- Activities contributing to the destruction of the coastline and coastal habitats.

Arab Environment of the Red Sea and Gulf of Aden Region (PERSGA)

The Red Sea and Gulf of Aden (RSGA) is recognized as one of the world's most unique coastal and marine environments, in its role as an important repository of marine biodiversity, largely through its complex systems of coral reefs, interspersed with mangroves, seagrass beds and other diverse coastal habitats. The relative physical isolation of the sea has given rise to high levels of species endemism, especially among some groups of reef fishes and reef-associated invertebrates. The Gulf of Aden presents a very different situation: its cold, nutrient rich upwelling water may inhibit coral development but gives rise to prodigious fisheries production (PERSGA, 2004a).

The marine resources of this region have sustained human cultures for centuries. Until relatively recently, the RSGA region remained comparatively unaffected by the changes being wrought worldwide, especially in neighbouring areas such as the Mediterranean Sea. The environment and resources of the RSGA are threatened by a variety of human activities such as dredging and filling operations, the disposal of domestic and industrial effluent, the non-sustainable use of non-living resources and the expansion of the tourism industry. Yet the present transboundary and region-wide concerns are far-reaching and require actions to minimize loss of vital ecological and economic services to the people of this region (PERSGA, 2004a).

The Member States to PERSGA (Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden) are: Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan and Yemen.

Arab Environment of the ROPME Sea Area (Gulf Region)

ROPME (Regional Organization for the Protection of the Marine Environment) Sea Area (RSA), is the sea area located at the most northwestern part of the Indian Ocean. The RSA is made up of three parts. These include the inner RSA which extends over 1,000 km along the NW-SW axis from the Strait of Hormuz to the northern coast of Iran; the middle RSA, which consists of the deep basin of the Gulf of Oman, with depths exceeding 2,500 m along its central channel; and the outer RSA, which extends to the southern border of Oman, and is an integral part of the Indian Ocean.

The ROPME area is surrounded by eight Member States, seven of whom are Arab countries: Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

The RSA is considered to have one of the greatest pollution risks in the world due to the large number of offshore installations, tanker loading terminals, and the high volume and density of marine transportation of oil (UNEP/GPA, 2006). Roughly two million barrels of oil are spilled annually from routine discharges of ballast, tanker slops and from 800 oil and gas platforms (GESAMP, 2001).

The most pressing current and emerging environmental issues in the RSA include: the introduction of various pollutants, physical alteration and destruction of habitats, the use of destructive fishing techniques and overexploitation of marine biological resources, and the introduction of invasive species (ROPME, 2003).

III. ALGAE CONCENTRATION IN COASTAL WATERS (EUTROPHICATION)

Eutrophication is a process by which waters enriched with nutrients (nitrogen and phosphorus) stimulates primary aquatic production. This leads to an increase in phytoplankton biomass associated with excessive algal blooms, including seaweed, 'red tides', seaweed scum, the growth of benthic algae and sometimes a massive growth of immersed and floating microphytes; oxygen depletion and fish kills.

The sources of excessive amounts of nutrients in the marine environment are diverse and include industry, agriculture, river run-off and sewage discharges.

The Mediterranean Region

Eutrophication has become a chronic problem in shallow waters near deltas such as the Nile in Egypt and major urban areas, because of the diffuse agricultural and industrial discharges. Agricultural projections in the Mediterranean indicate that the use of fertilizers could increase between 2000 and 2025 by as much as 70% in the east and 50% in the south.

The discharge of non-treated wastewater from industry and cities contributes 10% of the total input of phosphorus and 20% of nitrogen. This can intensify eutrophication locally. Examples are the hot spots associated with eutrophication in Egypt and Tunisia (UNEP / MAP / MEDPOL, 2005).

The Red Sea and Gulf of Aden Region

All Red Sea and Gulf of Aden countries have identified nutrients (particularly nitrogen, phosphorus and their compounds) as a primary area of concern (PERSGA, 2005).

The nutrients' principal sources in the region include:

- Fertilizer factories in Jordan and Egypt;
- Agricultural run-off;
- Discharge of untreated sewage. This appears to be a drastic problem in Djibouti, Somalia and Yemen (PERSGA, 1997).

Eutrophication is recognized in the Arab Marine Environment of the Mediterranean, RSGA and RSA Regions. However, eutrophication has become a chronic problem in shallow waters near deltas such as the Nile in Egypt and major urban areas. Rational agriculture – making more efficient use of fertilizers – could limit the risks of excessive soil additives, and thus the diffuse discharges of agricultural origin that are a primary cause of eutrophication. Along with waste treatment, this will minimize the eutrophication.

Some areas, particularly on the west coast of the Red Sea south of Suez, still receive a considerable load of nutrients and Biochemical Oxygen Demand (BOD) discharges from domestic sewage. This contributes to eutrophication of the coastal waters around selected population centres, major ports and tourist facilities (Gerges, 2002).

The ROPME Sea Area

Dense mats of filamentous green algae grew in the intertidal zone of the northern coast of Bahrain, indicating eutrophication. Similarly, sewage and agro-based industries have caused increased growth of benthic algae in the northwest RSA off Shatt Al-Arab. Signs of eutrophication were observed in Kuwait Bay and in the coastal waters of Muscat (Oman), Dhahran (Saudi Arabia) and Abu Dhabi (UAE). Oxygen depletion associated with high levels of H_2S, ammonia and the discharge of large quantities of wastewater in Kuwait Bay have led to several major incidents of fish mortality, such as the incident of 1999 which was the result of anoxic conditions caused by massive algal blooms. Red tides were recorded in Bahrain and Saudi Arabia; this may be taken as a result of eutrophication (ROPME, 2003).

IV. COASTAL AND MARINE POLLUTION

The Mediterranean Region

Land-based sources of pollution

Pollution from land-based sources consists of untreated sewage discharge, agricultural runoffs containing pesticides, nitrates and phosphates,

ill-managed coastal development and emissions of contaminants directly from the ever-expanding industries around the Mediterranean or through rivers. Industrial pollution mainly comes from the chemical/petrochemical and metallurgy sectors.

Direct impacts of effluents from industry cause pollution problems at the site level and create 'hot spot' areas. Pollution Hot Spots in the Arab Mediterranean Environment are shown in Table 2.

Sea-based sources of pollution

The Mediterranean Sea is the major route for transportation of crude oil from the oil fields in the Middle East and North Africa, and oil ports in the Black Sea towards major consumption centres in Europe and North America. The most important oil traffic lane (90% of total oil tanker traffic) connects the Suez Canal and the Sidi Kerir terminal of the SUMED pipeline in Egypt with Gibraltar, passing between Sicily and Malta and then following the coasts of Tunisia, Algeria

TABLE 2 **PRIORITY POLLUTION HOT SPOTS IN THE ARAB MEDITERRANEAN ENVIRONMENT AND ESTIMATES OF BOD DISCHARGED FROM THEIR HOT SPOTS**

Country	Hot Spot	Effluent Type	BOD t/y (UNEP/MAP, 2004)
Algeria	Oran	Domestic +industrial	113,600
	Rouiba-Peghaia	Domestic +industrial	
	Ghazaouet	Domestic +industrial	
	Alger	Domestic +industrial	
	Mostaganem	Domestic +industrial	
	Bejaia	Domestic +industrial	
	Annaba	Domestic +industrial	
	Skikda	Domestic +industrial	
Egypt	El-Manzala	Mixed (Wastewater)	213,160
	Abu-Qir Bay	Mixed	
	El-Mex Bay	Mixed (Wastewater)	
	Alexandria	Domestic	
	Damietta	Mixed (River)	
Lebanon	Greater Beirut area	Municipal +industrial	4,090
	Jounieh	Municipal +industrial	
	Saida-Ghaziye	Municipal +industrial	
	Tripoli	Municipal	
	Batroun-Selaata	Municipal +industrial	
Libya	Zawia	Domestic	2,160
	Tripoli	Domestic	
	Zanzur	Industrial	
	Benghazi	Domestic	
	Tobruk	Domestic	
Morocco	Tangier	Domestic +industrial	5,180
	Tetouan	Domestic+ industrial	
	Nador	Domestic+ industrial	
Syria	Tartous	Municipal +industrial	580
	Lattakia	Municipal +industrial	
	Banias	Municipal +industrial	
	Jableh	Municipal +industrial	
Tunisia	Gabes	Municipal +industrial	7,250
	Lake of Tunis	Municipal +industrial	
	Lake of Bizerte	Municipal +industrial	
	Sfax-South	Municipal +industrial	

Sources: UNEP/WHO, 1999 ; UNEP/MAP, 2004

and Morocco (REMPEC, 2002). Naturally, such heavy naval traffic brings with it many risks of marine pollution.

The Red Sea & Gulf of Aden Region

Land-based Sources of Pollution

The main land-based sources of pollution are:

Municipal wastewater discharges: The discharge of municipal wastewaters continues to present significant management problems in the Region. Although the levels of sewage discharge in the Red Sea are not particularly severe compared to other areas, due to the relatively limited coastal population and general lack of major population centres in its catchments area, the results of discharges are cumulative.

Industrial effluents: Impacts of industrial effluents, in the form of thermal pollution or brine water from power and desalinization plants, particulate matter and mineral dust from fertilizer and cement factories, and chemicals and organic wastes from food and textile processing factories, contribute to the land-based sources of pollution affecting coastal waters in the RSGA region (Gerges, 2002).

Sea-based Sources of Pollution

Although approximately 11% of the world's seaborne oil is transported through the RSGA region, there have been no major spills (>5,000 tonnes) resulting from shipping accidents. Most spills in this region have been the result of operational discharges, equipment failures and groundings (ITOPF, 2003).

Despite the low occurrence of major accidents within the region, the high volume of shipping results in chronic pollution in the form of tarballs arriving on the shorelines. Studies of water quality suggest that the Red Sea environment receives more oil/km^2 than any other regional sea. The coast of Saudi Arabia between Jeddah and Yemen is tarred in several places. The Egyptian coast near the offshore oil fields of the Gulf of Suez is similarly affected by oil discharges (ITOPF, 2003).

Plans to increase the volume of oil transported via the Yanbu Petroline and the SUMED Pipeline, along with the possibility of expanding the capacity of the Suez Canal to accommodate fully laden vessels of 250,000 tonnes create increased risks of major oil spills. Other potential sea-based sources of pollution in the region are the risks of spills and other production accidents associated with the offshore oil activities and operations (Gerges, 2002).

Pollution from land-based sources (mainly untreated domestic sewage and industrial wastes) is a common marine environmental issue in the Arab countries, while sea- based pollution is more acute in the RSA.

The ROPME Sea Area

Land-based Sources of Pollution

The impacts of municipal sewage and industrial effluents, particularly those of petroleum refineries and the petrochemical industry, are significant. Power plants cause thermal pollution and desalination plants release chlorine, brine and thermal loads into the seawater (ROPME, 2003).

Sea-based Sources of Pollution

The RSA has one of the highest oil pollution risks in the world because of the concentration of offshore installations, tanker loading terminals and the huge volume and density of marine transportation of oil. Out of twenty cases of oil spills greater than ten million gallons worldwide, six cases have taken place in the RSA. Smaller scale oil pollution incidents such as submarine pipeline rupture and well blowout are more frequent in the RSA (ROPME, 2003).

V. MARINE FISHERIES & ANNUAL CATCH

The Mediterranean Region

In the Mediterranean, 540 species of fish have been recorded (Batisse & Jeudy de Grissac, 2003). The yield of Mediterranean fisheries, in general, is relatively low compared to other oceans, probably as a result of the relatively low primary productivity and generally narrow continental shelves. There is some evidence of a gradi-

ent in the yield, decreasing from west to east and from north to south.

Exploitation of Resources

Approximately 1.5 million tons of fish are caught in the whole Mediterranean Sea each year (WWF, 2004), and fishing from the Levant Basin during 2000 was 80,915 tonnes (Benoit & Comeau, 2005). Overfishing is becoming an increasing problem in the Mediterranean waters, and is being driven by the rising prices and demand in the past decades. This is resulting in unsustainable exploitation of many fish stocks, and the destruction of their natural habitats. With 22 Mediterranean countries plus Asian fishing fleets competing for the same fish resources, there has been a dramatic decline in fish stocks which have already fallen to 20% of natural levels in some areas. Destructive and often illegal fishing methods have contributed to depleting fish stocks.

Data on the Capture Fishes of the Mediterranean region are shown in Table 3.

The Red Sea & Gulf of Aden Region

The fisheries of the RSGA are of considerable socio-economic importance in terms of national food security and income generation for rural communities. Fisheries resources are exploited by artisanal fishermen, local commercial fisheries and foreign industrial fisheries targeting invertebrates, demersal finfish and pelagic finfish. The shark resources in the region are heavily fished, especially in Djibouti, Somalia, Sudan and Yemen. Fish and shellfish stocks of the RSGA support artisanal, semi-industrial and industrial fisheries fleets of Djibouti, Egypt, Saudi Arabia, Somalia, Sudan and Yemen (PERSGA, 2004a).

A large number of fish stocks are exploited. Of the vast number of species of fish in the region, only around 65 species are presently considered to be of economic importance, in addition to sharks, rays, shrimps, lobsters, crabs, molluscs and sea cucumber.

Very few large-scale resource surveys and stock assessments have been conducted on major species on a regional basis. The total potential yield of fisheries resources for the Red Sea has been calculated at 360,000 mt (megatons) and 267,000 to 414,000 mt for the Gulf of Aden.

Unsustainable exploitation of living marine resources

According to PERSGA (2000), Egypt's trawl, purse-seine and reef-associated fisheries are all considered over-exploited. Severe fishing pressure, coupled with water pollution in the Gulf of Suez and the Red Sea have been indicated as negative impacts on fisheries.

In Sudan, stocks are fully exploited in waters adjacent to Suakin in the south and Mohammed Qol in the north; a steady decline in finfish catches of certain species of snapper is observed. Production from Suakin dropped from 163 mt in 1990/91 to 26.3 mt in 1992/93 and exports as a whole declined from 485 mt in 1991/92 to 432.7 mt in 1994/95. Shark resources have also shown rapid decline to only 163 mt in 1990/91 to 26.3 mt in 1993/94.

In Djibouti, parts of the coasts and territorial waters are still in a largely pristine state. However, some studies shown that in several areas there are alarming signs of degradation and threats. Djibouti has only traditional fisheries.

In Yemen, the lucrative industrial fishery for cuttlefish in the Gulf of Aden illustrates a clear example of overfishing and resultant decline of the fishery. The stock today has still not recovered and is still far below its biological potential. Similarly the deep-sea lobster was also over-fished. Reasonable data for landings by the Gulf of Aden rock lobster fishery off the coast of Yemen indicate that landings have declined since 1990 and the average size of rock lobster has decreased. Declines in the landings of sharks by fishermen operating in the Yemen's Red Sea waters and in Sudan is an indication of overfishing (PERSGA, 2000).

Data on the Capture Fishes of the RSGA are shown in Table 3.

The ROPME Sea Area

There is a generally low diversity of fish species in the RSA. The fisheries sector plays only a minor role in the national economies in the Region. The inner part of the RSA supports more than

TABLE 3 **CAPTURE FISHES FROM THE ARAB COUNTRIES OF THE MED, RSGA AND RSA**

		1000 tons					
Region	**Countries**	**Demersal mar. fish**	**Pelagic mar. fish**	**#Marine fish NEI**	**Crustacean**	**Molluscs**	**Cephalopod**
MED Region	**Morocco**	68	749	37	10	2	29
	Algeria	12	115	9	3	0	1
	Tunisia	31	54	6	7	1	12
	Libya	-	-	-	-	-	-
	***Egypt MED+RS**	216	35	19	14	4	3
	Lebanon	1	2		0		0
	Syria	1	1		0	0	
PERSGA Red Sea & Gulf of Aden Region	**Djibouti**	-	-	-	-	-	-
	Jordan	0	0	0	-	-	-
	***Saudi Arabia RS+RSA**	26	18	1	18	-	1
	Somalia	-	-	-	-	-	-
	Sudan	0	0	5	-	-	-
	Yemen	56	183		3	-	13
ROPME Sea Area	**Bahrain**	6	1	1	6		0
	Iraq	-	-	-	-	-	-
	Kuwait	2	1	0	2	-	-
	Qatar	7	3	1	0		0
	Oman	50	97	6	1	0	12
	UAE	57	31	2	0	-	0

#NEI not elsewhere included
*Egypt and Saudi Arabia data are for their total production from different regional seas.
Source: FAO, 2004

500 fish species, most of which live in pelagic or soft substrate demersal habitats: at least 125 species are found on the reefs; about 130 fish species are known to occur in Kuwait; 71 species in Bahrain; and 106 species from reefs in Saudi Arabia. Environmental extremes in the inner RSA have restricted the distribution of many species of fish (ROPME, 2003).

The commercial fisheries of the region are supported by over 1,000 species of finfish and shellfish, including six species of shrimp, two species of spiny lobster, one species of shovel nose lobster, one species of cuttlefish, one species of abalone and one species of crab. Considering the Arab countries of the RSA, the highest fish landings have been reported in Oman and UAE. Qatar had the lowest quantities during the period 1995–1999. Bahrain and Kuwait had similar volumes of landings.

The fisheries of the region are affected by environmental degradation caused by coastal zone activities which have led to the elimination of nursery areas for commercially important species of fin and shellfish. The reduction of outflow from Shatt Al-Arab has had significant negative effects on the reproduction of certain marine species. Bottom trawling has severely destroyed the benthic communities of the region. Several countries have taken remedial measures to protect shrimp stocks. Data on the Capture Fishes of the RSA are shown in Table 3.

In the Mediterranean and the RSGA, overfishing is becoming an increasingly severe problem as a result of unsustainable exploitation of many fish stocks. The fisheries of the RSA are affected by environmental degradation caused by coastal zone activities that eliminate nursery areas for important species. Inadequate Fisheries management is a result of the:

- lack of information on transboundary stocks and cooperation in management of shared stocks;
- inadequate baseline data on benthic and demersal stocks;
- lack of surveillance and enforcement of existing fishing regulations.

VI. CORAL REEFS

Coral reefs represent an important resource, both in terms of global biological diversity and with respect to the well-being of the people who live near or depend upon them. Reefs are an essential supplier of protein to subsistence communities; a valuable currency earner through exploitation of their resources and through tourism; and a naturalist's paradise (UNEP/IUCN, 1993).

Coral reefs exist only in the PERSGA and ROPME regions.

The Red Sea & Gulf of Aden Region

The Red Sea is most famous for its extensive fringing coral reefs. These reefs are composed of approximately 200 species of stony corals (belonging to more than 50 genera, Table 4). The warm water and absence of freshwater input provide very suitable conditions for coral reef formation adjacent to the coastline. This beautiful environment is extremely attractive as a tourist resource and is currently visited by hundreds of thousands of people each year particularly in Egypt, who dive and swim in the waters adjacent to the reefs. Further south the coastal shelf becomes much broader and shallower and the fringing reefs gradually disappear to be replaced by shallow, sandy shorelines and mangroves.

Reef development varies from north to south in the Red Sea, with well-developed, narrow fringing reefs north of 20°N with steep slopes dropping into very deep water. In the northern Red Sea the coast is fringed by an almost continuous band of coral reef, which physically protects the nearby shoreline. A longitudinal series of coral reefs exists within the Red Sea, effectively forming a series of barrier reefs. These barrier reefs are 10-40 km offshore of the Saudi Arabian coastline and extend southward for 400 km. Similar systems of reefs occur on the African side of the Red Sea. There are also isolated patch reefs and atoll-like structures, the most famous of which is Sanganeb Atoll in Sudan (PERSGA, 2002).

Corals require a range of physical conditions for healthy growth and reproduction, all of which are influenced by human activities. Physical destruction, changes in water quality, such as raised nutrient levels, and changes in salinity and temperature, high levels of sedimentation, and changes in water currents can all damage coral reefs. Recovery, through new growth and larval settlement, requires a considerable amount of time and freedom from chronic stress (PERSGA, 1998).

The ROPME Sea Area

There are numerous patch reefs in the RSA, with coral islands representing the peak of their development. Because of scouring by loose sand in the water column, patch reefs support fewer and less dense communities than island coral reefs, which have extensive reef flats and extend to depths of 10-20 meters. About 55-60 coral species have been identified in the RSA. This compares to about 200 species in the Red Sea (ROPME, 2003).

The coral reefs in the RSA are subject to a wide range of natural environmental stresses and human influences. Coral bleaching has been reported on some reefs in Bahrain, Oman, Saudi Arabia and the UAE over the past few years. Coral reefs are extensively destroyed by Crown of Thorns Starfish (COTS) in Oman and UAE.

Although the region contains only about 8% of the world's mapped coral reefs, almost two-thirds of them are classified as being at risk.

Most fishing activities in the **RSGA** occur in shallow waters in the vicinity of coral reefs.
Corals are largely destroyed in areas affected by "uncontrolled" urban and tourism development and tourism. Sedimentation from these operations has an adverse effect on the surrounding ecosystems (e.g coral reefs). The coral reefs in the **RSA** are subject to a wide range of natural environmental stress and human influences. Coral bleaching has been reported on some reefs.

VII. BIOCHEMICAL OXYGEN DEMAND (BOD) IN MARINE WATERS

The Mediterranean Region

Algeria and Egypt are the highest BOD contributors among all Mediterranean countries including the Arab states of the south Mediterranean. The BOD discharged from industrial sources in Algeria was estimated at

113,600 tons/year. This value is about 28% of the total industrial BOD discharged to the Mediterranean. The Egyptian Mediterranean coastal waters receive the pollution load of the major part of the country's population, agricultural and industrial activities. Accordingly, the BOD discharged from industrial sources in Egypt was estimated at 213,160 tons/year; this contributes about 52% of the total industrial BOD discharged to the Mediterranean.

BOD discharged from Hot Spots of the Arab Mediterranean countries is presented in Table 2.

The Red Sea & Gulf of Aden Region

Some areas, particularly on the west coast of the Red Sea south of Suez still receive a considerable load of nutrients and BOD discharges from domestic sewage (Gerges, 2002). According to PERSGA (2001), estimated total BOD generated by Saudi Arabia's municipal sewage treatment along the Red Sea coast is 122,000 t/y.

The ROPME Sea Area

Desalination and power plants discharge around 48% of the total industrial effluent volume which contribute to the BOD, COD (Chemical Oxygen Demand) and SS (Suspended Solids) load in the marine environment of the RSA (ROPME, 2003).

The liquid industrial discharge from Saudi Arabia is mainly from sewage treatment plants, and includes domestic and industrial wastes. In 1999, the quantity of waste discharged on the Saudi Arabian coast of the RSA was 600,000 m^3/d. The contaminant load of the discharged waste indicated that the BOD load was 6,622 t/y.

Levels of industrial liquid waste produced in the UAE were estimated at $37x10^6m^3$ in 1998, and BOD estimated as 11,082 t/y. In Abu Dhabi, the BOD is estimated at 3,018 t/y.

VIII. IMPACT OF COASTAL DEVELOPMENTS

The Mediterranean Region

The coasts of the Mediterranean Arab states supported a population of approximately 53 million inhabitants in 2000, a figure which is rapidly increasing, and is projected to rise to 77 million inhabitants in 2025 (Benoit & Comeau, 2005). Associated with this urban spread is the threat to species and habitats from land reclamation, waste water discharges and construction disturbance.

Tourism is flourishing at present in the southern Mediterranean (Morocco, Algeria, Tunisia, Egypt and Lebanon). The Arab Mediterranean countries received about 17 million tourists in 2005, with a projection of about 48 million in 2025 (Benoit & Comeau, 2005). The negative impact of tourism is the environmental degradation through extensive development, added pressure to the coastal areas, and stress on the marine environment.

The Red Sea & Gulf of Aden Region

The physical alteration and destruction of habitats as a result of dredging and filling operations associated with urban expansion, tourism and industrial developments are among the main sources of environmental degradation in the RSGA region. This is particularly witnessed in Egypt and Saudi Arabia (Gerges, 2002). Sedimentation from these operations has an adverse effect on the surrounding ecosystems (mangroves, seagrass beds, and coral reefs) and, as a consequence, a decline in the productivity of the sea. In addition, uncontrolled tourism has resulted in significant damage and destruction of key habitats. Although the environmental impact of tourism in the southern RSGA is not as prominent as in the northern and central areas, the growing tourism investment plans in various parts of these countries will ultimately induce environmental impacts on a regional scale (PERSGA, 2005).

The ROPME Sea Area

The coastline of the RSA is under increasing pressure from the high pace of development and extensive economic activities. By the early 1990s, some countries had already developed more than 40% of their coastlines (ROPME, 2003). Several coastal development projects have been or are being implemented in the region's countries. In Bahrain such activities considerably increased in the 1970s, due to industrial and residential pressures such as the construction of industrial complexes and to build the King Fahd Causeway. The reclaimed land in Bahrain increased the surface area of Bahrain from 661.87 km^2 in 1975 to 700 km^2 in 1994. Recently, urbanization has encroached on significant parts of the coastal areas of Bahrain.

Considerable stretches of the intertidal areas along the Kuwait City coast and some sections along the southern coast of Kuwait have been reclaimed. As a result, significant erosion problems have developed along most of the fill edge of the reclaimed areas.

Reclamation and particularly dredging for port, harbour and seafront development contributed to changes in coastal environments in the Sultanate of Oman in 2002.

Commercial and residential development has taken place along the coastal areas of Saudi Arabia, particularly around Jubail, and further south around Tarut Bay, Dammam and Khobar.

Industrial complexes and desalination plants were established in the UAE. Significant urban development is taking place along the coasts and their surrounding areas in Abu Dhabi and Dubai.

ROPME (2003) concluded that although dredging and land reclamation are also permanent features in many coastal areas of the region with significant damaging effects on the environment, the alarming magnitude of the physical alteration of the coastline of the RSA has had several adverse environmental effects on the coastal environment.

The negative impact of tourism and uncontrolled urban development is the environmental degradation which has generated several adverse environmental effects on the coastal environment of the three regions.
The lack of proper land use planning, ineffective zoning and environmental audit procedures in some countries, particularly with regard to urban development and industrial expansion are growing problems in different areas.

IX. MARINE AND COASTAL PROTECTED AREAS (MPAS)

A Marine Protected Area *(MPA)* is

> *Any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (IUCN, 1988).*

TABLE 4 THE COASTAL AND MARINE PROTECTED AREAS IN THE ARAB COUNTRIES

Region	Arab Countries	Number Mar & Coast Protected Areas	*Protected Areas % of total land areas (2003)	Number of Scleractinia Coral Genera
MED Region	**Morocco**	10	1.2	X
	Algeria	8	5.1	X
	Tunisia	7	1.5	X
	Libya	X	0.1	X
	Egypt	4	(Med + RS) 9.42**	X
	Lebanon	1	0.7	X
	Syria	X	1.9	X
PERSGA Red Sea & Gulf of Aden Region	**Djibouti**	2	0.5	55
	Egypt	7	(Med + RS) 9.42**	57
	Jordan	1	3.02**	44
	Saudi Arabia	4	(RS+RSA) 2.8	54
	Somalia	2	0.3	50
	Sudan	2	4.9	56
	Yemen	X	X	51
ROPME Sea Area (GULF Region)	**Bahrain**	1	1.3	29
	Iraq	X	X	X
	Kuwait	4	0.0	23
	Oman	2	13.74**	40
	Qatar	4	1.1	27
	Saudi Arabia	(RS+RSA) 4	(RS+RSA) 2.8	54
	UAE	4	0.3	28

Main source: World Resource Institute. Earth trends: The Environmental Information Portal (2006)
*Protected Areas (all types and categories, and not restricted to coastal and marine only) % of total land areas as in 2003
**EEAA (2006)

MPAs can provide a range of benefits to local communities and national development through the sustainable use of living marine resources and biodiversity conservation.

The coastal and marine protected areas in the Arab countries are listed in Table 4.

Significant efforts were recognized in the three regional seas to develop marine and coastal protected areas as a rational management tool for the coastal area and within the strategy of the sustainable development.

The Mediterranean Region

As part of the Mediterranean Action Plan, a protocol concerning specially protected areas and biological diversity in the Mediterranean was adopted by the contracting parties in June 1995. The protocol calls for the establishment of a list of Specially Protected Areas of Mediterranean Importance (SPAMI), with the objectives of biodiversity conservation and protection of specific Mediterranean ecosystems.

MEDPAN (the Mediterranean Protected Areas Network) was established in 1991 to facilitate the exchange of experience between protected areas managers.

The Red Sea & Gulf of Aden Region

PERSGA (2004b) found that although all countries in the region had designated MPAs, they were few in number and only one or two were adequately managed. Many of the current and/or proposed protected areas were under high pressure from fishing and/or tourism. Others were at risk from navigation and development activities in adjacent areas.

MPAs have been established in many parts of the RSGA. This has been initiated through the inte-

Although the Arab countries have designated MPAs, issues of their adequate and efficient management remain. Several of the current and/or proposed protected areas, particularly in the RSGA, are under high pressure from fishing and tourism. Others are at risk from navigation and development activities in adjacent areas. Designation of MPAs that can be adequately managed should be associated with efficient institutional and capacity building, including resource mobilization.

gration of 12 MPAs from throughout the region into a Regional Network of MPAs for the RSGA.

Twelve declared and proposed MPAs, representing different ecosystem types and biodiversity richness and uniqueness, were identified as regionally or globally important (PERSGA, 2004b)

The ROPME Sea Area

In the RSA there are eight parks and reserves already established along the coasts of the region, and over 85 sites have been recommended for protection (ROPME, 2003)

Of the protected areas, some areas are also covered by international conventions and programmes. In Iraq, most of the important nature conservation areas in the country are unprotected although many have been recommended for future protection as national parks or reserves. The coastline of Iraq is restricted to an area next to Faw by the mouth of the Shatt Al-Arab. Little-developed areas recommended for protection include the mudflats near Al-Faw and Khor Zubair/Khor Abdullah.

Table 4 shows the numbers of Marine and Coastal protected areas as well as the percentage (%) of protected areas to the total land areas in the three regional seas in the Arab world.

X. MARINE REGULATORY PROGRAMMES, REGIONAL AND INTERNATIONAL AGREEMENTS

The Mediterranean Region

The environmental policy of the Mediterranean countries is becoming progressively aligned with the requirements of the Barcelona Convention of 1976 and its Protocols, formally known as "The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.

The Barcelona Convention was adopted in 1976 and entered into force in 1978. The following are the Protocols related to this Convention:

- Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft *(1976).*
- The Protocol concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and other Harmful Substances in cases of Emergency (Emergency Protocol) *(1976).*
- The Protocol concerning Co-operation in Preventing Pollution from Ships and, in cases of Emergency, Combating Pollution of the Mediterranean Sea *(1976).*
- The Protocol for the protection of the Mediterranean Sea against Pollution from Land-based Sources (LBS Protocol) *(1980).*
- Protocol for the Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation (Offshore Protocol) of the Continental Shelf and the Seabed and its Subsoil *(1994).*
- The Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA & Biodiversity Protocol) *(1995).*
- Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal (Hazardous Wastes Protocol) *(1996).*

THE RED SEA & GULF OF ADEN REGION

The Jeddah Convention of 1982, formally titled Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment, and its two Protocols Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency (1982) and the Protocol for the Protection of the Marine Environment in the Red Sea and Gulf of Aden from Land-based Sources of Pollution and Activities (2005), provide an important basis for environmental cooperation in the region. In addition, another supportive instrument was developed, namely the Action Plan for the

Conservation of the Marine Environment and Coastal Areas in the Red Sea and Gulf of Aden.

The ROPME Sea Area

The Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution (1978) has four related protocols that were developed in accordance with the recommendations of the Legal Component of the Kuwait Action Plan. These protocols are:

- Protocol concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency *(1978).*
- Protocol concerning Marine Pollution resulting from Exploration and
- Exploitation of the Continental Shelf *(1989).*
- Protocol for the Protection of the Marine Environment against Pollution from Land-Based Sources *(1990).*
- Protocol on the Control of Marine Transboundary Movements and Disposal of Hazardous Wastes and Other Wastes *(1998).*

The status of the ratification of the regional and international conventions and protocols by the Arab states in the three regional seas is presented in Table 5 (UNEP, 1991; PERSGA, 2003, ROPME, 2003; EEAA, 2006).

XI. EMERGING ISSUES; THE IMPLICATIONS OF CLIMATE CHANGE

According to UNEP (1992), a substantial rise in the sea level would eventually invade wetlands and lowlands, accelerate coastal erosion, aggravate coastal flooding and salinisation of fertile lands and increase the salinity of estuaries and aquifers. Global climate change would play a role in the increase of coral bleaching events, and could cause the destruction of major reef tracts and the extinction of many coral species (GIWA, 2006). Climate changes would also affect the productivity and fisheries in the marine environment.

In the Mediterranean Arab Region, the Nile delta in Egypt and the deltaic plain of the River Medjerda in Tunis are examples of areas vulnerable to a rising sea level.

Although regional and national legislation concerning the coastal and marine environments were developed in the Arab countries of the three regions, the following are shared problems in most countries:

- Lack of enforcement of the existing laws and regulations
- Inefficient monitoring for compliance
- The need to standardise terms and identifications related to definitions, ecosystem, biodiversity and integrated management
- The need to consider regional/interregional transboundary issues (cooperation mechanism and dispute resolution)

In the RSGA no bleaching has been observed to date in the Gulf of Aqaba, the Gulf of Suez or along the Egyptian coast of the main basin. Bleaching was patchy along the Saudi Arabian coast, being more severe to the south. In Sudan, bleaching occurred at several locations, above all south of Port Sudan. Along the Red Sea coastline of Yemen, where reefs are already under considerable human-induced stress, effects of coral bleaching were severe. However, no quantitative data is available. Many areas of the Gulf of Aden were affected by bleaching. In Somalia, almost all corals in an area east of Berbera were killed, whereas further west, corals were only slightly affected. In Yemen, many corals along the shoreline died, and more than half of the corals of the Socotra Archipelago were affected by the bleaching (GIWA, 2006).

In the RSA coral bleaching has been reported in Bahrain, Oman, Saudi Arabia and UAE because of high temperatures over the past few years.

XII. PRIORITY ENVIRONMENTAL ISSUES, IMMEDIATE & ROOT CAUSES AND PROPOSED REMEDIAL MEASURES

Although located in different regional seas, the marine and coastal Arab environments share common priority issues. Some of these issues are transboundary in nature (e.g. pollution, overfishing).

Priority environmental issues, immediate and root causes and remedial measures in the Arab environment of the Mediterranean, PERSGA and ROPME regions are presented in Table 6.

TABLE 5 **THE STATUS OF SIGNATURE/AND OR RATIFICATION OF THE REGIONAL AND INTERNATIONAL CONVENTIONS AND PROTOCOLS BY THE ARAB STATES**

Region	Countries	Regional Conventions			International Conventions & Protocols							
		Barcelona Convention 1976	Jeddah Convention 1982	Kuwait Convention 1978	London Convention 1954	RAMSAR Convention 1971	MARPOL 73/78	UNCLOS 1982	Basel Convention 1989	CBD 1992	UNFCCC 1992	LBA Protocol 1995
MED Region	**Morocco**	Y			Y	Y		Y				Y
	Algeria	Y			Y	Y	Y	Y				Y
	Tunisia	Y			Y	Y						Y
	Libya	Y			Y			Y				Y
	Egypt	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
	Lebanon	Y			Y	Y		Y	Y			Y
	Syria	Y			Y				Y			Y
PERSGA Red Sea & Gulf of Aden Region	**Djibouti**		Y		Y		Y	Y	Y	Y	Y	Y
	Egypt		Y		Y	Y	Y	Y	Y	Y	Y	Y
	Jordan		Y		Y	Y	Y		Y	Y	Y	Y
	KSA		Y	Y	Y			Y	Y		Y	Y
	Somalia		Y								Y	Y
	Sudan		Y			Y		Y	Y		Y	Y
	Yemen		Y		Y			Y	Y		Y	Y
ROPME Sea Area	**Bahrain**			Y	Y	Y		Y	Y	Y	Y	Y
	Iraq			Y				Y	Y	Y	Y	Y
	Kuwait			Y	Y			Y	Y	Y	Y	Y
	Qatar			Y	Y				Y	Y	Y	Y
	KSA			Y	Y			Y	Y	Y	Y	Y
	Oman			Y	Y		Y	Y	Y	Y	Y	Y
	UAE			Y	Y				Y	Y	Y	Y

Sources: UNEP, 1991; PERSGA, 2003, ROPME, 2003 and EEAA, 2006

TABLE 6 **PRIORITY ENVIRONMENTAL ISSUES, IMMEDIATE & ROOT CAUSES AND PROPOSED REMEDIAL MEASURES**

Region	Priority Envir. Issues	Immediate Causes	Root Causes	Proposed Remedial Measures
MED Region	Land-Based Activities	Discharge of Industrial waste Discharge of untreated or partially treated sewage	Lack of regulation and enforcement Inadequate monitoring Inadequate technology	Develop/ implement NAP on LBA Reduce BOD by 50% by the year 2010 (UNEP/MAP/RAC/CP (2004) Establish WWTP Prevent/Reduce discharge of waste Apply Clean Production & BAT Enhancement of Awareness Enforce Laws and regulations
	Urban and Tourism Development	Large scale urban and tourism development Coastal modification Population pressure and mobilization	Lack of awareness, lack of enforcement	Develop/implement ICZM Prevent/Reduce landfill and dredge in the coastal areas Determine the carrying capacity of coastal development & Tourism
	Destruction of Habitats	Destruction of seagrass meadows, coastal habitats Release of untreated waste	Lack of enforcement, limited awareness, poor navigational control	Prevent/Reduce landfill and dredge in the coastal areas Prevent/Reduce discharge of solid and wastewater Enhancement of awareness
	Exploitation of LMR (Living marine Resources)	Overfishing Decline in landings Increased fishing efforts Landing beyond Maximum Sustainable Yield. Destructive fishing technique	Lack of stock assessment Lack of monitoring Lack of regulation enforcement	Enforcement of regulations Prevent destructive fishing techniques Assessment & Monitoring
	Sea-based Activities	Accidental oil spill, sand mining	Inadequate control. Lack of reception facilities	Navigational control Establish reception facilities Enhancement of REMPEC
PERSGA Red Sea & Gulf of Aden Region	Land-Based Activities	Discharge of Industrial waste. Discharge of untreated or partially treated sewage	Lack of regulation and enforcement Inadequate monitoring Inadequate technology	Develop NAP on LBA Establish WWTP Prevent/Reduce discharge of waste Apply Clean Production & BAT Enhancement of Awareness & Enforce Laws and regulations
	Destruction of Habitats	Destruction of coral reefs by anchoring, trawling and landfill, and mangrove	Lack of regulations and enforcement, limited awareness	Prevent/Reduce landfill and dredge in the coastal areas.Prevent or reduce discharge of solid and wastewater Carrying capacity for diving in coral reef areas/ NAP for coral reef management Protection of mangrove/ NAP for mangrove management. Prevent curio trade. Enhancement of awareness

TABLE 6 CONTINUED

Region	Priority Envir. Issues	Immediate Causes	Root Causes	Proposed Remedial Measures
	Urban and Tourism Development	Large scale urban and tourism development Extensive dredging and filling	Lack of awareness, lack of regulations and enforcement	Develop/implement ICZM Prevent/Reduce landfill and dredge in the coastal areas Determine the carrying capacity of coastal development & Tourism
	Sea-Based Activities	Exploitation of oil Tar balls and slicks on beaches and water Discharge of ballast and bilge water Discharge from Pipe lines	Inadequate control Lack of reception facilities	Navigational control Establish reception facilities Enhancement of MEMAC
	Exploitation of LMR (Living marine Resources)	Overfishing Decline in landings Increased fishing efforts Landing beyond Maximum Sustainable Yield Destructive fishing technique	Lack of stock assessment Lack of monitoring Lack of regulation & enforcement	Enforcement of regulations Prevent/Reduce destructive fishing techniques Assessment and monitoring
ROPME Sea Area	Sea-Based Activities	Oil spill (2 million b/y) Exploitation of oil Tar balls and slicks on beaches and water Discharge of ballast and bilge water Discharge from Pipe lines	Inadequate control Lack of reception facilities	Navigational control Establish reception facilities Enhancement of MEMAC

TABLE 6 CONTINUED

Region	Priority Envir. Issues	Immediate Causes	Root Causes	Proposed Remedial Measures
	Land-Based Activities	Discharge of Industrial waste Discharge of untreated or partially treated sewage	Lack of regulation and enforcement Inadequate monitoring Inadequate technology	Develop NAP on LBA Establish WWTP Prevent/Reduce discharge of waste Apply Clean Production & BAT Increase Awareness & Enforce Laws and regulations
	Urban and Tourism Development	Large scale urban and tourism development Extensive dredging and filling	Lack of awareness, lack of enforcement	Develop/implement ICZM Prevent/Reduce landfill and dredge in the coastal areas Determine the carrying capacity of coastal development & Tourism
	Destruction of Habitats	Destruction of seagrass, coral reefs by anchoring, trawling and landfill	Lack of enforcement, limited awareness, poor navigational control	Prevent/Reduce landfill and dredge in the coastal areas Prevent or reduce discharge of solid and wastewater Carrying capacity for diving in coral reef areas/ NAP for coral reef management Prevent curio trade Enhancement of awareness
	Exploitation of LMR (Living marine Resources)	Overfishing Decline in landings Increased fishing efforts Landing beyond Maximum Sustainable Yield. Destructive fishing technique	Lack of stock assessment Lack of monitoring Lack of regulation & enforcement	Enforcement of regulations Prevent/Reduce destructive fishing techniques Assessment and monitoring

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Aridity, Drought and Desertification

Mohamed Kassas

I. INTRODUCTION

The Arab region extends from the Atlantic coast (Morocco, Mauritania) in the west to the Arab Gulf in the east. It occupies the main part of the Afro-Asian desert. With the exception of the humid and rainy territories in the coastal highlands of Morocco, Algeria, Tunisia, and Lebanon, southern Sudan, and the Iraqi highlands, the region is part of the arid belt that extends across Africa north of the equator to West Asia (the Arab Peninsula and its adjoining territories). The Arab region comprises the southern sector of the Mediterranean basin (winter rainfall), and extends southwards to territories of summer rainfall (tropical) in Mauritania, Sudan, Somalia, Djibouti, Yemen and Oman. On the whole, aridity prevails, and habitable territories are limited.

The Arab region is crossed by a limited number of large river basins: the Nile (Egypt and Sudan), the Euphrates and Tigris (Iraq and Syria), and Yarmuk (Syria and Jordan). Other small rivers are present in Lebanon, Morocco, Algeria and Tunisia. Underground aquifers are present all over the region: Nubia Sandstone aquifers prevail in northeast Africa (Egypt, Sudan, Libya and Chad), limestone aquifers prevail in Morocco, Mauritania, Algeria and Tunisia. A diversity of aquifer formations extend in the Arabian Peninsula. The water of these aquifers is available under artesian pressure in oases, but otherwise requires pumping that is often expensive. Saudi Arabia and Libya have embarked on large-scale schemes of exploiting underground water resources. In Egypt the East-Oweinat project of land reclamation depends on underground water resources.

The area of the Arab region extends over 13.8 million km^2. Of this area, 3.4% is farmlands (crops, orchards, vegetables, etc.), 18.8% rangelands, and 10% forests and woodlands. This means that the total productive lands (4.1 million km^2) represent just over 30% of the total area, while the remaining territory is very arid. These proportions vary considerably: productive lands represent 30% of the total areas of Syria and Lebanon, 3% in Egypt, Algeria and Sudan, to a minimum of 0.5% in Saudi Arabia, Oman and Mauritania.

The map (Fig. 1) shows isohyets (annual rainfall) in the Arab region (from Atlas of Arab Homeland, pp. 38-39, 1995). It shows that low rainfall prevails in most of the territories of the region.

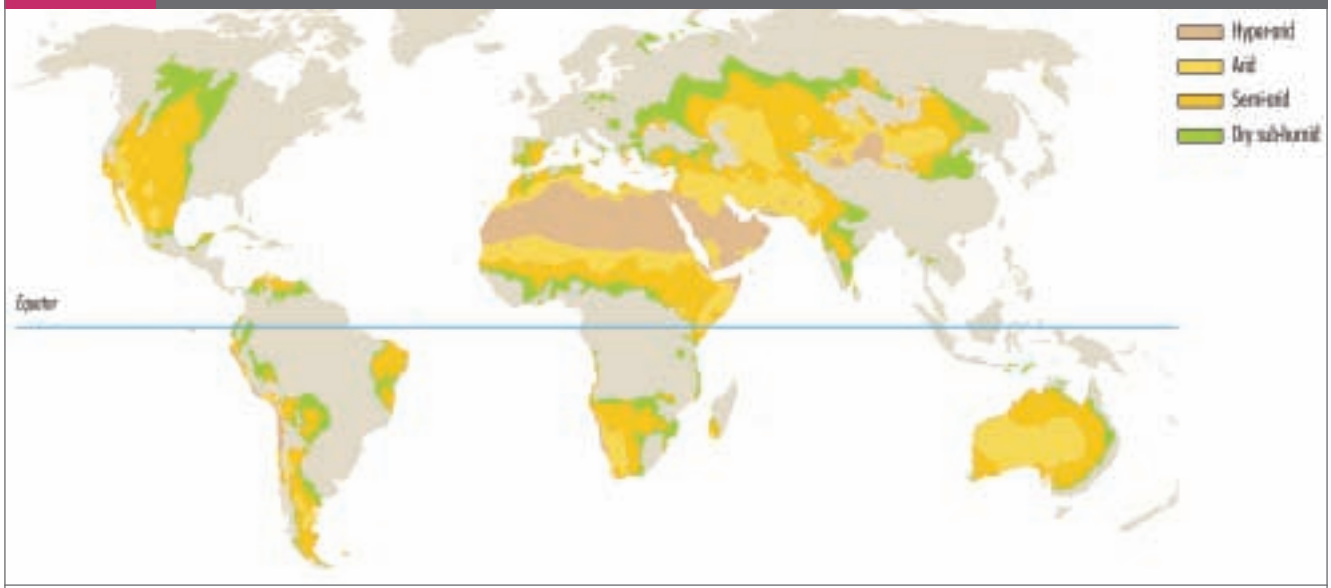
Land resources in the Arab region face three main issues: aridity, recurrent drought, and desertification. Aridity relates to shortage in water resources: water income less the expenditure (potential evapotranspiration). Aridity is widespread in drylands of the world, where a shortage of water prevails through the whole, or most of, the year. Aridity may be assessed on the basis of (1) climate variables (index of aridity), or (2) number of days when water balance favours plant growth (length of growing season).

Low rainfall is the salient feature of aridity. But it is the efficiency of rainfall that matters. Efficiency is high with low temperatures and high humidity: low evapotranspiration; efficiency is low with high temperatures and low humidity: high evapotranspiration. Several formulae have been suggested for calculating the index of aridity. The UNEP *Atlas of Desertification* (1992) adopted the simple formula:
index of aridity = rainfall (mm)/ potential evapotranspiration.

Drylands are accordingly classified into:

- extremely arid, aridity index = less than 0.05,
- arid, aridity index = 0.05 – 0.2, (200 mm. in winter rainfall territories, 300 mm. in summer rainfall territories).

FIGURE 1 **MAP SHOWING THE WORLD DRYLAND. THE ARAB REGION OCCUPIES THE HEART AREA OF WORLD DRYLAND. ARIDITY ZONES OF THE WORLD**



Source: World Atlas of Desertification, UNEP, 1992.

- semi-arid, aridity index = 0.2 – 0.5 (500 mm. in winter rainfall territories, 800 mm. in summer rainfall territories).
- dry sub-humid, aridity index = 0.5 – 0.65.

Within the boundaries of this classification, drylands occupy 47.2% of the terrestrial areas of the world: 7.5% is extremely arid, 12.1% arid, 17.7% semi-arid and 9.9% dry sub-humid.

The FAO classification based on "length of growing season" gives the following divisions: less than 120 days in drylands, 74 days or less in arid lands, and 75-115 days in semi-arid lands. The FAO assessment adds that arid lands climate is characterized by rainfall that is low and variable; this in turn means low and variable crops and livestock. This classification is based on rates of land productivity that depends on the volume of rainfall and its season.

Drought, a recurrent feature of rainfall in the world's drylands, means that available water resources are less than average (calculated through finding the means of a series of years). It may be manifest as:
- rainfall less than average,
- river flow less than average,
- groundwater resources depleted.

Management of drought is comparable to management of other natural hazards, and comprises three principal elements: a system of early warning, a system of societal preparedness, and an enabling system that provides support and assistance to imperilled societies.

Desertification as defined in the UN Convention to Combat Desertification is "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variation and human activities." Land is defined as "the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system." Land degradation is defined as "reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns."

The three principal productive land systems in the drylands are: irrigated farmlands where additional water resources are available (rivers, underground aquifers), rainfed farmlands (in semi-arid

TABLE 1 AREAS (1000 HA) OF IRRIGATED FARMLANDS (I.F.), RAINFED FARMLANDS (R.F.), RANGELANDS (R.) AND EXTREMELY ARID LANDS (D) IN ARAB COUNTRIES

Country	I.F.	R.F.	R.	D.	Total
Algeria	338	6,934	38,120	190,063	235,455
Bahrain	1	0	50	0	51
Egypt	2,486	10	2,604	94,900	100,000
Iraq	1,750	1,950	38,395	0	42,095
Jordan	43	375	6,862	1,820	9,100
Kuwait	1	0	2,306	0	2,307
Lebanon	86	214	688	0	988
Libya	234	1,659	17,172	157,655	176,720
Mauritania	8	170	59,173	43,702	103,062
Morocco	525	7,484	36,693	1,050	45,752
Oman	41	6	19,642	7,506	27,195
Pal.+Israel	271	147	369	1,246	2,033
Qatar	0	4	876	220	1,100
Saudi Arabia	415	760	112,345	126,480	240,000
Somalia	16	1,039	60,669	1,260	62,984
Sudan	1,700	5,108	142,542	68,700	218,050
Syria	652	4,971	12,945	0	18,568
Tunisia	215	4,258	7,968	3,037	15,478
UAE	5	0	1,008	8,197	9,210
Yemen	309	1,209	32,590	1,692	35,800

Source: Dregne & Chou, 1992

and dry sub-humid territories), and rangelands. To this we may add scrub and woodlands (within rangelands and rainfed farmland) and tree belts planted as shelterbelts to conserve land and combat soil erosion (and to provide fuelwood). Desertification is manifest in diverse forms according to land use. In irrigated farmlands degradation relates to imbalance between excessive irrigation and poor drainage. This results in waterlogging, salinisation, etc. In rainfed agriculture degradation relates to soil erosion, loss of soil organic content, depletion of nutrients, etc. In rangelands, degradation relates to loss of plant cover and capacity of range to provide for feed needs of livestock, invasion of non-palatable species. An FAO (1982) report refers to desertification as the breakdown of the fragile balance that provides for plants, animals and man to survive in arid, semi-arid and dry sub-humid territories. This breakdown relates to physical, chemical and biological factors and presents the initiation of a self-destructive process of all aspects of life. Soil is exposed to erosion by water and wind, groundwater becomes deeper, plant life is impaired and its ability to compensate losses decreases. These are all outcomes of desertification.

II. LAND AND WATER RESOURCES

Table 1 provides estimates of areas of land use in the Arab countries, giving a broad picture of land resources. Estimates are subject to yearly changes due to land reclamation programmes, afforestation and range management schemes, land transformation due to non-agricultural land-uses (urban sprawl, roads, etc) in urban and rural areas, and due to land degradation (desertification).

Figures in Table 1 show that certain countries (e.g. Egypt) are riverain oases that depend on irrigated agriculture, and where rainfed farmlands are limited, and while rangelands seem extensive their contribution to agricultural economies is poor. In countries like Algeria, Morocco, Tunisia, Syria and Yemen, rainfed agriculture represents the principal element of farmlands. Rangelands in Sudan, Somalia, and Saudi Arabia are extensive; Sudan and Somalia are exporters of livestock products. Balance among the three principal land use systems prevails in Sudan, Iraq and Syria.

The following are general comments on the figures in Table 1:

- About half of all territories are extremely arid lands (deserts) that may be agriculturally reclaimed wherever water resources are available (groundwater). Other land uses (oil and mineral production, urban settlements, industrial centres, etc.) are welcome prospects.

- Rangelands seem to occupy the main bulk of productive Arab territories, and these are territories prone to desertification.

- Rainfed farmlands areas occupy four times the total area of irrigated farmlands, but are prone to desertifaction, and their share of agricultural production is often less than that of irrigated farmlands.

- All agriculturally productive lands in the Arab countries are fragile systems prone to degradation. It may be stated that desertification is the prime threat to productive lands in the whole Arab region.

- In some of Arab countries where precipitous highlands prevail (e.g. Yemen), rainfed farming depends on the establishment and maintenance of terraces and contour-lines that conserve soil and water. These are labour-intensive structures. Emigration of labour from Yemen to oil-rich countries caused labour shortages that led to degradation of these conservation structures. Again the 20th century witnessed change in agriculture on the Yemeni slopes from productions of traditional Arab coffee to production of qat; this is a special socio-cultural change.

- Rangelands in arid territories are prone to incidents of drought (rainfall below average). Range societies have, all through history, managed to survive through nomadism or transhumance: across-country movements of herders and their flocks from territories of water shortage to less austere territories. Nomadism is a societal mechanism for survival under conditions of extreme variability of water resources (such as rainfall). Nomadism is often a seasonal journey from winter ranges to summer ranges. An extreme case is the Gizzu range, where rainfall is not an annual event but an event that may only happen once in several years. When it happens in otherwise rainless territories, e.g., northern Sudan, news attracts herders who with their flock to travel several hundreds of kilometres to take advantage of the almost accidental growth of vegetation (see El Shamy, 1965).

- While areas of food-producing land may have increased through land-reclamation projects, populations have increased at higher rates, and the balance between production and the needs of people has been upset. Many Arab countries (e.g. Algeria and Syria) were till the mid-20th century wheat exporters; now all Arab countries import considerable volumes of their food needs.

- The GEO 4 report (UNEP, 2007) sums up the situation in the eastern Arab region (12 Arab countries in the Gulf and Arab Peninsula): at the beginning of the 21st century 79% of land is impaired, 98% of which damaged by man and ill-management.

In Table 2 estimates are given of water resources available in the Arab region in 1996, as presented by a study of the Arab Centre for Studies on Arid Lands (ACSAD) and the Arab Fund for Development (1997).

The general picture is that the Arab region falls within the category of water stress areas (less than 1,000 m^3 of water per head/ year).

Water resources in Jordan and Palestine rest at the lowest levels. In the Gulf states the role of desalination establishments is evident as a principal source of freshwater. Riverain countries with rich resources that provide for irrigated farming (Iraq, Syria, Egypt and Sudan) are downstream countries in international river basins; this is a situation conducive to conflicts, a situation that is prevalent around all international river basins.

The GEO 4 report (UNEP, 2007) addresses the state of water resources in the region:

The per capita share of available water resources per year decreased from 1,700 m^3 in 1985 to 907 m^3 in 2005, and is expected to decrease further to 420 m^3 by 2050.

Riverain countries in the region need to enact regional river basin conventions that establish a

TABLE 2 **WATER RESOURCES (MILLION M³/YEAR) IN ARAB COUNTRIES, 1996 ESTIMATES**

	Traditional Resources		Non-traditional resources			Total
	Surface	Ground	Desal.	Agr.Dr.	Sewage	
Algeria	13,000	2,000	74.6	-	400.0	15,474.6
Bahrain	8	112	73.0	-	11.0	206.0
Egypt	55,570	4,100	31.7	3,800	600.0	64,101.70
Iraq	60,480	3,419	7.4	-	-	63,906.40
Jordan	692	276	3.0	-	51.0	1,022
Kuwait	-	182	350.0	-	42.0	574.10
Lebanon	4,800	4,250	1.7	-	2.0	9,053.70
Libya	397	650	210.0	-	110.0	1,367
Mauritania	5,800	1,500	1.7	-	67.6	7,369.30
Morocco	22,500	7,500	1.2	-	350.0	30,351.20
Oman	1,450	475	47.3	-	5.5	1,977.80
Palestine	306	185	-	-	-	491.0
Qatar	-	40	98.6	-	35.4	174.0
Saudi Arabia	3,210	2,340	7.95	-	100.0	6,445.0
Somalia	8,160	3,300	0.1	-	-	11,460.10
Sudan	26,000	1,000	0.6	-	-	27,000.60
Syria	16,375	5,075	2.0	1,270	-	22,722.0
Tunisia	2,700	1,200	8.7	-	6.0	3,914.70
UAE	185	120	385.0	-	108.0	798.0
Yemen	3,500	1,550	9.0	-	6.0	5,065.0

Note: Surface= rivers, Ground= aquifers, Desal= desalination, Agr.Dr= agricultural drainage, Sewage= treated sewage water. Source: ACSAD, 1997

framework of just and fair sharing of river resources (water and energy). The Nile Basin Initiative that is being elaborated by the ten countries of the Basin is a good example of action in the right direction.

Overexploitation of groundwater resources, which are mostly fossil (non-renewable), poses further threats to the water resources issues at present and in the future.

Exposure of surface and underground waters to pollution from industrial, agricultural and domestic sources, and especially from new urban centres, is a hazard that threatens water sources and human health. This is an especially important issue in Egypt where several land reclamation projects depend on the re-use of agricultural drainage water (15 billion m³ discharged into the northern lakes and the Mediterranean).

The high rates of water consumption in human settlements, exacerbated by increasing populations in Gulf cities, are issues that need to be addressed. Daily per capita water consumption ranges between 300 and 750 litres, among the higher ranges by world standards.

Water use by agriculture in the eastern Arab countries increased from 73.5 billion m³ in 1990 to 90 billion m³ in 2000.

From these comments, which may be repeated for the western section of the Arab region, it is evident that issues of freshwater (development of resources, protection against pollution, rational use of its limited resources) set one of the clear priorities for the Arab region. National and regional capacities in fields of science, technology and management to address such issues should be mobilized to guide water resources management in the region.

III. DESERTIFICATION IN THE ARAB REGION

Most of the territories of the Arab region fall within the boundaries of arid lands, where land degradation, primarily desertification, reduces abilities to produce. To clearly present an assessment of land degradation, we may remember that productive lands in arid regions include: irrigated farmlands, rainfed farmlands, and rangelands and animal husbandry. To this we may add

that man obtains his fuel (agricultural residues, wood from shrubs and trees) and other materials (drugs, etc.) from the products of land.

Table 3 gives estimates of irrigated farmlands and rates of their degradation in the Arab countries. Besides the low or slight degradation category (10% loss), we may consider losses (income foregone) of medium (10-25% loss), severe (25-50% loss) and very severe (more than 50% loss). This provides a useful measure of degradation (area of degraded lands as percentage of the total irrigated farmlands). The overall estimate of land degradation is 34% which is near the world estimate of 30% (Dregne et. al, 1991).

Irrigated agriculture depends on the water resources of principal rivers in Egypt, Sudan, Syria and Iraq. Land degradation ranges from 17% in Syria to 70% in Iraq. The history of irrigated agriculture in Iraq (Mesopotamia) is old; it is the cradle of irrigated farming. All through its long history the rise and fall of agriculture related to the state of governance: political stability and rational government meant maintenance of irrigation and drainage networks and hence flourishing of agriculture, and vice versa (Jacobon, 1958). Land degradation in river basins means imbalance between irrigation and efficiency of drainage. Conservation of land in irrigated farmlands requires undertaking projects to correct and maintain drainage networks (open drains and networks of tile-drains).

In irrigated farmlands that depend on small rivers or on underground water resources, excessive irrigation is not prevalent, but drainage networks are often limited or absent. Saudi Arabia is a special case (desertification 63%): here degradation does not relate to poor drainage and waterlogging (as is prevalent in lands of major river basins), but relates to failure in the management of water resources due to excessive use.

Studies presented to the UN Conference on Desertification in 1977 included a case-study on land degradation in irrigated farmlands in Iraq: the Greater Mussayeb Project. Work in this project extended for long years, aiming at reclaiming degraded lands and conservation of productive lands. The study showed that reclamation depends on a “packet of means” that

TABLE 3 **ESTIMATES (1000 HA) OF DEGREE OF DESERTIFICATION IN IRRIGATED FARMLANDS (I.F.) IN ARAB COUNTRIES**

Country	I.F.	Degree of desertification					%
		s	m	sv	vsv	m+	
Algeria	338	288	40	10	0	50	15
Bahrain	1	1	0	0	0	0	0
Egypt	2,486	1,735	700	50	1	751	30
Iraq	1,750	500	750	300	200	1,250	70
Jordan	43	30	10	3	0	13	30
Kuwait	1	1	0	0	0	0	0
Lebanon	86	80	6	0	0	6	7
Libya	234	179	50	5	0	55	24
Mauritania	8	7	1	0	0	1	12
Morocco	525	474	51	0	0	51	10
Oman	41	30	11	0	0	11	27
Pal.+Israel	271	230	31	10	0	41	15
Qatar	0	0	0	0	0	0	0
Saudi Arabia	415	155	200	40	20	260	63
Somalia	16	13	3	0	0	3	19
Sudan	1,700	1,340	350	10	0	360	21
Syria	652	542	70	30	10	110	17
Tunisia	215	145	60	10	0	70	33
UAE	5	3	2	0	0	2	40
Yemen	309	259	40	10	0	50	16

Note: s= slight, m= medium, sv= severe, vsv= very severe, m+=medium+severe+very severe. Source: Dregne & Chou, 1992

comprises: technical, economic and social means. Success requires integration of all elements. The situation in the Greater Mussayeb area is closely similar to problems of irrigated farmlands in the Indian sub-continent (a second case-study came from Pakistan, see Mabbut and Floret, 1980); similar conditions prevail in Syria, Egypt and Sudan. Lessons learned show that the way to combat desertification combines: technical means (completion, conservation and reclamation of drainage network; soil reclamation by adding conditioners as gypsum, etc.); and economic means relating to prices of reclaimed land, taxes, systems of agriculture subsidies and crop marketing. We may note that the World Bank and related agencies promote the idea of "pricing irrigation water" as a means of limiting excessive irrigation. Societal means include forming farmers' organizations and land lords' associations, that would be capable of providing support to farm management, enacting rules for owner-farmer and farmer-labour relationships, and setting rules of participation for all stakeholders in planning for development and in implementation of plans.

Table 4 provides estimates of land degradation in rainfed farmlands in countries of the Arab region. Rainfed farmlands prevail in semi-arid and dry sub-humid territories (annual rainfall more than 500 mm). Estimates of the total combined area of these lands in the Arab region amount to 36 million ha, degraded lands amount to 67%, compared with a world overage of 47%.

Greater rainfed farmlands are present in Morocco (7.4 million ha), Algeria (7 million ha), Sudan (5 million ha) and Tunisia (more than 4 million ha). Countries with less rainfed farmlands include Libya, Somalia, Iraq and Yemen (1-2 million ha, each). Estimates of desertification (medium and more) are highest in Algeria (93%), and are also high in Morocco (69%), Tunisia (69%) and Syria (70%). The figure is less (41%) in Sudan.

Aspects of desertification in rainfed farmlands include:

- Soils are subject to erosion (wind-water) damage, through which organic matter and nutrient-rich surface layers are removed. Land dam-

TABLE 4 **ESTIMATES (1000 HA) OF DEGREE OF DESERTIFICATION IN RAINFED FARMLANDS IN ARAB COUNTRIES**

Country	R.F.	Degree of desertification					%
		s	m	sv	vsv	m+	
Algeria	6,934	484	5,800	600	50	6,450	93
Bahrain	---	---	---	---	---	---	---
Egypt	10	9	1	0	0	1	10
Iraq	1,950	550	1,150	230	20	1,400	72
Jordan	375	165	155	54	1	210	56
Kuwait	---	---	---	---	---	---	---
Lebanon	214	84	90	39	1	130	61
Libya	1,659	1079	540	40	0	580	35
Mauritania	179	150	27	2	0	29	16
Morocco	7,484	2284	4.9	270	30	5,200	69
Oman	6	3	2	1	0	3	50
Pal.+Israel	147	47	35	63	2	100	68
Qatar	4	3	1	0	0	1	25
Saudi Arabia	760	300	420	38	2	460	61
Somalia	1,039	489	450	95	5	550	53
Sudan	5,108	3018	1,870	205	15	2,090	41
Syria	4,971	1,471	2,840	650	10	3,500	70
Tunisia	4,258	1318	2,500	400	40	2,940	69
UAE	---	---	---	---	---	---	---
Yemen	1,209	429	700	73	7	780	65

Note: s= slight, m= medium, sv= severe, vsv= very severe, m+=medium+severe+very severe. Source: Dregne & Chou, 1992

aged by gullies, surface crusts that impede water percolation to root zones and increase surface runoff.

- Increases in crop losses by pathogenic and parasitic pests.
- The net outcome is a reduction of crop yields from land units (per hectare); this is "income forgone."

One important factor in this area related to rises in population (increase in density), and hence increased competition for land, is the subsequent reduction in periods of fallow that are necessary for soil recuperation. Deficiencies or improper management of soil conservation measures such as bunds, contour terraces, shelterbelts, etc. are added causes for degradation.

Relationships between rainfed farmlands and rangelands could be "integration" when farmers and herders agree that herds may use farmland stubble (after harvest), and the soil would benefit from livestock droppings. Conflicts between the two groups arise when farmers expand their used lands onto rangelands, often in years with above-average rainfall. Conflicts between tribes of farmers and rangers are societal issues that are parts of the history of the Sahel (sub-Saharan Africa).

Table 5 provides estimates of degradation in rangelands of the Arab countries. Rangelands are extensive (more than 593 million ha), rates of desertification (medium and more) here amount to 83%, higher than the world average of 73% (Dregne et al, 1992). Rangelands extend from the fringes of arid and semi-arid zones, and show gradation from cattle herds in semi-arid territories, to sheep and goat herds in arid territories, and camels in nomadic ranges.

Grazing lands in arid territories may not be widespread but can be confined to water-collecting sites in *wadis* and depressions. In semi-arid territories (annual rainfall 500 mm.) grazing lands are more spread out. Grazing and livestock husbandry are associated with transhumance: travel seeking plant growth. Journeys may be seasonal (summer range – winter range) or may be accidental in years of drought. Nomadism is part of the traditional

culture of the whole of the Arab region. In all cases rangeland degradation is caused by overgrazing, that is, exploiting the range beyond its carrying capacity.

Countries with extensive rangelands include Algeria, Iraq, Mauritania, Morocco, Saudi Arabia, and Sudan. Rates of desertification may be as high as 80%.

If we apply cost estimates of desertified lands (income forgone, Dregne and Chou, 1992): $250 per ha in irrigated farmlands, $38 per ha in rainfed farmlands, and $7 per ha in rangelands, we calculate that yearly income foregone in the Arab region due to desertification is about $5 billion. This may sound little compared with the total GNP of the region including the oil rich countries. But while traditional land uses including grazing may have receded in oil-producing territories, development programmes in all Arab countries, including Saudi Arabia and Gulf states, include agricultural schemes with a view to securing – at least partly – food security.

IV. COMBATING DESERTIFICATION IN THE ARAB REGION

Sudan was the site of earlier studies on "desert creep" and "desert encroachment" published between 1937 and 1953 (see Stebbing 1937, and Kassas 1970). The regular pattern of isohyets in the midlands of Sudan (between isohyet 200 mm and isohyet 800 mm) is associated with a regular pattern of vegetation types in belts from the arid north to wooded Savanna belts in the south. In west Sudan, Kordofan and Darfur (sand), and east Sudan, Butana and Gezira (clay), patterns of vegetation structure are similar though species are different. These patterns made possible the monitoring of change and degree of degradation by comparing maps (and aerial photographs) over a sequence of years. Land degradation causing deterioration of rangeland, degradation of gum arabic producing territories in the west and rainfed farmland in the east were matters of concern to government agencies and research institutions.

The Government of Sudan (Ministry of Agriculture and the National Research Council), with technical assistance of UNDP and FAO, formulated a national plan for combating desertification and rehabilitation of degraded lands. The plan and programmes of action (projects) were completed in 1976, one year before the UN Conference on Desertification (UNCOD, 1977). The Sudanese document (DECARP, 1976) was presented to the UNCOD. This pioneering programme comprised 3 principal elements:

1- A unit for monitoring and assessment, preparing maps of environment and natural resources, and surveillance of land degradation.
2- A central unit for managing the programmes of action and providing supporting measures (training, public awareness, public participation, etc.).
3- Programmes (groups of field projects) for corrective actions (rehabilitation, reclamation, etc), and for establishing reserve areas. Special attention was given to rehabilitation of rangelands and the gum arabic belt, stabilization of sand formations, building green belts around towns and villages, and development of water resources.

The Government of Sudan – with international aid – implemented several of the DECARP projects. In 1984 the Sudanese Ministry of Agriculture with the assistance of UNEP set the second phase of the national plan guided by the UNCOD Plan of Action. This phase addressed in particular rehabilitation of rainfed farmlands in east Sudan and gum arabic belts in west Sudan.

Tunisia is one of the pioneering Arab countries in fields of survey of natural resources, land degradation, conservation of biodiversity and establishing nature reserves. Tunisia has a well perceived atlas of scientifically based maps. Features of desertification (land degradation) prevail in areas estimated to be 10 million ha, 64% of the total area of Tunisia. Aspects of desertification include:

- The number of grazing animals increased from 4 million to 7 million, leading to overgrazing.
- Water erosion menaces some 60% of farmlands, with one consequence being the silting of water reservoirs.
- Wind erosion is evident in building of sand bodies, and encroachment of sand dunes over productive lands.
- Salinisation of land expanded salt-affected areas (sebkhas), reaching 557 thousand ha.

TABLE 5 **ESTIMATES (1000 HA) OF DEGREE OF DESERTIFICATION IN RANGELANDS IN ARAB COUNTRIES**

Country	R	Degree of desertification					%
		s	m	sv	vsv	m+	
Algeria	38,120	3,820	9,200	25,000	100	34,300	90
Bahrain	50	40	10	0	0	10	20
Egypt	2,604	504	300	1,800	0	2,100	81
Iraq	38,395	3,815	7,000	27,250	250	34,500	90
Jordan	6,862	662	1,150	5,000	50	6,200	90
Kuwait	2,306	346	1,558	400	2	1,960	85
Lebanon	688	68	195	400	25	620	90
Libya	17,172	3,472	1,700	11,800	200	13,700	80
Mauritania	59,173	17,773	5,000	36,000	400	41,400	70
Morocco	36,693	3,693	3,000	29,900	100	33,000	90
Oman	19,642	1,942	5,000	12,650	50	17,700	90
Pal.+Israel	369	39	80	230	20	330	89
Qatar	876	86	100	685	5	790	90
Saudi Arabia	112,345	22,345	60,000	29,800	200	90,000	80
Somalia	60,669	15,669	10,000	34,900	100	45,000	74
Sudan	142,542	28,540	30,500	83,000	500	114,000	80
Syria	12,945	1,345	3,000	8,550	50	11,600	90
Tunisia	7,968	1,168	1,270	5,500	30	6,800	85
UAE	1,008	108	198	700	2	900	80
Yemen	32,590	6,590	10,000	15,900	100	26,000	80

Note: s= slight, m= medium, sv= severe, vsv= very severe, m+=medium+severe+very severe. Source: Dregne & Chou, 1992

- Forested areas decreased, by cutting and incidents of fire, and due to clearing for expansion of farmlands.
- Area of alfa-grasslands decreased from 950 thousand ha in 1931 to 433 thousand ha in 1985.

One of the case studies presented to UNCOD (1977) prepared by Tunisia, with assistance of UNESCO and UNEP, addressed desertification in the Oglat Merteba Region representing winter rainfall (Mediterranean) drylands, an area of 20,000 ha. The study provided analyses of land degradation and means for rehabilitation (Mabbut and Floret, 1980).

In 1985, Tunisia completed – with international assistance – setting a national plan of action to combat desertification guided by the UNCOD (1977) world plan of action. The Tunisia plan comprised 21 projects of corrective measures with estimated costs of implementations of 50 million Tunesian Dinar. The Government managed to mobilize international aid and national resources to implement most (14) of these projects.

Other Arab countries set national action plans in the light of the UNCOD world action plan: examples are Mauritania (principal issue movements of sand formations) and Yemen (principal issue conservation of mountain slopes and of water resources).

Several Arab countries responded to the UN Convention for Combating Desertification (1994) by revising earlier plans or preparing new ones. An example is the national action plan prepared by Egypt (Desert Research Centre). The plan envisaged two frames: a set of thematic land use systems (irrigated farmlands, rainfed farmlands, rangelands and sand movements) and a set of four eco-agricultural regions (coastal belt of north Egypt, Nile Basin and Delta, oases and remote areas of western desert, deserts in Eastern Egypt and Sinai). A matrix of the two sets indicates areas of action. To this is added a programme of supporting measures: field surveys, monitoring, manpower development, and societal participation. (For details see ACSAD, 1996.)

The Arab countries established science institutions capable of addressing issues of arid lands,

dealing with conservation and development of natural resources; ACSAD (Damascus) and ICARDA (Aleppo) are two of these regional institutions. The Council of Arab Ministers of Environment set the issues of drylands among the priorities of its agenda and established a workforce of experts to set frameworks of regional programmes of collaborative actions.

These are all commendable efforts that deserve appreciation, but are still short of what would set back menaces of land degradation. More resources (financial, manpower, etc) need to be mobilized in this area.

V. DROUGHT

Drought is (often) due to a failure of rainfall, that is, the volume of rainfall is less than expected (long-term mean). Mean annual rainfall at the agricultural research station at Borg-el-Arab (45 km to the west of Alexandria) is 150 mm.; this is a mathematical mean, and actual rainfall may be 250 mm or more ('fat' years) or 50 mm or less (lean years - drought). An incident of drought may be short (one year) or may be long: a drought of several consecutive years, as menaced the African Sudano-Sahel belt from 1968 to 1984, is referred to as a protracted drought. In years of drought range and livestock deteriorate, and crops fail. Drought is a natural hazard, as lean years are a naturally recurring aspect of dryland climate. This is one difference between desertification that is primarily the result of mismanagement of the land system and whose combating requires revised procedures of development and use of natural resources, and drought that is a natural hazard.

A Pioneering Syrian Drought Management Programme

We refer to a Syrian pioneering experiment that is nearest to complete management of drought, and it provides lessons to be learned. Rangelands prevail all over the Arabian Peninsula, and the Syrian Badia is its northern part. The Syrian rangelands are menaced by recurrent incidents of drought associated with losses in livestock. Between 1958 and 1961 the sheep population decreased from 6 million to 3 million. Losses were due to death or low-priced hurried sales. It was usual for the Syrian Government (and donor institutions) to rush relief support to menaced societies. The Syrian Government wanted a system that would enable these often menaced rangelands to survive incidents of drought. This was the pioneering programme (Draz, 1995) that was implemented. It comprised four principal sectors: societal organization, technical support, financial resources, and research and training.

1- Societal organization

Herders communities are usually organized on a tribal basis: ethnic or cultural. Here they re-organized themselves on the basis of their relation to space: hema. The re-organized community became a cooperative, a functional unit of herders. Between 1969 and 1973 eight cooperatives were formed: six in Hama Governorate and one in Damascus rangelands, and one in Homs rangelands. Then the process became widespread, and the number of cooperatives in 1979 became 46 covering rangeland territories of 4.5 million ha.

The concept of cooperatives was further developed by establishing specialized cooperatives: a first sheep fattening cooperative was created in Hama; 14 such cooperatives were operative by the end of 1972, each with feedlots and feed storage barns; and by 1979 there were 65 such cooperatives with feed storage capacities of 160 thousand tons.

2- Technical Support

The first technical centre was established at Wadi El-Azeeb in 1959 to train herders and to provide

extension services. The success and utility of this centre encouraged the creation of eight centres in 1971-75 at Hesya (Homs), El-Manqora (Damascus), Marg-Maryan (Hama), Tool Eleba (El-Ragga), Om-madfa (El-Hasaka), El-Shoula (Der-el-zour), Orai (Esuweida), and Shatha (Hama). Other centres were added, all providing technical support and services to herders, and they also helped in clearing and rehabilitating ancient water storage cisterns, and in building water conservation dams on *wadis*.

3- Fodder Fund

This was a financial mechanism to support the herders and fattening cooperatives, established in 1965 with resources from:

- Sales of materials provided by the World Food Programme;
- Government contributions;
- Loans and donations from the World Bank.

By 1983 the Fund had collected 120 million Syrian Lira. The Fund provided loans to the cooperatives and through them to members.

4- Research and Training

Seven research centres participated in programmes for selecting and testing plant species that may be used in range improvements, and development of water-harvesting studies. Faculties of agriculture participated with research centres in training technicians and specialists.

With this integrated scheme the rangelands (land) and the herders (societies) became capable of withstanding incidents of drought without losing their herds through death and urgent sales. This pioneering scheme deserves to be studied so as to be emulated on a regional scale, with appropriate modifications to suit rangelands in Arab countries.

VI. BIODIVERSITY

The most apparent and visible manifestation of desertification is degradation of vegetation (plant cover) and its insufficiency to protect soil against erosion; subsequently its productivity fails to provide fodder in rangelands or crops in farmlands. Loss of plant cover entails loss of animal life. This degradation has another aspect: loss of biodiversity, that is, loss of elements of plants and animals that fail to withstand habitat deterioration (desertification). This loss has special global importance.

The Fertile Crescent is a region that embraces the Levant and its adjoining territories in Asia Minor and Iraq. Specialists in the history of agriculture including history of domestication of plants (crops) and animals (livestock), consider the Fertile Crescent region one of the centres of origin of agriculture. This means that certain species have been domesticated (and husbanded) into crops. The Russian scientist Vavilov (1949) concludes that the East Mediterranean region is the centre of origin of 83 cultivated plants:

18 crop plants,
39 fodder plants,
26 fruits and spices plants.

Principal crop plants, whose centre of origin is designated in East Mediterranean Basin, include:

- Triticum turgidum subsp dicoccum (emmer wheat)
- Triticum monococcum (Einkorn wheat)
- Hordeum vulgare (barley)
- Pisum sativum (pea)
- Cicer arietinum (chickpea)
- Vicia faba (broad/fava bean)
- Linum usitassimum (flax plant that linen can be produced from)

In addition we may include several species of legumes and grasses that provide fodder. The importance of this region relates to the presence of a diversity of wild relatives of these crop species that maintain valuable gene-resources (see Balter, 2007).

To this we may add that the flora of the Arab region include hundreds of plant species that have long provided the people of the region with useful drugs. The pharmaceutical industry supports survey missions in many parts of the world for plant prospecting for chemical resources. The island of Socotra (Yemen) is one of the world's "hot spots" for such surveys. The relics of the once extensive Cedrus libani (Lebanese cedar) forests of Lebanon represent another "hot spot" area. Conservation of biodiversity in the Arab region has critical regional and worldwide significance. It is therefore the responsibility of the region to guard these biodiversity resources for the benefit of the world.

TABLE 6 **FOREST AREAS AND AREA CHANGE (1990-2000) IN ARAB COUNTRIES, (IN 1000 HA.)**

Country	Forest Area		Annual change
	Forest Pl.in 2000		1990-2000 (%)
Algeria	2,145	718	1.3
Bahrain	--	--	--
Egypt	72	72	3.3
Iraq	799	10	--
Jordan	86	45	--
Kuwait	5	5	3.5
Lebanon	36	2	-1.2
Libya	358	168	1.4
Mauritania	202	13	-0.6
Morocco	3,025	534	--
Pal.+Israel	132	91	4.9
Oman	1	1	5.3
Qatar	1	1	9.6
Saudi Arabia	1,504	4	--
Somalia	7,515	3	-1
Sudan	61,627	641	-1.4
Syria	461	229	--
Tunisia	510	202	0.2
UAE	321	314	2.8
Yemen	445	--	-1.9

Source: FAO, 2005

Territories with ample rainfall that could support forest growth are limited in the Arab region. But certain countries have areas of forests. Table 6 presents estimates of forest areas and areas of afforestation projects (in 1,000 ha) in the Arab countries (FAO, 2005).

The largest forested areas are in Sudan, whose southern humid territories and eastern and western highlands have forest habitats. Somalia, Morocco, Algeria and Saudi Arabia have areas of forest that range from 7.5 million ha (in Somalia) to 1.5 million ha (in Saudi Arabia). Areas of afforestation seem limited, but there is an apparent parallel between areas of natural forests and areas of afforestation. We refer later to forests and afforestation in Sudan (a case study).

The plantation of trees in drylands of the Arab region relates to sewage treatment plants. The purpose is often to use the treated water for establishing green belts (to protect human settlements against sand storms), environmental improvement, and as a source of fuelwood. In Egypt such projects consider planting African mahogany trees (timber for furniture), mulberry shrubs (for silkworm husbandry), and species of Jatropha (for production of biofuel). Almost all Gulf States have carried out field projects for rehabilitation of mangrove forests in their coastal zones.

The FAO established six forestry commissions in the world, including the Near East Forestry Commission (1953) and the African Forestry and Wildlife Commission (1959). Each Commission holds a general conference every two years. The two commissions held a joint conference in Khartoum, Sudan in February 2008. The conference addressed issues related to impacts of climate changes in the 21st century on forests.

VII. CONCLUDING REMARKS

Desertification and recurrent drought are among the most serious menaces that damage land productivity in areas of irrigated agriculture, rainfed farming and rangelands, and also in woodlands and scrublands. The two menaces cause degradation of the food-producing capacities of the Arab region and hence undermine the bases of food security. As populations increase and their rates of consumption continue to rise, the gap between production and consumption of food increases, and dependence on the importation of food increases.

Although the Council of Arab Ministers of Environment gave priority to this issue, the actual efforts and resources devoted to the purpose are less than are needed to face up to the problem. The ventures at both the national and regional level remain modest. More mobilization of national and regional inputs remains necessary.

Governmental agencies should play the principal role in setting work plans, national and regional programmes and field projects. Mobilization of national and regional efforts is necessary. Non-governmental bodies should play their active roles in ensuring positive public participation, a cardinal element of success.

Reviewing worldwide endeavours to combat desertification, we note that this movement was spurred by the widespread damage caused by droughts that menaced the countries of the Sahel in West Africa in 1969 and extended in time across several years (1969-1982) and in space

until it menaced the whole Sudano-Sahel belt. Relief materials were rushed in for salvation, and the UN General Assembly resolved in 1974 to hold a UN Conference on Desertification (Nairobi, Kenya, August 1977) to set a plan of action to combat desertification. Years passed and the UN held its conference on environment and development in 1992. This conference reviewed the world status of desertification and the outcomes of world action in the 1977-1992 period. Outcomes were very modest. The conference decided that there was need for a legally binding convention that would commit governments to action. A draft convention was ready in 1994, became operational in 1996 and its first conference of parties was held in the same year.

One question persists: How did the Arab countries participate in these international concerns? The few positive answers include the laudable actions of Sudan which formulated a national plan of action to combat desertification in 1976 (one year earlier than the UN 1977 Conference), and of Tunisia which pioneered setting a national plan of action to combat desertification in the light of the World Plan of Action set by the 1977 Conference. Steps by other Arab countries were slow. Countries are strongly urged to give priority

CASE STUDY: SUDAN

Data presented in Table 6 show that forest areas in Sudan, at 61,627 thousand ha the largest forest area in countries of the Arab region, cover the equivalent of 28% of the total area of Sudan. Most of these areas are in southern Sudan (upper Nile, Equatoria, Bahr El-Ghazal, Darfur and Kordofan) and in limited areas in highlands in the middle territories.

To the natural forest areas are added areas of afforestation that consist of indigenous species and a number of exotic (introduced) species especially eucalypts and casuarina. Afforestation schemes aim at planting crop-trees to produce timber, fuelwood, gums, etc., and at rehabilitation of degraded forests especially in gum Arabic producing woodlands. Degradation is often due to overcutting or to desertification. Principal afforestation areas planted with indigenous species include:
52,227 ha Acacia Senegal (gum Arabic tree)
18,200 ha Acacia nilotica (qarad tree)
10,130 ha Tectona grandis (teak).

Areas planted with introduced species (eucalyptus) include 41,442 ha.

The Doum forests grow along the banks of water courses of seasonal rivers (El-Gash, Atbara, etc) and principal wadis and khors (valleys) in semi-arid territories. The Doum palm, though not a timber-producing tree, has notable economic value to rural communities. A button-producing industry dependent on the fruits of Doum (vegetable ivory) was initiated in Sudan, but new synthetic materials undermined this industry. The efficacy of germination and saplings growth sustain the survival of Doum growths against negative impacts of rainfall variations and hence availability of water in *khors* and *wadis*.

To these land-based woodlands we may add mangrove formations (mostly Avicennia and in a few localities Rhizophora) along the coastal littoral of the Red Sea. Surveys show 19 sites of mangrove with a total area of nearly 4,200 ha.

Forest management in Sudan, and in other African countries, relates to the management of nature reserves and national parks, and establishes links between forest management and the management of nature reserves (plant and animal biodiversity conservation. In Sudan there are 3,225 conservation sites, with a total area of 11.9 million ha. Nature reserves in forest areas are sites of tourist attraction, notable are the Dinder National Park in the east and Random Park in southern Darfur. There are several reserves in the south that were subject to deterioration during the long years of unrest; these will hopefully regain their status in years of peace.

The growth of the gum Arabic producing trees (Acacia Senegal) has a notable place in the economy of Sudan. The gum Arabic belt extends in Africa south of the Sahara from the Atlantic to the Red Sea, between latitudes 10° and 14° N.; in Sudan this belt covers one fifth of its area. Acacia Senegal plantations in sand territories of the west (Darfur and Kordofan) represent the main gum Arabic producing areas. Sudan used to command the main share (nearly 80%) of the world production until the early 1990s, but desertification in Sudan damaged this belt and dropped the Sudan share of world production to 50% (World Bank 2007). Plans to rehabilitate this gum Arabic belt aim at combating desertification and recapturing Sudan's previous position of gum Arabic production in the world market.

to the formulation and implementation of plans and programmes for combating desertification.

Success can be achieved within the frame of national policies that make the combating of desertification an integral part of national endeavours to develop natural resources sustainably as outlined in Agenda 21 (1992) and the outcomes of the UN Summit on Sustainable Development (2002). Every country is invited to set a national plan to combat desertification and to manage incidents of drought. Such a plan should be part of the national plans for sustainable development of land and water resources and for the conservation of ecosystems producing renewable resources (croplands, rangelands, woodlands and fisheries).

Sustainable development that is the framework within which land degradation (including desertification) is mitigated depends on the integration of three processes:

1- Economic and technological efficiency, which requires the support of institutes of research and development and economic assessment;
2- Social equity that does not allow the deprivation of the marginalized, and that ensures positive public participation;
3- Conservation of the environment, both in terms as a human habitat, and as a depot of natural resources.

To set and to implement national policies for sustainable development (combating of desertification is one element) requires the collaboration of various government sectors, non-governmental organizations concerned, and research institutions. The Arab region has several international research centres concerned with land resources (The Arab Centre for the Studies of Arid Lands and Dryland – ACSAD, Damascus, and the International Centre for Agriculture Research in Dry Areas – ICARDA, Aleppo). In all Arab countries there are centres of desert research or university units of research on dryland problems. The potentials of these scientific institutions are yet to be effectively utilized to provide sound bases for regional and national development schemes. We note and welcome the initiatives in Saudi Arabia and Qatar to establish funds for supporting research; it is hoped that these institutions will include programmes for sustainable development of land and water resources in their priority areas.

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Waste Management

Nefisa Abou-Elseoud

I. INTRODUCTION

All types of human activity produce diverse residues called "wastes," and these differ in terms of quantity and quality and in their properties from one country to another. Waste treatment methods also vary according to the circumstances and capabilities of respective countries. In this chapter, we intend to bring to attention the waste issue in Arab countries by highlighting quality, quantity and efforts made to address it according to available information and data.

II. IDENTIFICATION AND CLASSIFICATION

Waste in the general sense of the word is whatever is left behind from any activity and has no primary or secondary use at source, though it might be of value if present in a different site where more suitable conditions are provided for ample utilization.

This concept underlines three important points, namely:

- Wastes are not found in nature but are generated from various activities, such as domestic, industrial, agricultural and others;
- Some wastes could be of no consequence and must be disposed of because there is no chance of putting them to use;
- Wastes could be cost-effective resources, as they might contain components that can be appropriately used if the right means are employed.

Wastes can be classified according to their original condition or source of generation or magnitude of hazard.

Classification of wastes according to their nature

Wastes are classified into two types according to their nature: solid and liquid waste.

- **Solid wastes** are the solid or semi-solid substances left behind from ordinary human day-to-day and other activities and are disposed of at source as residues of no value, because they are not considered to be worth keeping. They could, however, be of benefit in a different site or under different circumstances, where more adequate conditions are likely to be provided, which would allow reuse or recycling processes (EEAA, 2000; EEAA, 2001).

- **Liquid wastes** are the remains of daily activities in liquid form, such as wastewater, industrial effluents and agricultural drainage. Sediments

TABLE 1 QUANTITY OF SOLID WASTE AS PER ITS SOURCE IN SOME ARAB COUNTRIES [1]

Source of Waste	Egypt Million tons/year [2]	Kuwait 1,000 tons/year	Bahrain 1,000 tons/year [2]	Qatar 1,000 tons/year	Emirates 1,000 tons/year
Municipal (domestic)	15-16	905	680	563	2,120
Demolition and construction	3-4	1,149	-	782	3,631
Industrial	4.5-5.0	7	140	64	95
Agricultural	25-30	-	-	-	615
Sludge	1.5-2.0	-	-	-	-
Health Care	0.10-0.12	33	911	450	-
Dredging of canals and drains	20	-	-	-	-

Sources: 1. GCC 2004 ; 2. 2005 data, Egypt Ministry of State for Environmental Affairs 2006

known as sludge resulting from sanitary wastewater and industrial effluent treatment processes constitute the solid strand of these liquid wastes.

Generally speaking, residues contain manifold types of materials, with some having harmful or rather serious bearing, directly or indirectly, on sanitation, environment and national economy. These are called hazardous wastes.

Segregation of solid wastes according to the source of generation

1- Municipal solid waste or "garbage" comes from residential units, alongside commercial, service, educational and health facilities, streets, gardens, markets, hotels, and recreational places. It also covers waste of small factories and camps.
2- Industrial solid waste resulting from medium and large-scale industrial activities containing hazardous ingredients, such as chemicals and heavy metals.
3- Construction and demolition as well as road building debris which include numerous components that can, for example, be appropriately recycled for utilization in building and construction works.
4- Health care waste from hospitals, health service units such as dispensaries, polyclinics, medical centres, pharmaceutical laboratories and veterinary units, which produce both household-like waste and high-risk waste.
5- Residues of wastewater and industrial effluent treatment processes as well as sludge of sewage pits and sampling tanks, which also contain high percentage of organic matter, pollutants and infectious organisms.
6- Wastes from dredging canals and drains in the form of plant and animal residues (for example grass and dead birds) and also black mud. These wastes can be re-used if they do not contain hazardous substances.
7- Agricultural waste resulting from various farming activities, including:
   - Agricultural crop remains, suitable for recycling and the production of energy, or animal feed and fertilizers.
   - Pesticides residues and agricultural fertilizers, which are regarded as hazardous waste, and thus require safer methods of handling.
   - Animal manure and sludge of sewage pits and sanitary wastewater tanks.

III. NON-HAZARDOUS WASTE

Quantities and Rates of Non-Hazardous Wastes

While statistics and data on quantities of solid waste in most Arab countries are not available, Table 1 shows the quantity of solid waste in some countries, according to published data and information collected from local sources.

There is no definitive or common rate for all Arab countries at which wastes are generated, as this differs from one country to another and among different regions within the same country, according to community characteristics, social conditions and average income in each area. Quantities of generated waste are mainly correlated to population increases as well as economic, industrial and urban development.

TABLE 2 RATES AND QUANTITIES OF MUNICIPAL SOLID WASTE IN SOME ARAB COUNTRIES

Country	Population-2006 (approximately) [1] (x1000)	Average Rate of Generated Municipal Solid Waste kg/per capita/day	Estimated Gross Quantity of Municipal Solid Waste ton/Year (millions) [6]
Total Arab Countries	318,321	Approximately 0.7	81.300
Egypt	71,348	0.63 [2]	16.400
UAE	4,229	1.20 [3]	1.850
Bahrain	746	2.70 [5]	0.735
Saudi Arabia	23,678	1.40 [3]	12.100
Oman	2,577 **	0.70 [3]	0.658
Qatar	838	1.30 [3]	0.398
Kuwait	3,052	1.40 [3]	1.560
Yemen	22,650	0.45 [4]	3.720
Jordan	5,600	0.90 [4]	1.840
Morocco	31,567	0.33 [4]	3.800
Syria	18,701	0.50 [4]	3.410
Tunisia	10,131	0.60 [4]	2.220
Sudan	36,297	0.60 *	7.950
Iraq	28,808	0.87	9.150
Lebanon	3,917	0.60	0.858
Mauritania	3,054	0.90	1.004

Source:
1. LAS 2007;
2. Egypt Ministry of State for Environmental Affairs 2006, 2007;
3. GCC 2004;
4. Al Yousfi;
5. Egypt Environmental Affairs Association 2007;
6. Calculated using population and average waste generation rates
* Only the city of Khartoum
** Year 2003

With regard to solid municipal waste, the gross generated quantity from Arab countries is estimated at 81.3 million tons annually on the basis of an average rate of around 0.7 kg per capita daily. Table 2 shows the average rate and quantity of solid municipal waste produced in some Arab countries, based on population figures, according to available data. The quantity of municipal solid waste which is adequately treated is less than 20%, while recycled waste does not exceed 5% of the gross quantity of residues.

Components of Municipal Solid Waste

Municipal solid waste is comprised of a relatively high percentage of organic matter, while other materials such as paper, glass, plastics and minerals are less organic. Table 3 shows that the proportion of organic waste to total waste ranges between 35% in Bahrain and 63% in Jordan.

These wastes also contain some hazardous substances such as drug residues, expired medicines, chemicals, paints, household insecticides and their empty containers, used dry batteries, and electrical and electronic equipment.

Organic components represent a source of compost material intended for the improvement of soil properties, and, if properly sorted and recycled, for the production of electricity from methane gas. The remaining components (paper and glass, for example) are subject to recovery upon proper segregation and reuse processes of manufacturing of similar or different products, which yield revenues as well as economic returns in the form of health benefits. These practices are still very limited in the Arab region.

Efforts by Some Arab Countries in Solid Waste Management

Some Arab countries have pursued an integrated waste management strategy, namely handling waste as recoverable resources through a series of integrated interrelated links involving successive stages (birth-to-death life cycle), starting with at-source generation (where waste is reduced quan-

titatively, qualitatively and hazard-wise), followed by in-house storage and later multi-source amassing and transport to suitable sites for phased stockpiling or treatment. This strategy develops the possibility of recycling recoverable materials and the environmentally safe final disposal. However, problems still persist in respect of making this system operational. Efforts in this regard can be highlighted as follows:

Gulf Cooperation Council (GCC)

The GCC member countries devised a uniform waste management system that was adopted in December 1997 to codify waste treatment (whether domestic, commercial or industrial, inactive or hazardous), curtail its haphazard handling, and put in place a monitoring mechanism for waste production, storage, transport, treatment and disposal by applying techniques inhibiting harmful effects on the health, safety and prosperity of humans and ensuring long and short-term environment protection.

Nonetheless, the rate of solid waste generation in Bahrain was raised from around 1.3-1.6 kg to almost 2.7 kg per capita/day as a result of growing family income, increased purchasing power alongside flourishing urban and trade businesses. Bahrain's Environment Protection Law includes articles on waste, and waste management is undertaken by the Ministry of Municipality Affairs and Agriculture together with a 50-50 private sector partnership. These wastes are disposed of by land filling, which does not seem to be the optimal way of doing it as far as Bahrain is concerned, bearing in mind the shortage of land for this purpose, in addition to social problems and others related to environment, development and operation. At present, waste sorting and recycling processes are being implemented regarding for example paper, carton, minerals, plastic and tires, with some of these materials exported after being compressed to scale down their size (GCC, 2004).

Sudan

The solid waste situation in Sudan is not much different from that in other Arab countries with similar circumstances. For example, in Khartoum Governorate (with a population of approximately 5 million), the solid waste generated ranges between 0.6 and 1 kg per capita/day (totalling 3,200 tons). Only 35% of this quantity is transferred to landfills, while the remaining 65% is disposed of in open dumps. Foremost among the problems facing solid waste management in Sudan are the following:

- Absence of solid waste management strategies;
- Limited financial resources coupled with outdated machines and equipment, poor maintenance operations, and low wages;

TABLE 3 **COMPONENTS OF SOLID MUNICIPAL WASTE IN SOME ARAB COUNTRIES**

Country	Organic materials %	Paper %	Plastic %	Mineral %	Glass %	Wood %	Textile %	Others %	Total %
Egypt[1]	50-60	10-25	3-12	1.5-7.0	1.0-5.0		1.2-7.0	11.0-30.0	100
Bahrain[2]	35	28	6	12	5		8	6	100
Saudi Arabia[3]	37	28.5	5.2	8.3	4.6	8	6.4	2	100
Oman[2]	40	26	12	11	5		6		100
Qatar[2]	45	18	15	4	10	5	3		100
Kuwait[2]	50	20	12.6	2.6	3.3	4.8	4.8	1.9	100
Yemen[3]	55	14	13	2	1.5			14.5	100
Jordan[3]	63	11	16.8	2.1	2.1			5	100
Syria[3]	62	4	7	6	4			17	100
Iraq[3]	63	1	1	1.1	1.6			32.3	100
Lebanon[3]	58	18	8	2.4	8			6.6	100
Dubai[3]	42	6	10	3	3			16	100
Abu Dhabi[3]	49	6	12	6	9			18	100

Sources:
1. Egyptian Ministry of State for Environmental Affairs 2006;
2. GCC 2004;
3. Al Yousfi

- Meagre basic infrastructure, low-level efficiency of existing systems, degraded road conditions and deficiency of land-use planning to identify final disposal sites;
- Non-governmental organizations are short of sufficient resources and are in need of subsidies to strengthen their partnership with the government in envisaging policies on solid waste management (El Sayed, 2006).

Tunisia

Dealing with the solid waste issue, and tackling the problem of increasing quantities accumulated as a result of production and consumption patterns in the country, can only materialize through the adoption of an integrated waste management concept.

The common method of solid waste disposal in Tunisia is uncontrolled land filling sites designated for waste disposal, considered as temporary sites, to be gradually changed into controlled dumpsites. The problem of accumulated waste with its impacts on environment is one that the Tunisian government has so far failed to resolve notwithstanding the fact that Tunisia was the first Arab country to promulgate a special law on waste (GCC, 2004).

Egypt

Gross solid municipal waste generated daily is estimated at approximately 44,630 tons with a general average of 0.63 kg per capita/day (ranging between 0.2-0.35 in rural areas and 0.4-1.3 in urban areas). These wastes include organic matter, paper, plastic, etc, with relative density amounting to almost 0.3 ton/cubic meter and humidity percentage reaching 30% to 40%, whereas the thermal content is proportionally low.

The general average of waste collection efficiency is put at almost 65%; i.e. 35%, or nearly 15.6 thousand tons, are not systematically collected on a daily basis. In Egypt, the Environment Protection Law contains articles on waste. In July 2000, the national strategy for solid municipal waste management was released and a national program was developed to encompass 13 integrated projects.

The state adopted thermal and biological treatment methods but favoured bio-treatment by composting with recyclables recovery, which proved effective since 1995 as regards expanded manufacture of waste by converting it into compost materials. The number of plants designed and established in Egypt was 66 in 2005, the capacity of each amounting to 10 tons/hour, thus possibly recycling nearly 22% of the aggregate generated municipal waste daily if these plants were fully operated; unfortunately, some of them struggled with sustained administrative problems.

The remaining wastes or treatment process residues are disposed of either in controlled or informal landfills. The state therefore headed for phased transformation into sanitary dumping in appropriate sites. 52 sites were already selected and designated in conformity with environment protection and human health standards, of which 4 were established and made functional and the rest, due to various problems and obstacles, are yet to be completed (Egyptian Ministry of State for Environmental Affairs, 2006, 2007).

Yemen

With reference to the incredible increases in solid waste quantities in Yemen, legislation was issued in 1999 on establishing the Municipal Cleaning Fund that provided for three underlying strategies:

decentralization, cost recovery and private sector participation in waste management. In 2000, the Sanaa Institution was incorporated into Yemen's waste management efforts. Besides sorting waste, it undertook segregating and amassing components not subject to decay and exporting some of it to such countries as India, China, Lebanon, Greece, Saudi Arabia and UAE, for recycling. Thus it can be said that amounts transformed into compost materials were increased, and consequently revenues were earned and environmental benefits accrued. Moreover, part of the recyclable components is sold to agents whereas non-recyclables are once again returned to the dumpsite.

Jordan

In Jordan, no national strategy for solid waste management has been drafted. The average rate of solid municipal waste surge is estimated at around 0.77 kg per capita daily, most of which is collected and transported to a systematically regulated dumpsite. In addition to recycling operations carried out at the informal sector level, initiatives for utilizing organic waste for bio-gas production were launched.

Table 4 shows the percentage of treated solid municipal waste and different ways of their disposal in some Arab countries based on limited data made available in recent years (Metap RSWMP, 2004).

Table 4 shows low treatment and recycling rates in general, and the reliance on disposal in open dumps or landfills.

IV. HAZARDOUS WASTE

The term "hazardous waste" is used as an indication of all residues representing hazard in connection with human health and environment upon use, storage, treatment or disposal. This is due to their characteristics, quantities and concentrations, thereby demanding special procedures for their circulation and disposal (Center for Curbing Environmental Risks, Cairo University, 2006).

TABLE 4 PERCENTAGES OF SOLID WASTE TREATMENT AND RECYCLING IN SOME ARAB COUNTRIES

Item/Country	Syria	Lebanon	Egypt	Jordan	Palestine	Tunisia
Quantity						
Million tons annually	3.65-5.50	1.4	15.3 (2001)	1.46	1.1 (2001)	1.8
Surge Rate						
Countryside	0.20-0.40	0.5-0.7		0.65		0.2
Urban areas	0.40-0.50	0.75-1.1		0.7-0.850		0.8
Collection processes %						
Rural areas	Unspecified	95.0	General Average	95.00	General Average	90.0
Urban areas	80.00	100.0	65.0	95.00	75	95.0
Treatment						
Transformation into compost materials %	Less than 5.00	80.0	Less than 22.0			4.0
Re-cycling %	Less than 15.00	8.0				5.0
Final disposal						
Land filling %	Less than 25.00	46.0		85.00		50.0
Open dumps %	Over 60.00	38.0		15.00		44.6
Generated Waste						
Annual increase	2.50-3.50	6.5 (Beirut)	3.4	3.00	4	2.0

TABLE 5 ESTIMATION OF HAZARDOUS WASTE QUANTITY ON GDP BASIS

State	World Bank Classification	GDP estimates for 2006 (in $ million)	Waste Hazard Coefficient Ton/$billion	Estimates of hazardous waste quantity (Around 1000 tons)
Egypt	Medium-Low	107,378	2,000	214
Saudi Arabia	High	348,673	Over 2,000	Over 697
UAE	High	164,865	Over 2,000	Over 329
Kuwait	High	101,904	Over 2,000	Over 203
Bahrain	High	15,828	Over 2,000	Over 31
Oman	Medium-High	35,656	2,000	71
Qatar	High	52,722	Over 2,000	Over 105
Yemen	Low	21,196	1,000	21
Jordan	Medium-Low	14,258	2,000	28
Morocco	Medium-Low	65,899	2,000	132
Syria	Medium-Low	34,190	2,000	68
Tunisia	Medium-Low	31,416	2,000	63
Lebanon	Medium-High	23,285	2,000	46
Sudan	Low	43,894	1,000	44
Mauritania	Low	2,713	1,000	3

Source: World Bank 2007

The US Environment Protection Agency, the European Waste Catalogue, the Canadian Environment Protection Law, the Basel Convention On the Control of Transboundary Movements of Hazardous Waste, and many national environment laws of Arab countries have set out definitions of hazardous waste under which hazard-incurring attributes apply when the wastes are flammable, corrosive, effective, oxidizing, irritating (non-erosive), toxic, harmful, distorting, cancroid or contagious, not to mention the quality of post-final disposal potential transformation and generation of toxic gases.

Hazardous Waste Sources

Hazardous wastes are generated from activities such as:

- Heavy industries, as well as medium industries: these produce the bulk of hazardous waste in most Arab countries.
- Agricultural activities: expired or invalid fertilizers and pesticides and their empty packs.
- Oil-related activities: numerous hazardous wastes result from oil drilling, refining, transportation and utilization.
- Therapeutic and health-care activities: waste generated from hospitals, health treatment units, private clinics, pharmacies and drug stores.
- Research and lab activities: examples are expired chemicals and interaction residues.
- Service activities: sanitary wastewater stations, car-service stations, photograph laboratories, printing houses and dry-cleaning shops.
- Military operations: massive quantities of hazardous waste are generated, mainly from land and marine mines and expired ammunition, and lately from depleted uranium.
- Garbage and municipal waste: garbage contains some hazardous waste of such materials as expired medicines, chemicals, paints, insecticides and their empty containers, consumed dry batteries, and electrical and electronic equipment. Slaughter house wastes include dead animals or infectious parts or remains of animals, amounting to sanitation hazard.
- Illicit trafficking in hazardous waste: some countries face attempts by other countries to export hazardous waste into their territories under the cover of recycling or reuse.

Many activities commonly engender hazardous wastes which are not confined to just one activity, such as:

- Residues of electric and electronic equipment such as computers- televisions, telephone sets, photocopiers, fax machines, and recorders.
- Oil-related waste (machine oils – brake and motor oils).
- Expired or non-conforming chemical substances.
- Chemicals and pesticides' empty packs.

- Used batteries and car tires.
- Equipment not suitable for use, with components containing asbestos or PCB or CFC.

Hazardous Waste Quantities

One main determinant for sound hazardous waste management rests with the insufficiency of available updated data relating to relevant quantities from different sources. A report issued in 2004 (GCC, 2004) put forward the following estimates of hazardous waste quantities in some Gulf Cooperation Council member states during the second half of the 1990s:

Bahrain	95,000 tons/year
Saudi Arabia	220,000 tons/year
Oman	81,000 tons/year
Qatar	75,000 tons/year
Kuwait	120,000 tons/year

To determine the quantity of hazardous waste, surveys and statistical studies need to be conducted. There are methods that can be applied to estimate quantities of hazardous waste including reference to universally acknowledged standards.

- By applying coefficients for weak hazardous waste according to WHO lists for 1993.
- By conforming to standards of the US Environment Protection Agency (EPA).

Applying the GDP method (see box 1), the gross domestic product of all Arab countries in 2006 can be estimated at approximately $1,276,282 million. Taking into account progress and development scales depending not only on income levels but also on other criteria related to education, training, scientific research, trade movement and others, Arab countries are categorized as developing countries, some in the development stage characterized by variant incomes. Therefore it can be said that the aggregate quantity of hazardous waste is estimated between 1,276 and 2,552 thousand tons from Arab countries combined, i.e. between 1.6 and 3.2% of the gross quantity of solid municipal waste. Based on the World Bank country classification according to average per capita estimates of 2005, the quantity of hazardous waste is calculated at over 3,055 thousand tons, or nearly 4% of the aggregate quantity of solid municipal waste as shown in Table 5. Given the unavoidable inaccuracy of these estimates, more effort is needed to determine the exact quantities which can then become the basis from which to embark on sound planning for its safe handling.

Estimates of the quantity of specific types of hazardous waste (such as health-care residues)

The quantity of health-care waste in some Arab countries is estimated as follows:

UAE	2,739 ton/year
Oman	2,112 ton/year
Bahrain	755 ton/year
Qatar	516 ton/year
Saudi Arabia	18,860 ton/year
Kuwait	2,038 ton/year
Lebanon	5,568 ton/year
Morocco	10,605 ton/year
Syria	9,750 ton/year

Despite the inaccuracy of hazardous waste estimates in general, there is obvious disparity in health-care waste quantity compared to gross hazardous waste, with a percentage ranging between less than 1% (for Qatar and Bahrain) and 8.6% (for Saudi Arabia), thus corroborating the significance of regularly updating data and scrutinizing existing data for inconsistencies.

Egypt

The total health-care waste is estimated at approximately 390,901 kg/day including around 109,514 kg/day as hazardous (about 28%) generated from 165,138 beds in health care facilities around the country; therefore the average output of such waste can be perceived as:

2.37 kg/bed/day	gross waste
0.66 kg/bed/day	hazardous waste

GLOBAL ESTIMATES OF HAZARDOUS WASTES ON GDP BASIS

For developing countries	**1,000** ton/$billion
For countries in the development stage	**2,000** ton/$billion

Yemen

A sample-based study in 2002, which covered 49 health facilities in Yemen, revealed that the generation rate of related waste ranged between 1–2.1 kg/bed/day, 0.58 of which were hazardous.

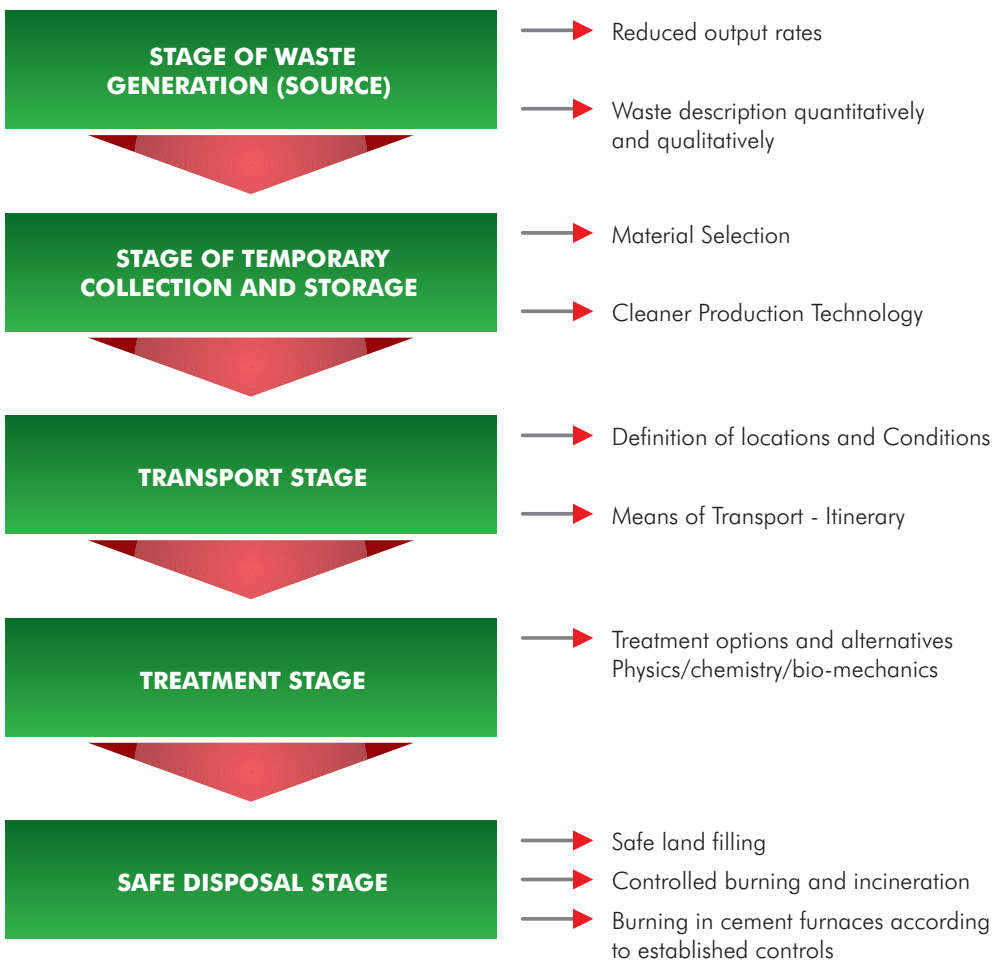
Hazardous Waste Management

The following diagram shows stages of hazardous waste management from generation to final disposal.

Handling these wastes differs from one country to another according to conditions and capabilities with regard to meeting the requirements of the full-fledged system. Given limited data and information, it becomes difficult to identify the management efficiency level as far as Arab countries are concerned; however some important deliverables are outlined to this effect:

- In GCC member countries, a unified system for health-care waste management was set and adopted in April 2001.
- Bahrain established a law on environment with articles dealing with hazardous waste focusing on the concept of at-source reduction and segregation by applying cleaner production techniques. A special site is designated for final disposal.
- Saudi Arabia developed relevant standards and guidelines.
- Oman issued a law and a statute on management, and furnished some equipped sites in addition to temporary storage of some of these wastes and burning in special incinerators of medical waste.

FIGURE 1 STAGES OF HAZARDOUS WASTE MANAGEMENT SINCE GENERATION



- Kuwait elaborated a law and set standards for environment protection while using burning and incineration plus land filling (sterilization of medical waste).
- Qatar has special incinerators for medical wastes.
- Tunisia provided a special site for hazardous waste treatment.
- Egypt developed a law on hazardous wastes, also a strategy and work program for healthcare waste. It laid down relevant rules, controls and guidelines, adopted life-cycle, cleaner production and at-source reduction concepts and used burning, incineration and disposal in cement furnaces and waste landfills.

V. ELECTRICAL AND ELECTRONIC WASTE (EEW)

Electrical and electronic waste is what remains from the production and use of electrical and electronic equipment, their parts and inputs, including:

- Manufacturing processes and production waste, such as plastic, glass and mineral materials, rubber and the like, in addition to oils, lubricants and inks which all contain heavy metals such as lead, cadmium, chrome, nickel and zinc, as well as precious elements (such as gold and silver).
- Waste resulting from operational processes, which include:
  - Inputs of operating electrical and electronic equipment such as batteries, charging cards, magnetic tapes, printing inks and used oils;
  - Expired equipment;
  - Equipment or parts thereof that were irreparably damaged, broken or became dysfunctional and no longer fit for use.
- Outdated equipment or parts thereof, namely all electrical and electronic equipment, their attachments and operational inputs are considered wastes if proved unfit or unable to cope with technological advancement and modern requirements (Abu El Saud, 2004).

Quantity and Components of Electrical and Electronic Equipment

Available data reveals that electronic and electrical wastes represent a small percentage of the aggregate waste generated in any country. For example, this type of waste in the European Union member states accounts for 1% of the total generated waste (European Parliament, 1998), while in the US it ranges between 2% and 5% of the gross quantity of solid municipal waste, and is increasing by 3% to 5% annually. Assuming an average rate of around 3%, the quantities of electrical and electronic residues of Arab countries can be estimated as shown in Table 6.

A 2004 report by the Department of Environmental Health in the State of California (California IWMB, 2004) indicated that electronic equipment waste includes more than 1,000 substances in varying, mixed or blended quantities regarding different ingredients of equipment, some are hazardous and others are of value for possibly being regarded as recyclables. Some examples are:

- Lead which is found in glass screens of TV sets and computer monitors;
- Plastic materials and heavy metals in printed circuit boards;
- Batteries containing nickel, chrome, and other heavy metals;
- Hazardous polychlorinated substance (PCBs) found in condensers.
- Brominated flame retardants;
- Mercury found in medical apparatuses and cellular phones;
- Plus gold and silver, being precious elements seen as a source of economic value on account of their potential recovery.

The same report states that each computer contains 3.7 pounds of lead, 11.4 pounds of plastic, 0.006 pounds of cadmium and 0.001 pounds of mercury. These figures have been used to estimate quantities of various substances available in computers used across the Arab countries (Table 6). Until now, used or obsolete computers and other electronic and electrical equipment end up in dumps, while they should be segregated to reuse some components, recycle others, and properly dispose of hazardous contents. Still, a limited portion is recycled or reused, largely on selective basis and through private initiatives.

It must be recognized that with electronics continuously advancing and in view of increased dependence thereon, it is certain that for the few coming years, much equipment and accessories will be generated as waste requiring safe disposal.

TABLE 6 QUANTITY AND CONTENTS OF ELECTRICAL AND ELECTRONIC EQUIPMENT WASTE

State	No. of cellular phones/100 persons [1]				No of Personal Computers [1]			
	1996 [4]	2004	2005	2006	1996 [5]	2002	2003	2004
Egypt	6.7	10.92	19.10	23.86	337,745	1,120,000	2,000,000	2,300,000
Saudi Arabia		38.21	57.64	78.05		3,300,000	5,045,000	8,476,000
Kuwait		57.16	78.34	88.57		285,000	400,000	450,000
Bahrain		90.77	103.04	121.71		107,000	114,000	121,000
Oman	17.1	31.82	51.94	69.59	24,133	95,000	106,000	118,000
Qatar		66.59	62.15	109.06		110,000	121,000	133,000
Yemen		3.47	5.17	9.54		145,000	200,000	300,000
Jordan		28.93	55.02	74.40		200,000	245,000	300,000
Morocco	20.9	31.24	40.89	52.07	45,642	500,000	600,000	620,000
Syria	2.3	12.87	15.49	23.96	20,538	330,000	500,000	600,000
Tunisia	5.2	37.43	56.32	71.88	60,896	335,325	400,372	472,132
Lebanon	22.7	24.91	27.78	30.53	15,355	300,000	350,000	400,000
Sudan		3.04	5.21	12.66		200,000	348,000	606,000

Sources:
1. ESCWA Report for 2007;
2. Calculated on the basis of 3% of total solid municipal wast;

Efforts made to this end are very limited (according to available data). In Egypt, one of the mobile companies collected consumed batteries of cellular phones from the Egyptian market for recycling in the United Kingdom in collaboration with Phone Back Company. The company also collected fitting parts of photocopiers and printers for reshipping to the mother company abroad (Egyptian Ministry of State for Environmental Affairs, 2007). Etisalat, the UAE based telecommunications giant, has also announced a mobile phone recycling initiative.

Safe Alternatives Regarding Disposal of Electrical and Electronic Equipment

To achieve safe management of these wastes and redress effects related to environment and health of unsystematic disposal processes carried out in solid waste unloading sites or by burning, the optimal approach hinges on the adoption of the "reduction, reuse, recycling and recovery" principle by applying advanced high-tech procedures and activities and clean technology during the manufacturing and production stage, and other means relevant to the post-operation stage. These activities are promoted by a framework of appropriate and supportive legislation based on specific and agreed policies. Figure 2 shows the hierarchical arrangement of this management.

VI. CROSS-BORDER HAZARDOUS WASTE MOVEMENT

Many countries have recourse to the export of hazardous waste to other countries which are able to handle it. Such movement is governed by the Basel Convention which controls the Transboundary Movements of Hazardous Wastes. This Convention was adopted in 1989 and entered into force in 1992.

Under this Convention, members are not authorized to proceed with export and import processes or transnational transfer of hazardous waste except in accordance with controls and procedures articulated in the Convention.

19 Arab countries have ratified this Convention and some of them are in the process of exporting hazardous waste to other state parties. Vessels carrying hazardous waste shipments are allowed by some other countries to cross their borders. Some examples from the Arab region:

- In 1996, Yemen exported 262 tons of expired pesticides to Britain for disposal. Between 1999-2004, around 152,500 tons of expired batteries were exported to Indonesia.

- In 2001, Bahrain exported 761.45 tons of acid lead batteries to Indonesia and about 27 tons of chemical waste to Canada for treatment and disposal.

Estimated quantity of wastes for 2004 (Ton/Year)	Estimated computer contents/2004 (tons) [3] Lead	Plastic	Cadmium	Mercury
480,000	3,860.0	11,889	6.30	1.050
348,000	14,255.0	43,906	22.10	3.700
39,000	757.0	2,331	1.23	0.200
20,400	203.5	627	0.33	0.055
180,000	197.5	611	0.32	0.055
9,065	223.7	689	0.36	0.060
99,600	504.0	1,554	0.82	0.120
54,000	504.0	1,554	0.82	0.120
108,900	1043.0	3,116	1.69	0.280
96,000	1009.0	3,108	1.64	0.270
65,100	793.8	2,445	1.29	0.210
25,400	672.7	2,072	1.09	0.180
219,000	1,019.0	3,139	1.65	0.270

3. Calculated according to components of electronic equipment waste, California IWMB 2004;
4. World Bank – Development Indicators for Africa, 2002;
5. Calculated against the number of population and world development indicators – World Bank 1988-2002

- In 1996, Tunisia exported batteries containing cadmium and lead to some EU countries. In 2001, 65 tons of electric transformers containing poly-chloro bi-vinyl compounds were exported to a private establishment in France.

- In the Sultanate of Oman, used oils are exported.

Egypt permits navigation across the Suez Canal of ships carrying hazardous waste for purposes of recycling, reuse or final disposal in compliance with respective national conditions in addition to provisions set forth in relevant international conventions. Saudi Arabia is set to operate observation and control systems applicable to crossing and anchored ships in ports.

VII. LIQUID WASTE

Liquid waste is the wastewater resulting from using water for different purposes.

Quality and Quantity

- Agricultural Wastewater: These are liquids resulting from water used in irrigation. Irrigation and agriculture water accounts for the main percentage of water utilized in most Arab countries. Moreover, agricultural wastewater drainage differs in percentage according to type of crops, technology applied and climate condition, ranging between 30% and 90%.

- Industrial Effluents: These are liquids resulting from water consumed or used in major industrial activities. A report indicated that only 5% of the water used in industry is consumed and unrecoverable. These liquids include organic pollutants and chemical substances posing, in most cases, environmental and health risks.

TABLE 7 WASTEWATER IN SELECTED ARAB COUNTRIES

State	Wastewater Estimates Million m^3/year
Algeria	1,069
Egypt	4,394
Jordan	171
Kuwait	160
Lebanon	362
Libya	308
Morocco	817
Oman	76
Saudi Arabia	1,546
Syria	479
Tunisia	349
UAE	424
Yemen	212

Source: Estimated at 80% of domestic consumption, EarthTrends 2005

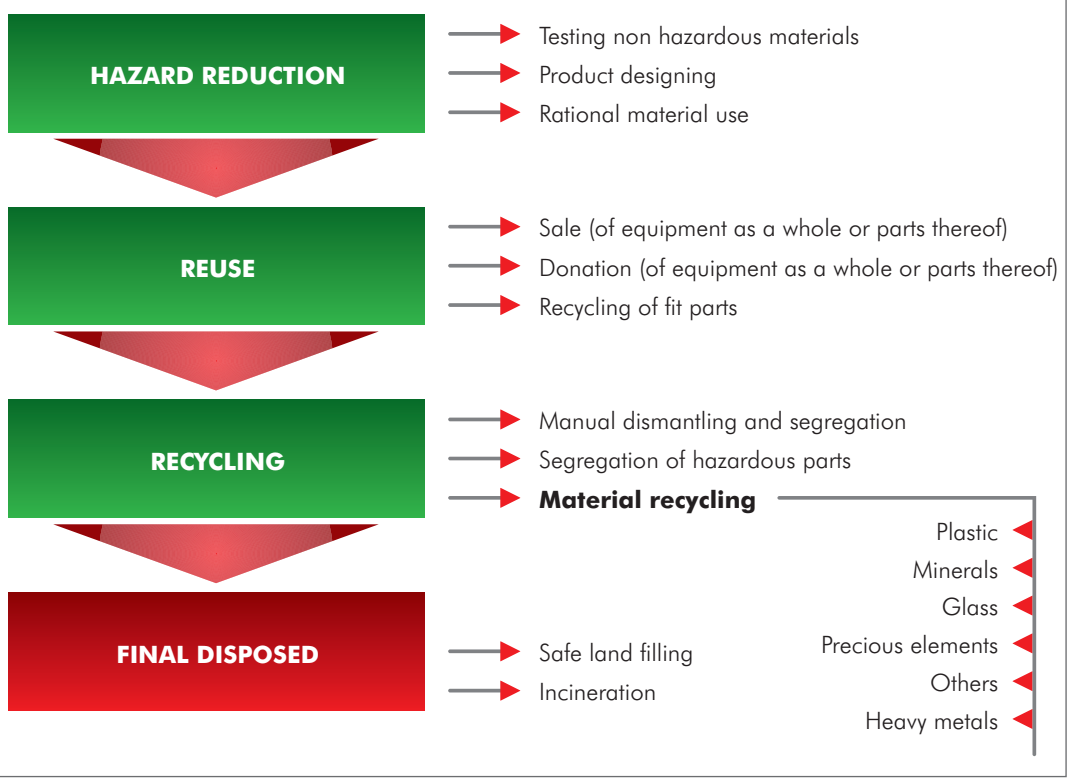
- Drainage/Sewage: This results from using water in domestic, commercial and other municipal purposes. Though constituting the smallest percentage of water utilization, it is normally pathogen-bearing water that may cause illnesses, in addition to hazardous chemical substances, especially if mixed with industrial effluents. Wastewater is responsible for almost 80%-90% of water consumption in household activities.

Table 7 shows estimates of wastewater generated and industrial effluent contamination levels in Arab countries for 2000. Table 8 indicates quantities of recoverable treated wastewater.

Methods of handling liquid waste

Methods of handling wastewater differ from one country to another. However, in view of

FIGURE 2 HIERARCHICAL ALIGNMENT OF ELECTRICAL AND ELECTRONIC EQUIPMENT WASTE TREATMENT AND DISPOSAL



the limited water resources available, it is generally required that this water is reused, directly or indirectly, according to environment protection and sanitation standards. Many Arab countries have issued codes and controls for the use of wastewater, but reuse levels remained limited.

In Egypt, and within the framework of synergy of ministries of environment, housing and agriculture together with private sector participation, part of the treated sanitary wastewater is utilized in afforestation and cultivation of wood trees to partly absorb environment-polluting gases (especially carbon dioxide), provide job opportunities and yield returns. Up till 2005, 11,195 acres were cultivated consuming around 492,000 cubic meters daily of treated sanitary wastewater (about 0.01% of its gross quantity). In 2006, the basic infrastructure for cultivating a further 890 acres was finalized and this activity is planned to be continued.

Abu Dhabi and Dubai use most of the treated wastewater in irrigation, mainly for landscaping purposes. Although 60% of the wastewater generated in Kuwait is treated by advanced reverse-osmosis process, making it safe for any type of use, certain taboos still restrict full utilization.

TABLE 8 REUSABLE TREATED WASTEWATER

Country	Volume of reusable treated wastewater (million cubic meter/year)	Percentage of wastewater %
Egypt	200.00	4.60
Jordan	65.00	38.00
Kuwait	52.00	32.50
Lebanon	2.00	0.55
Oman	9.00	11.80
Qatar	0.13	
Saudi Arabia	122.60	7.90
Syria	550.00	
Yemen	185.30	87.40

Source: UN Economic and Social Commission for West Asia (ESCWA) 2005

VIII. CONCLUSION

Some Arab countries have embarked on the application of an integrated environment management approach towards waste, and demonstrated deliverables especially with regard to non-hazardous waste. However, the Arab countries are still faced with numerous challenges embodied in:

- Lack of surveys, statistics and consequently data and information on hazardous waste in particular;
- Lack of enforcement of environmental legislation;
- Limited technical infrastructure, plans and strategies;
- Insufficient financial resources;
- Low-level of awareness;
- Incomplete institutional structure and limited participation of non-governmental organizations.

Subsequently, it is worth noting that in the best scenario, what is needed is a multi-component integrated system involving full waste life cycle stages starting from waste generation to final disposal, taking into consideration the principle of reducing the consumption, reuse, recycling and recovery. In all processes, the following steps should be duly taken:

- Provide appropriate environmental legislative frameworks and give effect to international conventions regulating them;
- Promote national institutional capacities and coordination with international organizations to control locally-generated hazardous wastes and prevent their illicit trafficking;
- Provide human resources in sufficient numbers, and in terms of appropriate capacity and efficiency, specify their roles and responsibilities at all levels and develop sustained training programs;
- Sensitize entities concerned at all levels and the community in general regarding issues pertaining to waste management;
- Provide necessary funds from different sources and always bear in mind local circumstances;
- Encourage research and development activities to ensure that technologies are adequately provided to curb waste surges and secure their safe handling.

There is widespread acceptance that waste management is a challenge that Arab countries have to address by adopting an integrated approach. A first prerequisite for any such endeavour would be the collection of accurate data, which is still lacking, and mostly based on estimates.

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Impact of Climate Change on Arab Countries

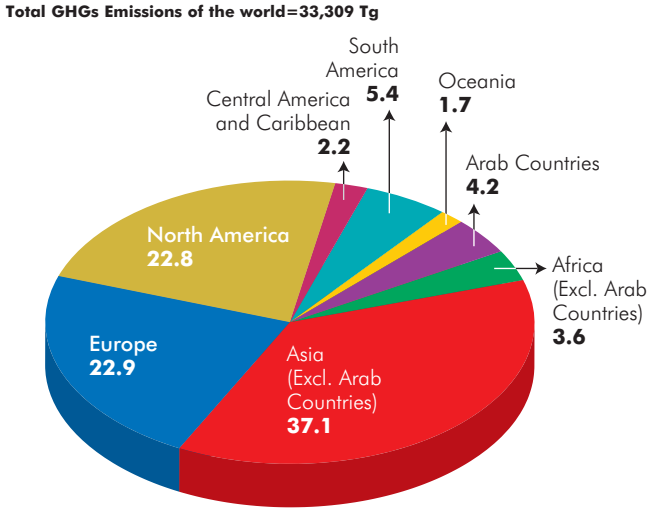
Mahmoud Medany

I. INTRODUCTION

There is a widely-held scientific conviction that the global climate is changing as a result of the combined anthropogenic forcing due to greenhouse gases, aerosols, and land surface changes. Many pieces of evidence have concluded with a high degree of probability that human activities have exerted a substantial net warming influence on climate since 1750 (IPCC, 2007b). Recent climatological studies found that the global surface air temperature increased from 1850 to 2005 by 0.76°C. Moreover, the linear warming trend over the last 50 years is recorded by 0.13°C per decade (IPCC, 2007b). Furthermore, there has been an increase in the number of heat waves, a reduction in the frequency and duration of frosts, and an increase in extreme events frequency and intensity in many parts of the world. Regarding these global trends, the recent studies found that the Arab region experienced an uneven increase in surface air temperature ranging from 0.2 to 2.0°C that occurred from 1970 to 2004 (IPCC, 2007a).

For the next two decades, a warming of about 0.2°C per decade is projected for a range of IPCC SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected (IPCC, 2007b).

FIGURE 1 **REGIONAL DISTRIBUTION OF GHGs EMISSIONS OF YEAR 2000**



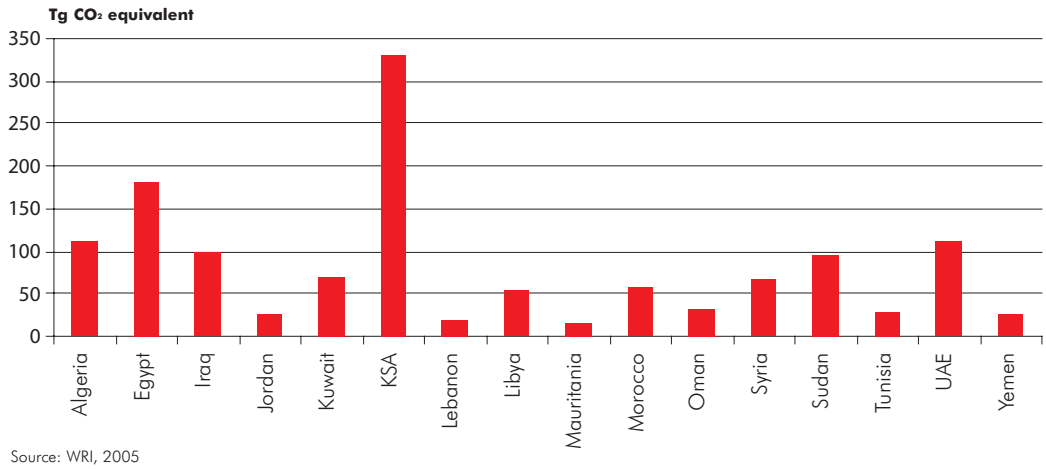
Source: WRI, 2000

Physical and biological ecosystems on all continents and in most oceans have already been affected by recent climate changes (IPCC, 2007a). It is now generally accepted that this climate change is the result of increasing concentrations of carbon dioxide, methane, nitrous oxide and other greenhouse gases (GHGs) in the atmosphere (IPCC, 2001a).

For the year 2000, the statistics showed that the world total GHGs emissions from all resources was about 33 thousand Tg (teragram) (Figure 1), with Arab countries contributing about 4.2% of these total world emissions (WRI, 2005). As presented in Figure 2, the Kingdom of Saudi Arabia (KSA) is contributing the highest percentage of the total GHGs emissions from the Arab countries, followed by Egypt and Algeria (WRI, 2005).

This relatively small contribution of GHGs of all Arab countries does not correspond to the projected impacts of climate change over the region. The Middle East and North Africa region is a vast zone of generally diverse climatic conditions, characterized by very low and highly variable annual rainfall and a high degree of aridity (FAO, 2002b). As shown in Figure 3, most of the Arab region lands are classified as hyper-arid, semi-arid and arid land zones (WRI, 2002). Most recent assessments have concluded that arid and semi-

FIGURE 2 GHGS EMISSIONS OF YEAR 2000 FROM ARAB COUNTRIES



Source: WRI, 2005

arid regions are highly vulnerable to climate change (IPCC, 2007a; see also Chapter 7). Generally, the Arab countries are considered as developing countries and are highly vulnerable to climate change impacts due to their arid climates. If temperatures in the region get higher, or precipitation gets lower, pressure on natural and physical systems would be intensified.

According to modelling studies, the Arab region will face an increase of 2°C to 5.5°C in the surface temperature by the end of the 21st century. This increase will be coupled with a projected decrease in precipitation from 0 to 20%. These projected changes will lead to shorter winters, dryer and hotter summers, a higher rate of heat waves, a higher level of weather variability and a more frequent occurrence of extreme weather events.

The purpose of this chapter is to give a general overview of the studied impacts of the projected climatic changes in the Arab region, in order to address some key points in the way of adaptation and mitigation planning.

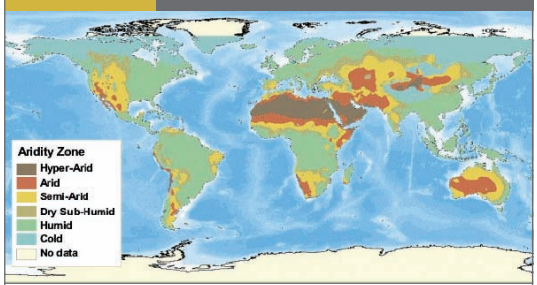
II. THE IMPACT OF SEA-LEVEL RISE

Sea level rise (SLR) is an important consequence of climate change and a serious global threat. It is very likely that 20th century global warming has contributed significantly to the observed sea level rise, through thermal expansion of sea water and widespread loss of land ice (IPCC, 2001b). The rate of the global sea level rise was observed to be 1.8 mm per year through the period of 1961-2003; it should be noted that the observed rate over 1993 to 2003 was markedly higher, at about 3.1 mm per year. The total 20th century rise is estimated to be 0.17 m (IPCC, 2007b).

The available scientific evidence has found that the continued growth of GHG emissions and associated global warming could lead to SLR of 1 to 3m in the 21st century, and an unexpectedly rapid break-up of the Greenland and West Antarctic ice sheets might produce a 5m SLR (IPCC, 2001b). However, there are uncertainties in the estimates of SLR in the longer run (IPCC, 2007b).

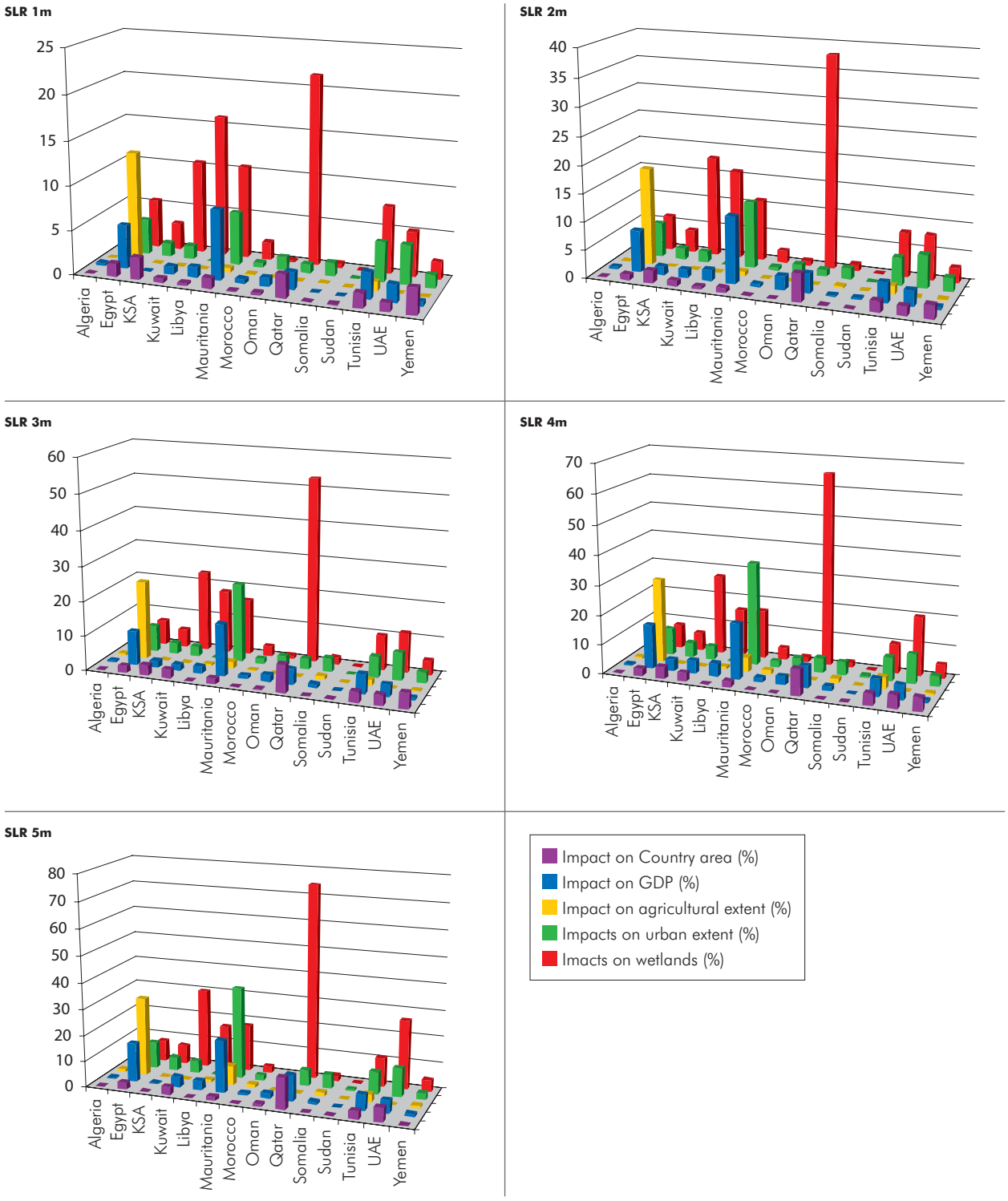
The nature of the impacts of sea level rise will vary from place-to-place and country-to-country. This is due to a variety of factors, depending on local conditions such as elevation of the land and currently occurring geological land subsidence, reflecting that certain settings are more vulnera-

FIGURE 3 ARIDITY ZONES OF THE WORLD



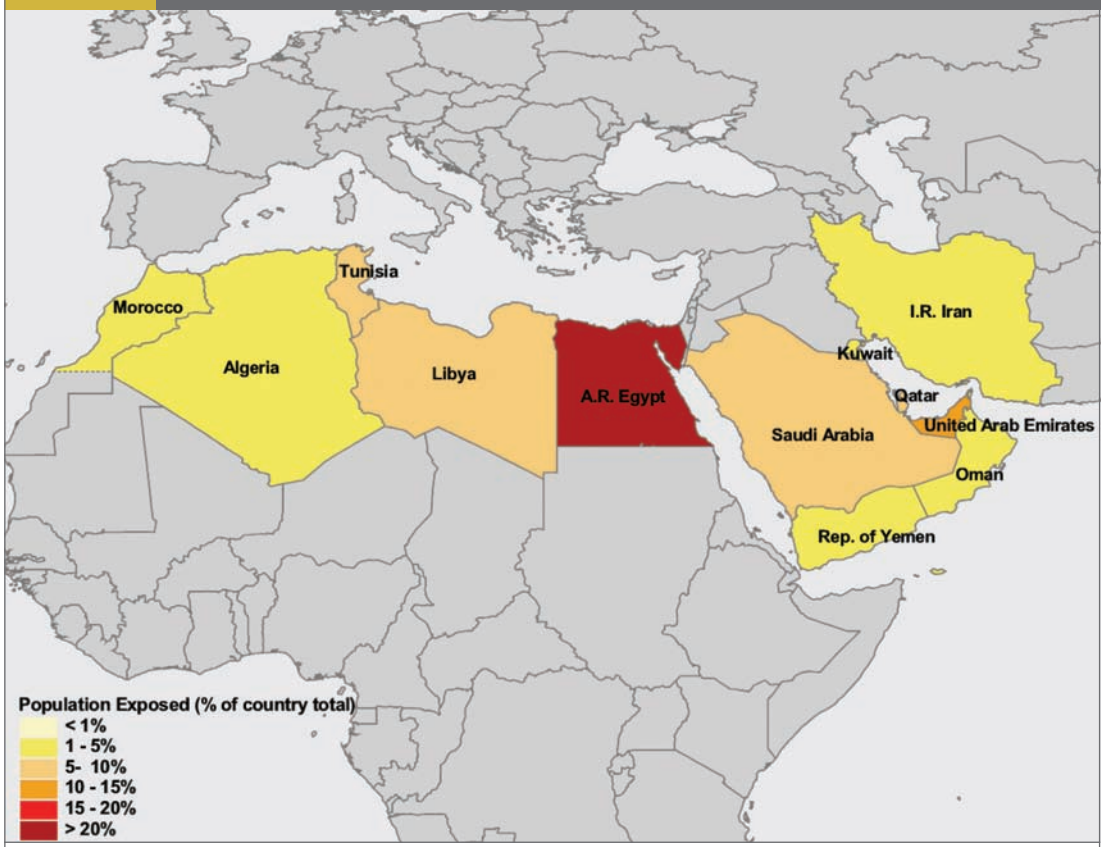
Source: WRI, 2002

FIGURE 4 **THE IMPACT (%) OF SLR ON COUNTRY AREA, GDP, AGRICULTURE EXTENT, URBAN EXTENT, AND WETLANDS EXTENT IN ARAB COUNTRIES, UNDER FIVE SCENARIOS OF SLR OF 1, 2, 3, 4 AND 5M**



Source: Dasgupta et al., 2007

FIGURE 5 **MIDDLE EAST AND NORTH AFRICA REGION, EXPOSED POPULATION TO THE NEGATIVE IMPACTS OF 5M SLR**



Source: Dasgupta et al., 2007

ble than others. Socioeconomic factors, including human response to climate change, are also considered (Neumann et al., 2000). River deltas, low-lying coastal urban areas, and small islands have the highest exposure of key human vulnerabilities to climate change and sea-level rise (Nicholls, 2004).

Egypt is one of the highly vulnerable countries to the impacts of SLR. A 1m SLR would affect 6 million people in Egypt, where under this scenario 12 to 15% of agricultural land in the Nile Delta region would be lost. The high-risk areas in Egypt include parts of Alexandria, Behaira, Port Said, Damietta and the Suez governorate. If no protective measures were to be taken, or a business-as-usual scenario to prevail, the agriculture sector would be severely negatively affected (a loss of over 90% of the total area of the governorates under risk), followed by the industrial sector (loss of 65%), and the tourism sector (loss of 55%) due to SLR of 0.5m.

The impact of SLR on the Arab countries is studied in a recent assessment by the World Bank (Dasgupta *et al.*, 2007). This study examined the impact of SLR, of 1, 2, 3, 4 and 5m, on country area, population, GDP, agricultural extent, urban extent, and wetlands (Figures 4 and 5). The results of the study indicated that Qatar's land area would experience a significant reduction of about 2.6 to 13% due to 1m and 5m rises, respectively. Dasgupta et al. found that with an SLR of 1m, approximately 10% of Egypt's population would be directly impacted, with the strongest impact being in the Nile Delta; it reaches a loss of 20% with a 5m SLR. In the United Arab Emirates and Tunisia, a SLR of 1m would impact about 5% of the population.

The study by Dasgupta et al. also covered the projected impact of SLR on the GDP and agricultural sector, finding that Egypt's GDP would also be significantly impacted by SLR. The study partially attributes this negative impact on

GDP by pointing to the direct impact of SLR on agricultural production in Egypt; in fact, in the Arab region, Egypt's agricultural sector is most vulnerable to SLR. A 1m SLR would impact approximately 12.5% of Egypt's agricultural output, with the percentage rising to 35% with a 5m SLR.

Abd-El Wahab (2005) emphasized that the projected impact of SLR on agricultural lands in Egypt could be intensified by 80 to 120% due to land subsidence and ground water rise. Urban areas of the Arab region would also be significantly impacted; in Egypt, Libya, the United Arab Emirates, and Tunisia, the impact reaches approximately 5% with a 1m SLR, 6 to 7% with a 2m SLR, and approximately 10% with a 5m SLR. The wetlands of Qatar, and to lesser extent Kuwait, Libya, and United Emirates would be significantly impacted by SLR.

The results of the previous studies are presented with high degrees of uncertainties, and there is no continuous monitoring for the sea level in the threatened spots. Therefore, there is no way of assessing the real magnitude of the impact and the suggestion of adaptation measures required.

III. THE IMPACT ON FRESHWATER SOURCES

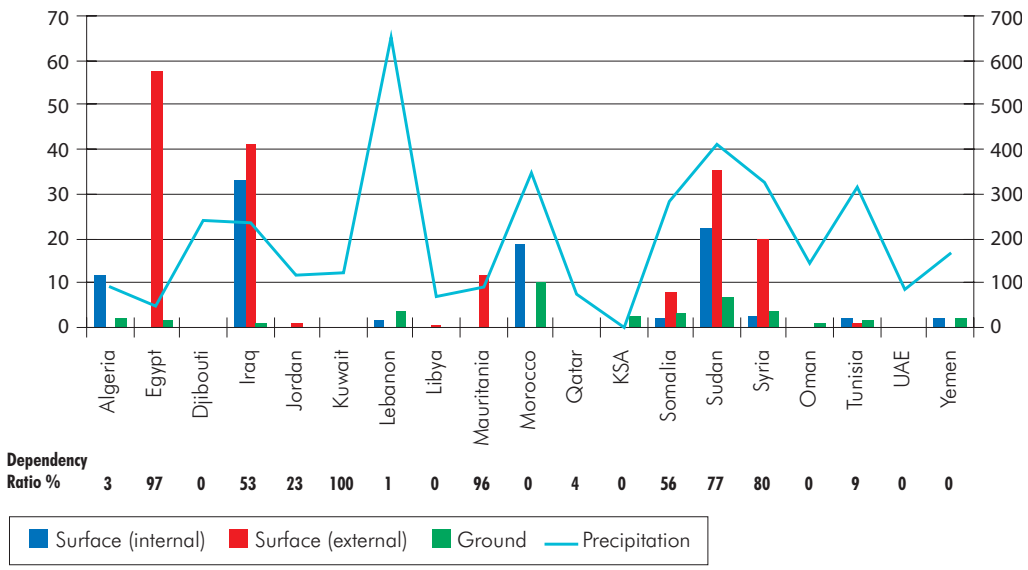
As stated earlier, most of the Arab countries are located in arid and semi-arid regions that are characterized by low and limited water resources and high evaporation. Total water resources are defined as an aggregation of total renewable ground water, internal surface water resources, and external surface water resources. The higher the "external surface water resources" percentage of "total renewable water resources," the higher the "dependency ratio" (%) and the lower the water-security. The "dependency ratio" (%) is the part of the total renewable water resources originating outside the country (FAO, 2003); a high dependency ratio thus implies a degree of external vulnerability (see also Chapter 5).

Iraq, Sudan and Egypt have the highest annual water resources between the Arab countries of 75, 65 and 58 billion m^3/year, respectively. Nonetheless, since more than 50% of their surface resources are external, more pressures are generated on their water situation. Figure 6 shows that Algeria, Lebanon, Mauritania, Morocco, Somalia, Syria, Tunisia and Yemen fall in the second category of total water resources between 5 to 30 billion m^3/year. The rest of Arab countries are the worst endowed with water resources of less than 5 billion m^3/year.

Total annual groundwater resources in the Arab region are about 35 billion m^3, and more than 50% of the water in the Arab Peninsula is ground water. Annual average precipitation is varied along the Arab region. In Lebanon and Syria the average annual amounts of precipitation are 600 and 300 mm/year, respectively. This rate decreases gradually to be 300 mm/year by moving to northern and eastern parts of Mediterranean coast of Morocco and Tunisia. The average annual precipitation reaches 130 mm/year over North African countries and the Arab Peninsula, while the average annual precipitation over the rest of the Arab countries is about 290 mm/year.

Kuwait has the poorest water resources in the Arab region with average precipitation of 121 mm/year, total annual water of 0.02 billion m^3/year and a 100% dependency ratio. Egypt has the second lowest annual precipitation in the region. The overall situations of Egyptian, Mauritanian,

FIGURE 6 **RENEWABLE WATER RESOURCES OF THE ARAB COUNTRIES**



Source: AQUASTAT- FAO, 2002a

Syrian and Sudanese water resources are very vulnerable, because they have high dependency ratios in the region of 97, 96, 80 and 77%, respectively, in addition to their limited total renewable water resources.

"Annual water resources per capita" is an important measure of national water situations. All Arab countries can be classified as vulnerable in this regard, except Iraq that has water resources of more than 2,900 m^3/capita/year. Syria is currently facing water stress (1,000 to 1,500 m^3/capita/year), while the rest of the Arab countries are facing water scarcity (less than 1,000 m^3/capita/year).

The water situation in the Arab region is threatened by both environmental and socio-economic pressures. Many negative impacts of climate change on freshwater systems have been observed in recent studies. These impacts are mainly due to the observed and projected increases in temperature, evaporation, sea level and precipitation variability (IPCC, 2007a). Many arid and semi-arid areas will experience a decrease in water resources due to climate change.

Generally, by the end of the 21st century, the flow of high latitude rivers is projected to increase, while those from major rivers in the Middle East, Europe and Central America tend to decrease. However, the magnitude of change is highly uncertain (Arnell, 2004). Moreover, sea-level rise will extend the area of saline groundwater, resulting in a decrease in freshwater availability for humans and ecosystems in coastal areas (Bobba, *et al.*, 2000). In addition, groundwater recharge will decrease considerably in some already water-stressed regions (Doll and Florke, 2005).

As a direct consequence of climate change, and given the current rapid trends of population increases, FAO projections show that Algeria, Egypt, Morocco, Syria and Tunisia are expected to experience severe water shortages by 2050, and only Iraq is expected to be in a relatively better situation (FAO, 2002b). Typically, heavy reliance on surface and groundwater prevails in all countries of the region, with 60–90 percent of water being used for agriculture. All over the region, water demand is steadily increasing while water supply is steadily decreasing.

The shortage of water resources is aggravated by water accessibility factors. Water quality, watershed conditions, infrastructure, and policy and conflicts are nearing the top of the priority list of water accessibility strategies in the Arab region. Currently, the quality of water resources in the Arab region is affected by pollution, urbanization, floods and over use of water resources. Climate change is projected to increase salinity

levels of lakes and ground water as a result of increased temperature (Haas, 2002). Moreover, higher pollutant concentrations in rivers, increased ground water contamination, and increased leaching of agricultural chemicals into groundwater are projected as a result of changes of runoff in catchments (IUCN, 2003). Watersheds are now facing frequent drought coupled with sudden intense rainfall events that cause serious soil erosion and desertification. Under climate change conditions, watershed degradation and desertification processes would intensify (Haas, 2002).

Haas (2002) projected first order impacts of climate change on Mediterranean hydrological systems as wetter winters and dryer summers, hotter summers and heat waves, and more variability and extreme weather events take their toll. These impacts may induce an increase in evaporation (E) from natural and artificial water bodies and soils that reduce the available water supply. Additionally, it will increase evapotranspiration (ETo) from crops and natural vegetation. Attaher *et al.* (2006) carried out a case study of Egypt to investigate the impact of climatic changes on ETo based on air temperature changes according to different scenarios. The study indicated that projected future climatic changes will increase the potential irrigation demand of Egypt by 6-16% due to the increase in ETo by the 2100s.

IV. THE IMPACT OF INCREASING DROUGHT

Drought is one of the serious water related disasters threatening the Arab region for both current and future time scales. From a climatic point of view, drought can be defined as a "temporary reduction in water or moisture availability significantly below the normal or expected amount for specified period." From the hydrological point of view, drought is "a period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance, carrying connotation for moisture deficiency with respect to man's usage of water" (Rossi, 2001).

Droughts affect rain-fed agricultural production as well as water supply for domestic, industrial, and agricultural purposes. Some semi-arid and sub-humid regions of the globe have suffered from more intense and multi-annual droughts, highlighting the vulnerability of these regions to the increased drought occurrence that is expected in the future due to climate change (Nicholson, 2005).

Drought frequency increased during the last 20-40 years in Morocco, Tunisia, Algeria and Syria, and changed in Morocco from an average of 1 year of drought in every 5 year period, before 1990, to 1 year drought for each 2 year period (Karrou, 2002. Abbas, 2002. Mougou and Mansour, 2005). In Lebanon, varying conditions of water shortage (regarding the availability of the hydraulic resources) have been experienced in the last decade (Karam, 2002).

In Morocco, of the twenty-two drought years in the twentieth century, ten occurred during the last two decades and included the three successive dry years of 1999, 2000 and 2001. Drought is also a recurring event in the Near East. Jordan, for example, is predominantly arid and has experienced chronic water shortages and has suffered from severe shortages since the 1960s. The recent droughts in Jordan and Syria were the worst ever recorded in recent decades (FAO, 2002b).

A warmer climate, with its increased climate variability, will increase the risk of both floods and droughts (Wetherald and Manabe, 2002). Drought-affected areas will probably increase, and extreme precipitation events, which are likely to increase in frequency and intensity, will augment flood risk. Increased frequency and severity of floods and droughts will also have implications for sustainable development (IPCC, 2007a). Water shortage is already the main constraint in most countries of the region, and IPCC model simulations indicate that water scarcity may worsen substantially as a result of future changes in climatic patterns.

V. SCIENTIFIC RESEARCH, MITIGATION AND ADAPTATION MEASURES

Although climate change is projected to have serious impacts on natural and human systems in the Arab region, only modest efforts and steps are taken in scientific research related to mitigation and adaptation.

The scientific community in most Arab countries still harbours many suspicions regarding climate

change phenomena, and remains hesitant to acknowledge the risks. Climate change studies are based in most cases on using modelling, remote sensing and projection techniques, but, due to the lack of facilities and low allocated funds for the Arab research institutions, the empirical and experimental techniques are still applied in Arab countries.

As a result of this, a small and scattered number of research studies were published in the field of climate change, and there are many gaps that still need to be filled in the future, especially pertaining to the vulnerability of water resources, agriculture, and health sectors.

Few and limited studies on mitigation and adaptation are developed in the Arab countries. In Morocco, a drought insurance program based on rainfall contracts is an important example of adaptation strategies, and it had a potentially significant benefit over the current scheme, minimizing drought hazard and protected the cereals production (IUCN, 2003). Shoreline protection along the northern coast of Egypt is another obvious example of an adaptation strategy (El-Raey, 1999).

VI. CONCLUSION AND RECOMMENDATIONS

Integrating climate change mitigation and adaptation in development strategies and policies strengthens these strategies and increases their efficiency. The following considerations could be included to encourage and enhance the planning of adaptation and mitigation strategies under Arab countries' conditions:

- Improving the scientific capacity in the various fields related to climate change should be a top priority.
- Ensuring political and financial support for the implementation of adaptation strategies.
- Applying the bottom up approach of planning and implementing adaptation and mitigation strategies.
- Developing community-based measures by stakeholders' involvement in adaptation planning, and improving the adaptive capacity of the different sectors of the society.
- Increasing public awareness of the impacts of climate change on the environment and human health. Public awareness activities should cover the following:
  - Clarify and explain the scientific facts and terms to improve the vision of stakeholders and to reduce the communication gaps between researchers and stakeholders.
  - Simplify the scientific message to match background level, education level, knowledge level, experiences, and role of stakeholders.
  - Indicate the best sources of information available.

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Pesticides, Fertilizers and Food Safety

Isam Bashour

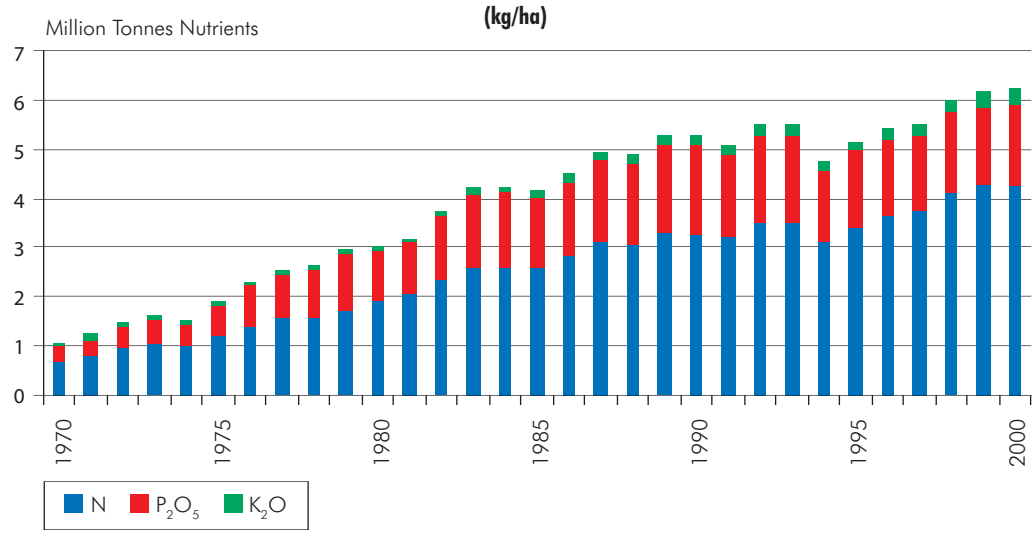
I. INTRODUCTION

Arab countries face profound sustainability challenges that will influence their ability to achieve lasting environmental goals. The rapidly changing and globalizing food economy and the concerns and commitments of a wide range of stakeholders about food production and security, food safety and quality, and the environmental sustainability of agriculture have prompted international organizations to establish standards for the safe production of fresh crops that can be safely consumed. Fertilizers and pesticides, when used in higher quantities than needed, become contaminants to food, feed and environment. However, when used properly, they will improve crop yield and quality. In the Arab countries as in every other region of the world, the misuse of pesticides and fertilizers is common; it is thus a subject that should be given sufficient magnitude and attention.

II. FERTILIZERS AND PESTICIDES USE IN THE ARAB COUNTRIES

The Arab world is faced with many constraints, such as: limited arable land (per capita about 0.22 ha); severe water shortages (16 countries are below the deficiency level of 500 m^3 per capita of annual renewable water resources); poor soil fertility; low investments in water-saving irrigation techniques; inappropriate pricing for agricultural commodities; and weak marketing systems. Over 55% of the increase in agricultural production was generally attributed to the use of fertilizers. The existing food gap in all Arab countries

FIGURE 1 FERTILIZER CONSUMPTION IN THE MIDDLE EAST REGION



Source: IFA, 2002.

TABLE 1 **TOTAL ANNUAL FERTILIZERS CONSUMPTION (Kg/ha) IN ARAB COUNTRIES**

Country	Population (x1000) as of 2004	Arable Land (1000 ha) as of 2000	Total use of fertilizers (ton) in 2002	Average Rate of fertilizer (kg/ha)
Algeria	32,339	7,662	196,000	26
Bahrain	739	2	200	100
Egypt	73,390	2,801	2,537,606	906
Iraq	17,357***	5,300*	414,000*	78
Jordan	5,614	242	67,000	276
Kuwait	2,595	10	2,100	210
Lebanon	3,708	190	78,840	414
Libya	5,659	1,815	123,800	68
Mauritania	2,980	488	5,800	12
Morocco	31,064	8,767	798,000	92
Oman	2,935	38	24,466	644
Qatar	619	18	1,800**	100
Saudi Arabia	24,919	3,592	762,600	294
Sudan	34,333	16,233	138,992	8
Syria	18,223	4,542	645,610	142
Tunisia	9,937	2,864	204,000	72
UAE	3,051	60	70,000	1,166
Yemen	20,733	1,545	23,200	16
TOTAL	**290,195**	**56,169**	**6,094,014**	**4,624**

Source: FAO, 2006.
* 1990 - ** 2001 - *** 1989 - 1991

(except perhaps Syria) would necessitate a vertical expansion in agricultural production to meet the increased food demand (Hamdallah, 2007)

Fertilizers

The consumption of NPK (N+ P_2O_5 + K_2O) fertilizers in the Middle East region increased from 1.5 million tons in 1970 to more than 6 million tons in 2002 (Figure 1). The major share of elements goes to nitrogen; phosphatic fertilizers are used at a smaller rate and then potassium is used in very low quantities (Figure 1).

Relative to the cultivated area, the rate of applied fertilizers in the region (overall average 108 kg/ha) is lower than the world average of 218 kg/ha in 2002 (Table 1). The data of the FAO (Food and Agriculture Organization) and ESCWA (United Nations Economic and Social Commission for Western Asia) shows that the UAE and Egypt use the highest rates (more than 900 kg fertilizers per hectare) followed by Oman (644 kg/ha) and Lebanon (414 kg/ha). However, other countries like Sudan, Yemen and Mauritania use very low rates of fertilizers (8–20 kg/ha). Another problem in the use of fertilizers in the Arab states is the imbalanced application of nutrients (Hamdallah, 2007).

Following are some examples of impact of fertilizers on food (Havlin et al., 2005):

- Adequate supply of N increases protein quality and quantity (more of the essential amino acids) and some vitamins.
- Excessive N supply tends to increase amide content, resulting in bad flavour after cooking, or in raising the nitrate content to unacceptable levels, especially in vegetables grown under protected culture systems.
- Low N causes premature ripening, while high N causes delayed ripening.
- High amounts of N and K decrease dry matter and starch content and affect the quality of starch in potatoes; low K affects the coloration of fried potatoes negatively and causes black spots in fresh potatoes.
- Adequate Ca supply leads to high quality of different fruits and vegetables. Ca deficiency causes low quality banana fruits (fruit peels and splits at ripening).
- Sulphur increases the protein content in grain and the oil content of oil-seed crops.

Pesticides

There is a shortage of and a gap in the provision of data on the use of pesticides (herbicides, insecticides and fungicides) given that fewer than half the ESCWA member countries provided data for 2000, and only two countries provided such data for 2001 (Table 2).

The data in Figure 2 shows that the rates of pesticides usage per hectare in Lebanon, Kuwait and Qatar are 2 to 3 times the rates used in Egypt, Jordan and Oman. Farmers should use these chemicals only when needed and in moderation to avoid sending to the market low quality products, especially fruits and vegetables which are consumed fresh.

III. FOOD SAFETY IN RELATION TO FERTILIZERS AND PESTICIDES USE

Food Safety is increasingly viewed as an essential public health issue in the Arab region. In collaboration with the WHO, most countries of this region have undertaken extensive reviews of their food safety systems and have updated their national legislation. In many countries in the Middle East, legislation is inflexible and unable to cope with new challenges. Often standards are not consistent with international and national needs.

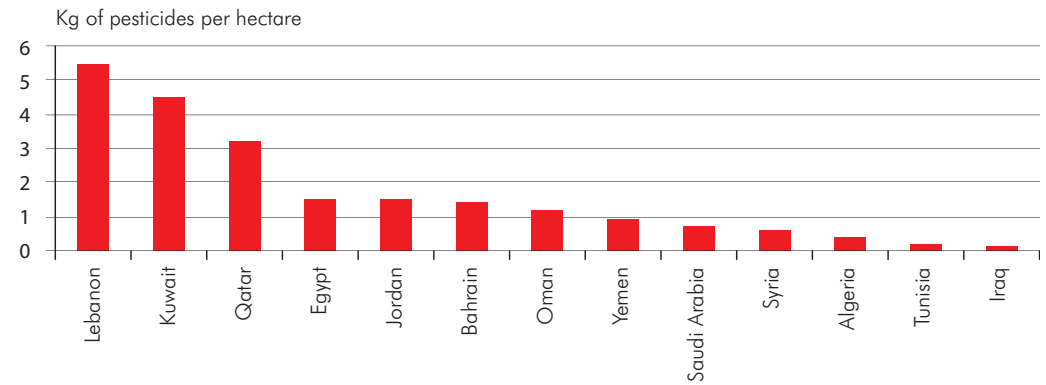
In this context the FAO has established Good Agricultural Practices (GAPs) and defined this concept as: "Applying available knowledge to addressing environmental, economic and social sustainability for on-farm production and post-production processes that result in safe and healthy food and non-food agricultural products."

From the time of planting a crop until its consumption, there are many opportunities for contamination with harmful microorganisms, pesticides and other toxic substances. On the farm, soil, manure, water, animals, equipment, and workers may spread such contaminants. Produce may be harvested on a farm, processed in one plant, repackaged in another, then stored, displayed, or served commercially or in the home. Each of these steps is an opportunity for harmful contamination of the food supply.

The Codex Alimentarius Commission was established in 1963 by the FAO and the WHO (World Health Organization) to develop international food standards, guidelines and recommendations to protect the health of consumers and to ensure fair practices in food trade. This collection of food standards, entitled the *Codex Alimentarius*, or the food code, has become the global reference point for consumers, food producers and processors, national food authorities and participants in the international food trade (FAO/WHO, 2004).

Almost all countries of the Near East region are members of the Codex Alimentarius Commission. Their participation in Codex work, however, is very erratic and certainly not as effective as it could be in protecting their interests.

FIGURE 2 **AMOUNT OF PESTICIDES USED IN KG/HA IN SELECTED ARAB COUNTRIES**



Source: ESCWA, 2007. Most recent year available 1993-2002.

The Codex Alimentarius Food Hygiene Committee mandated a working group in 1991 that has since developed guidelines for the Hazard Analysis and Critical Control Point (HACCP) application which is a process control system designed to identify and prevent microbial and other hazards in food production.

Although the Best Management Practices (BMP) and quality assurance systems such as HACCP have been introduced throughout the region, they are not fully integrated in the domestic inspection systems which continue to focus primarily on end-product control. In a number of countries, many industries apply HACCP on a voluntary basis in order to improve food safety domestically as well as increase their share of export markets.

Crop protection is probably the most limiting factor in crop production. The wide range of pests that attack crops during the various stages of growth from seed to fruit necessitate the application of various means of pest control. Farmers have depended mainly on the use of pesticides to combat the multitude of pests. The development of the synthetic organic pesticides in the mid-forties was a turning point in pest control. Prior to this development, the available quantities of botanical and inorganic pesticides were limited and fairly expensive. In contrast, synthetic organic pesticides were produced in huge quantities and thus were readily available and at reasonable cost. In the beginning, the health hazards of pesticides were not sufficiently studied before their extensive use.

TABLE 2 **TOTAL INSECTICIDES CONSUMPTION IN TONS PER YEAR**

Country	2000	2001
Bahrain	7	6
Iraq	190	...
Jordan	61	...
Oman	91	...
Qatar	60	...
Syria	1,219	994
Yemen	933	...

Source: ESCWA, Compendium of Environment Statistics in the ESCWA Region, 2007.

Furthermore, crop pests and especially insects started to show resistance to these chemicals which in turn prompted farmers to use more and more quantities in their quest for efficient pest control. A second turning point occurred in 1962 with the publication of *Silent Spring* by Rachel Carson. The book alerted the scientific community and the public about the health hazards of pesticides and their indiscriminate use. The book was adopted by various environmental groups and induced a public awareness campaign about the hazards of pesticides. Consequently, the scientific community had to assess the situation and initiated various studies about the hazards of the commonly used pesticides and realized their risks to human and animal health as well as the environment. This resulted in the banning of several pesticides in many countries starting with DDT in 1973 (Kawar, 2007). All persistent chlorinated hydrocarbon pesticides

were finally banned in 2004 by the Stockholm Convention (Stockholm Convention on Persistent Organic Pollutants, 2008).

Standards for pesticide residues were developed, a particularly important element of which concerned the Maximum Residue Limit (MRL) for pesticides permitted on specific foods. The MRL is determined from a number of factors including:

- How much of the food is eaten in the average diet;
- How toxic the pesticide is; and
- How easily the food absorbs and retains the pesticide.

The problem of pesticide use in the Arab countries is not only a problem of unregulated use, but it is also a problem pertaining to the handling and misuse of pesticides at all levels.

IV. ORGANIC FARMING

Production and use of inorganic manufactured fertilizers has continued for about 160 years beginning with the use of calcium phosphate in 1843. By 1901, England had begun to use small amounts of manufactured nitrogen (N) fertilizer. Over the last 100 years, use of inorganic fertilizers has played a great role in the world's ability to sustain adequate agricultural production. The Arab countries are major producers and exporters of synthetic fertilizers in the world.

Popularization of the concept of so-called "natural" or "organic" agriculture and the increased environmental awareness in the Arab world has led to misconceptions regarding the effects of inorganic fertilizers on the quality and safety of agricultural products and the environment. In many situations, this misinformation has resulted in general public misunderstanding regarding the benefits of manufactured fertilizer application to crops. These misunderstandings commonly include four points:

1. Inorganic fertilizers pollute agricultural produce and negatively affect human and animal health. For example, high nitrate in vegetables.
2. Application of inorganic fertilizer decreases agricultural produce quality.
3. Manufactured inorganic fertilizer application results in soil hardening and a decline in soil's fertility.
4. Manufactured inorganic fertilizer application can negatively affect the environment causing greenhouse gas emission, water pollution and the eutrophication of lakes, rivers, and seas.

According to some, the answer to all these so-called negative effects of manufactured fertilizers is to recommend an "organic farming only" or "green food" strategy which is supposed to produce agricultural products with little pollution and greater safety. It is a fact that this region needs to use the entire supply of organic nutrients (manure/crop residue) available, but it must also supplement it with balanced inorganic fertilizers to produce high yielding, high quality crops while protecting the environment (Potash and Phosphate Institute PPI, 2008).

Many scientific research results reported that manufactured fertilizers are harmless to human/animal health and in some situations may be more beneficial than organic sources. Negative effects from inorganic fertilizers are most commonly a result of improper use, a consequence that can just as easily occur if organic manures are misused. Thus, to ensure sustainable development of agricultural production and satisfy the requirement for safe agricultural products in the Near East, further discussion and understanding on this issue is needed.

V. CHALLENGES FACING THE ARAB COUNTRIES

Despite efforts to modernize food safety laws, there is limited information available to fully evaluate the food safety problems and issues in the Arab region. Pesticide regulations in the Arab countries have improved but are still not satisfactory. Regulations for the registration and import of pesticides have been established and a large number of pesticides have been banned. However, the sale and handling of pesticides is not regulated and there is no control over the use of pesticides. Accredited pesticide residue analysis laboratories are not available in many Arab countries, and frequently shipments of fresh produce are refused entry into an importing country because of residues exceeding the MRLs. It is imperative that all Arab countries establish such laboratories (De Waal and Robert, 2005).

The major constraints that face the Arab states for intra-regional trade include inadequate international transport and communication facilities and poor information about markets and investment opportunities. Moreover, the existence of administrative and procedural obstacles to trade and the absence or inadequacy of a system for standardized packing, grading and quality control systems at the regional level continue to frustrate efforts to expand trade and establish transparent information systems. Improvement and harmonization of inspection and certification systems are among the missing ingredients for promotion of intra- and extra-regional trade. Inadequate financing and guaranteeing of regional exports/imports has also been a factor in some countries in the Middle East.

In most countries responsibility for the supervision and enforcement over food safety is shared among several agencies. In Lebanon, for example, food safety responsibility is shared among six different government agencies. Yet, it has no comprehensive food safety law, and the existing laws are not fully implemented. Extensive use of pesticides has led the European Union to ban some exports from several Arab countries (De Waal and Robert, 2005).

VI. CONCLUSIONS

New legislation and an institutional commitment to environmental governance are becoming extremely important. Creating regulatory systems to face the new challenges and to be updated regularly is the major task that Arab countries should start with. Although some countries perform better than others, all face issues that have to be tackled at the regional level and not merely the country level. Many countries have resources and capacities for a better performance if a commitment to greater environmental sustainability and food safety is made.

Governments should develop effective extension programs to teach farmers about proper methods for the use and handling of agrochemicals and adopt modern laws concerning the use of fertilizers and pesticides.

In addition, governments should consider institutional reforms and support the establishment of laboratories to ensure the safety of the food consumed, produced and exported from the region.

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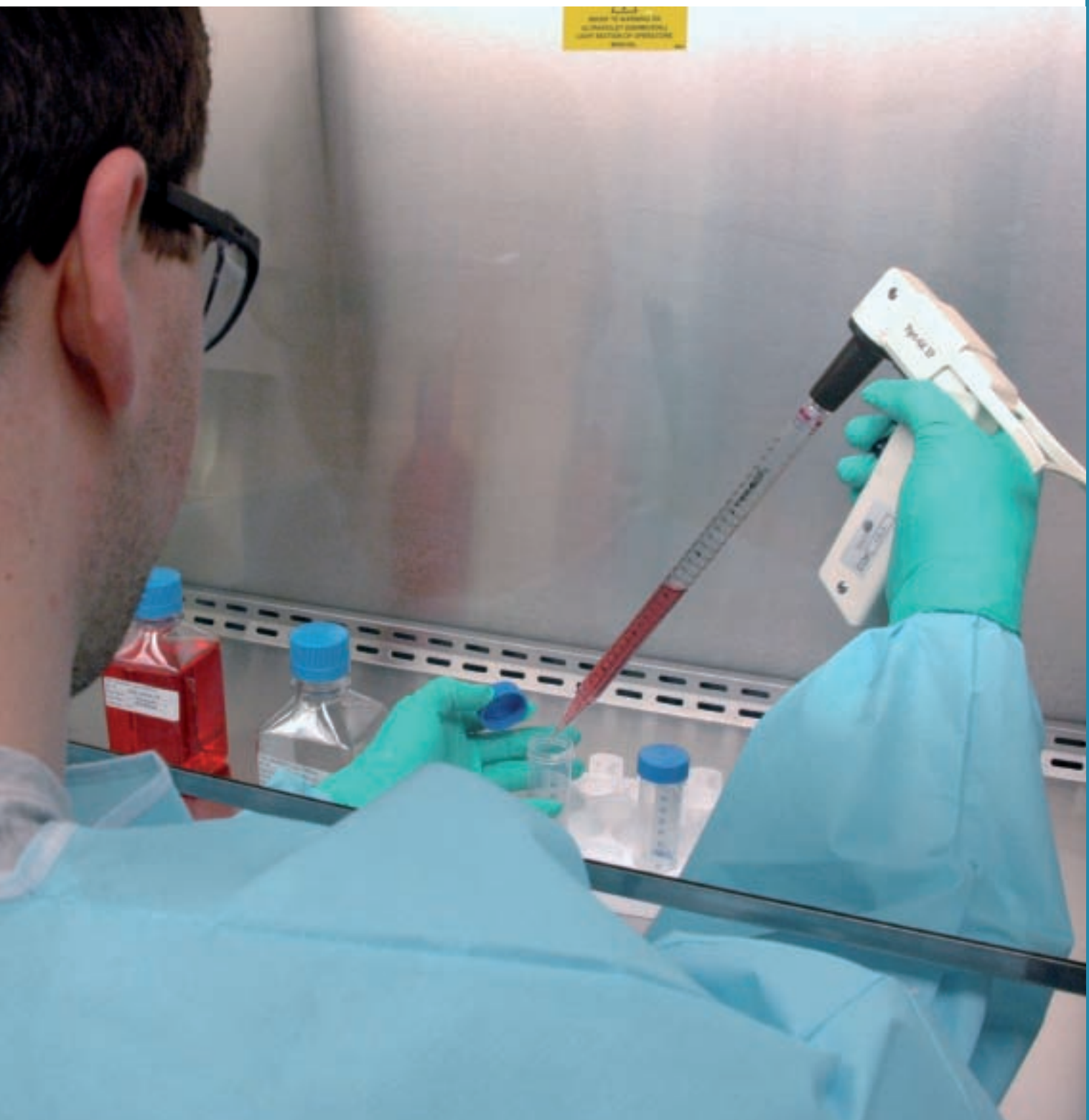
Biosafety of Biotechnology Products

Osama El-Tayeb



I. INTRODUCTION: WHAT ARE BIOTECHNOLOGY PRODUCTS?

Biotechnology is the science and application of "biological entities" to provide goods and services for human welfare. "Biological entities" refers to plants, animals, microorganisms and their subcellular components. As such, biotechnologies have been exploited by humans since ancient history for the production of food, fibres, drugs and many products such as bread, cheese and various fermented foods and goods.

Although the genetic material of all living beings is essentially similar in chemical nature, it is distinctive to each individual type (strains or varieties) of each species. While different living beings may live together in the same ecosystem, the exchange of their similar genetic material is strictly limited to individuals within the same species. Living beings have a precise system which recognizes any foreign genetic material which may gain access to the cell, and subsequently destroys it. This natural genetic barrier helped maintain the basic unique properties and characteristics of each species over millennia, while allowing the development of vast diversity within each species.

In 1971 this natural barrier was broken in the laboratory when genetic material from one species of bacteria was incorporated permanently in another species of bacteria and was "expressed" in the host, imparting novel properties to it as a result of creating a laboratory genetic hybrid possessing properties derived from two incompatible species. This laboratory technique was termed "genetic engineering." Soon, the human genetic material responsible for producing the hormone insulin (that was not then available as a drug) was incorporated into a bacteria which was grown industrially to produce human insulin for diabetic persons in unlimited quantities. More applications followed in the healthcare field and later in crops. Thus the bacterial genetic material responsible for the production of substances which kill certain insects was incorporated into crop plants making them toxic to, and hence resistant to attack by, these insects. New techniques of biotechnology are being developed continuously and offer a potential for the provision of novel services and goods for human well being limited only by human imagination!

II. THE ORIGIN OF CONCERN FOR BIOSAFETY OF BIOTECHNOLOGY PRODUCTS

The novelty of genetic engineering raised a number of concerns including ethical concern with intervention with "God's creations." The environmental concern focused on the possibility of escape from laboratories of exotic, possibly harmful, organisms developed deliberately or accidentally during experimentation. The concern was that such organisms did not develop in harmony with nature; hence their behaviour in a natural ecosystem is unpredictable and could cause risks to humans and other beings which would be difficult or impossible to contain. While the interaction between naturally occurring living beings following rules of natural biology has been tested over millennia, interaction with genetically engineered beings where such rules have been violated in the laboratory will not be predictable.

Over time, the scare of an escape from laboratories of monster living beings became muted and more confidence crept into public opinion, catalyzing the commercialization of many biotechnology products on a wide scale. Such "open environment release" of genetically engineered products, however, raised a new alarm: what influence could this massive "invasion" have on natural biodiversity? Agenda 21 of the Rio Summit of 1992 (para 16.29) recognized the potential benefits and risks associated with biotechnology. This coincided with the negotiation and drafting of the Convention on Biological Diversity (CBD) in 1992; two articles of the CBD touched specifically on the issue:

- Article 8(g) which states that each Party *"shall establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health."*

- Article 19(3) which states that *"The parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling*

and use of any living modified organism resulting from biotechnology that may have adverse environmental effect on the conservation and sustainable use of biological diversity."

III. THE VALUE OF BIODIVERSITY

Biodiversity is the total genetic make up of all living beings in all ecosystems on the planet, and covers the diversity between and within species. Biodiversity was influenced not only by the changes which the planet encountered throughout its history, but also by human activity: that is, by humans favouring, developing and manipulating certain varieties of species which better served their needs (using natural biological phenomena) while neglecting others. Perhaps more importantly, humans developed land use systems which destroyed entire ecosystems (and their biodiversity) replacing them with novel ecosystems such as monoculture used in agriculture and animal production systems.

Over thousands of years, but especially in the last few centuries, biodiversity was eroded. Concerns over a continuation of these trends were expressed and calls for remedial action were raised by different groups of nature lovers. To them, maintaining biodiversity and natural ecosystems are important. Those responsible for breeding so-called "economic species" on which further human development depends for food, fibres and drugs looked at it differently: breeding programs required parental breeding varieties and strains obtainable only from traditional farming and wild ecosystems which came to be called genetic resources. Modern biotechnologists too needed all kinds of natural genetic material since they could not "invent" synthetic genetic material. These various interests merged in the launching of the CBD which was drafted in 1992 and came into force in 1994. Presently, over 190 states are Parties to the CBD. Many industrial interests, especially in the drug industry, felt that there is an un-exploited potential wealth of drugs and industrial products in biodiversity which warrants its conservation and sustainable use. Since developing countries are home to most such natural biodiversity they added a third objective to the CBD: benefit sharing between the developer and the provider of sustainably exploitable biodiversity.

TABLE 1 **BASIC DATA ON INTERACTION BETWEEN ARAB COUNTRIES AND THE CPB**

Country	CPB party since (dd/mm/yy)	National focal point at	Competent national authority	Nbf signed	Bch project signed
Algeria	3/11/2004	Environment Division, Ministry of Science	Not designated	No	Yes
Bahrain	Has not signed	Environment Department	Not designated	No	No
Comoros	Has not signed	Environmental Section, Ministry of Agriculture, Forestry, Industry and Environment	Not designated	2/12/2002	No
Djibouti	11/9/2003	Environment Department, Ministry of Human Settlements and Environment	Same as NFP	1/4/2003	Yes
Egypt	21/3/2004	Egyptian Environmental Affairs Agency, Ministry of State for Environmental Affairs	Same as NFP	1997/1999 (concluded)	Yes
Iraq	Has not signed	Embassy of Iraq, Ottawa, Canada	Not designated	No	No
Jordan	9/2/2004	Biodiversity Division, Ministry of Environment	Not designated	16/06/2002 Concluded 15/08/2004	Yes, 2007
Kuwait	Has not signed	Environment Public Authority	Not designated	No	No
Lebanon	Has not signed (1)	Department of Conservation of National Wealth, Ministry of Environment	Not designated	10/06/2003 Concluded 1/02/2006 (2)	Yes
Libya	12/9/2005	Environment General Authority	Not designated	No	Yes
Mauritania	20/10/2005	International Convention Affairs, Prime Minister's Office	Not designated	No	Yes
Morocco	Signed only 25/05/2000	Department of Environment, State Secretary of Water and Environment	Not designated	5/2/2004	Yes
Oman	11/9/2003	Nature Conservation, Ministry of Regional Municipalities, Environment and water	Same as NFP	No	No
Palestine	Has not signed	Not defined	Not designated	No	No
Qatar	12/6/2007	Supreme Council for Environment and Natural Resources	Same as NFP	No	No
Saudi arabia	7/11/2007	King Abdul Aziz City for Science and technology	Not designated	No	No
Somalia	Has not signed	Ministry of Foreign Affairs	Not designated	No	No
Sudan	11/9/2005	Higher Council for Environment and Natural Resources, Ministry of Environment and Physical Development	Ministry of Science and Technology	14/11/2002	Yes
Syria	30/06/2004	General Commission for Environmental Affairs, Ministry of Local Administration and Environment	Ministry of Agriculture and Agric. Reforms (3) Ministry of Economy and Trade (4)	30/09/2003	Yes
Tunisia	11/9/2003	Ministry of Environment and Sustainable Development	Not designated	1997/1999 Concluded	Yes
Uae	Has not signed (5)	Federal Environmental Agency	Not designated	No	No
Yemen	1/3/2006	Environmental Protection Agency	Not designated	27/06/2003	Yes

(1) According to the records of the CPB. According to the response to the questionnaire, Lebanon is a party
(2) UNDP was involved along with UNEP
(3) For microorganisms and Plants
(4) For Handling, identification, import/export and human health
(5) According to the records of the CPB. According to the response to the questionnaire, UAE is a Party

IV. THE SCOPE OF RISKS POSED BY BIOTECHNOLOGY APPLICATIONS

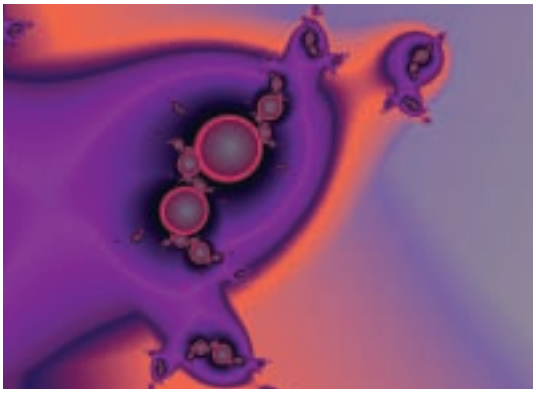
As mentioned above, the main risk is erosion or contamination of natural biodiversity. However, because of the short experience humanity had had with biotechnology products there was concern that human health too could be negatively impacted upon, hence a reference to this aspect in Article 8(g) of the CBD. Negotiations for the protocol referred to in Article 19 of the CBD started in 1995 and ended with the approval by the Parties to the CBD of the Cartagena Protocol on Biosafety (CPB) regulating trans-boundary movement of Living Modified Organisms (LMOs, another term for Genetically Modified Organisms, or GMOs) in 2000. The protocol came into force in 2003 and currently 141 Parties to the CBD are Parties to the Protocol. Three Meetings of the Parties were convened in 2004, 2005 and 2006 where two unsettled issues were discussed:

1. Article 18 on documentation necessary for transport of LMOs; and
2. Article 27 on "international rules and procedures" for liability and redress for damage resulting from trans-boundary movement of LMOs

The 4th Meeting of the Parties is planned for May 2008.

The main thrust of the protocol, in line with Article 19 of the CBD, is to regulate trans-boundary movement of LMOs in such a way that a state accepts shipment of LMOs only after *explicit* Advance Informed Agreement (AIA) procedures have been applied. Decision by an importing country on whether to receive a shipment relies on the provision of certain information by the exporter which makes it possible for the National Competent Authority (NCA) of the country of import to decide, based on risk assessment (RA) in the receiving environment. Decision-making may take into account socio-economic considerations arising from the impact of LMOs on the conservation and sustainable use of biodiversity, "especially with regard to the values of biodiversity to indigenous and local communities" (Article 26).

During the negotiations, it was recognized that the Protocol would have serious implications for



international trade, especially for GMO commodities. The Preamble of the Protocol, while clearly "reaffirming the Precautionary Approach contained in Principle 15 of the Rio Declaration on Environment and Development," also recognized "that trade and environment agreements should be mutually supportive with the aim of achieving sustainable development," and emphasized that the Protocol "shall not be interpreted as implying a change in the rights and obligations of a party under any existing international agreements" but expressed the understanding that "this is not intended to subordinate this Protocol to other international agreements."

Finally, while the Protocol deals only with trans-boundary movement of LMOs, Article 2 dictates that "each Party shall take necessary and appropriate legal, administrative and other measures to implement its obligations under this Protocol." Simply stated, this requires each Party to formulate national legislation which makes compliance with Protocol obligations possible. The Protocol also established a Biosafety Clearing House (BCH) to facilitate the exchange of information and experiences and to make national information available, if applicable.

V. THE ROLE OF ARAB STATES IN THE NEGOTIATION OF THE PROTOCOL

Although the Arab League enjoys a formal status at the United Nations, the Arab world is not recognized as a region and is split between the African and the Asia-Pacific regions. During the negotiations for the Protocol (1995-2000) the Asia-Pacific group was not very effective except through the *Group of 77 and China* which in fact re-formed as the Like-Minded Group (LMG) due

TABLE 2 **INFORMATION AVAILABLE[1] ON ARAB COUNTRIES ON THE BCH[2]**

Country	Designate CNA	Experts listed in Roster	Capacity needs defined	Formulate NBF	Formulate National legislation	URL for NFP	Submit Interim National Report	Submit First national Report
Algeria	No	2	No	No	No	No	Yes	No
Bahrain	No	1	No	No	No	No	No	No
Djibouti	Yes	None	No	No	No	No	No	No
Egypt	Yes	7	Yes	Yes	Draft, 30/12/06	www.egbch.com	Yes	Yes
Lebanon	No[3]	6	No	Yes[4]	No	www.biosafety.moe.gov.lb	No	No
Mauritania	No	None	Yes	No	No	No	No	No
Morocco	No	19	No	No	No	No	No	No
Oman	Yes	None	No	No	No	No	No	No
Qatar	Yes	None	No	No	No	No	No	Yes
Saudi Arabia	No	2	No	No	Yes[5]	No	No	No
Sudan	Yes	2	Yes	Yes[4]	No	www.biosafety.gov.sd [6]	No	Yes
Syria	Yes	4	No	No	No	No	No	Yes
Tunisia	No	7	No	No	No	No	No	No

(1) The following countries only reported designation of NFP: Comoros, Iraq, Jordon, Kuwait, Libya, Somalia, UAE, Yemen. All countries listed in the table designated NFP. No decisions were reported by any of the countries listed, except for one by Syria relating to non-recognition of Israel. Palestine is not listed on the BCH
(2) www.bch.cbd.int/default.asp
(3) This is in contradiction of the response to the questionnaire
(4) Preliminary, to be finalized.
(5) No details are available
(6) Covers the NBF project only.

to conflicting positions of a few members (notably Argentina and Uruguay) with the rest of the group. Arab states belonged to the LMG in which the African bloc exercised significant influence. Coordination among Arab states was occasionally catalyzed by a representative from the Arab League but this was not particularly effective or consistent. Within the African group, Egypt exercised significant influence mainly because it was the only Arab country where the same representative was present in all negotiation sessions. Informally, there was a degree of concerted action between Asian and African Arab representatives.

VI. CAPACITY BUILDING UNDER THE PROTOCOL

Capacity building is covered by Article 22 of the Protocol which encourages efforts to enhance the capacity of developing countries towards meeting their obligations under the Protocol. The financial mechanism established under Article 28 of the Protocol is the same as that established under Article 21 of the CBD. Multilateral capacity building efforts were accordingly funded by the Global Environment Facility (GEF) established in 1991 as the financial mechanism for activities in developing countries "which protect the global environment." GEF placed emphasis on 6 "focal areas," including biodiversity to which it allocated $1.89b in 1991-2004. Its "strategy for biodiversity" (with 4 strategic objectives) includes – within its Strategic Objective No. 3 – an "initial strategy for biosafety" supporting the implementation of the CPB through national, sub-regional and regional projects aiming at establishment of:

- National coordination mechanisms;
- Effective regulatory policy frameworks;
- Administrative frameworks;
- Capacity to conduct risk assessment including standardized regional methodologies;
- Workable and up-dated biosafety clearing house (BCH) participation including regional cooperation.

GEF funded a pilot project in 1997-1999, even before the Protocol became operational, to test the feasibility of developing a framework for Biosafety (NBF) in each of 18 countries – including 2 Arab states: Egypt and Tunisia. The project was expanded, in June 2001, to cover some 139

developing countries, including an additional 8 Arab states. This was complemented with small grants to also develop capacity to interact with the BCH in the same countries. GEF also funded a number of medium-sized projects in a few countries to develop the full implementation phase of the NBFs, and this included projects in Egypt and Tunisia.

Development of NBFs includes: information gathering, analysis, consultation, training and preparation of a draft NBF (draft legal instruments, administrative systems, risk assessment procedures, systems for public participation and information). Regional workshops will: increase understanding of the Protocol and assess implications for risk assessment and decision-making at national levels, while sub-regional workshops aim to identify: capacity building needs, opportunities for collaboration, mechanisms for sharing of risk assessment and management experiences, coordination of capacity building activities and networking to share lessons and experiences. The total cost of the project is $38.4 million. This is funded by a contribution of $26.1 million from GEF, with co-financing of $12.3 million from UNEP and participating countries. These countries contributes one third of the costs of their national projects, in cash and/or in kind.

VII. THE STATUS OF IMPLEMENTATION OF THE PROTOCOL IN ARAB STATES

Thirteen Arab states are presently Parties to the Protocol and an additional state (Morocco) only signed it, while seven neither signed nor ratified (Table 1). Thirteen Arab countries are eligible for GEF funding and the GEF pilot project assisted two of them (Egypt and Tunisia) draft NBF in 1997-1999. Within the full scale project eight additional Arab countries were supported. While 95 countries concluded their projects, only three Arab countries finalized theirs: Egypt, Jordon and Tunisia. This effort was largely done with technical support from the United Nations Environment Program (UNEP). The project produced three toolkits (none in Arabic) for (i) starting the project; (ii) taking stock; and (iii) consultation and analysis.

Another toolkit on drafting the NBF was produced in Arabic with two components: formulation of the regulatory regime and design of the administrative system for handling applications and notification. No regional or sub-regional workshops were conducted either in or for Arab countries.

The "add on" activity, aiming at establishing national BCH nodes in each of the countries funded, aimed at "building capacity for effective participation in the BCH" of the CPB. It was signed with 12 Arab countries but none have been concluded as yet (Table 2). The project designated 47 "regional advisors" including four from Arab countries of which only three can speak Arabic. The project also offers free software solutions for BCH nodes developed by the United States, Canada and Switzerland. No Arab country seems to have made use of this offer.

VIII. INTERACTION BETWEEN ARAB STATES AND THE BCH OF THE PROTOCOL

The BCH presents information which is voluntarily provided by Parties and non-Parties. The information provided by each of the Arab states is presented in Table 2. Only one Arab country (Egypt) has a national site linked to the central portal of the BCH with 2 others (Lebanon and Sudan) linking their sites for the GEF NBF projects only.

IX. RESPONSE OF THE NATIONAL FOCAL POINTS IN ARAB STATES TO A QUESTIONNAIRE

In early September 2007, a questionnaire was emailed to the NFP of each of the Arab countries along with a covering letter explaining the purpose of the questionnaire. Two appeals for speedy responses were sent two weeks apart afterwards. The information received in nine responses is presented in Table 3. Since several countries did not respond, information was retrieved from the records of the BCH site as well as those of GEF, UNEP, UNDP, and the International Center for Genetic Engineering and Biotechnology (ICGEB) – all of which maintain records of biosafety activities – and this information was incorporated in Tables 1 and 2. Whenever a URL for the national agency respon-

TABLE 3 **INFORMATION ON ARAB COUNTRIES RESPONDING TO QUESTIONNAIRE [1]**

Country	Egypt	Jordon	Lebanon	Libya
NBF in place	Yes	Yes	Yes	Near completion
Capacity needs defined	RA/RM [2] Detection, Administration	Not defined	RA/RM Administration, Detection, Interagency coordination	RA/RM Detection, Law enforcement, Public awareness
National legislation status	Draft Approved by Ministry of Justice	"launched" October 2006	Draft by Ministry of Environment	Chapter 10 of Law 15-2003 on environment
NCA designated	Ministry of Environment			Yes, EGA
Detection facilities available	Yes	No information	Yes	No
Risk assessment capability	Yes	No	Yes	No
Requirements for shipping documents	No	No information	Yes	Under preparation
Liability and redress arrangements	No	No	Yes	Yes
BCH site operative	Yes		Yes	No
GMO shipments received	Not legally	No information	Not known	Not known
Regional approach	Useful	Useful	Useful	Useful

(1) Only Egypt and Tunisia signed implementation projects
(2) RA/RM: Risk assessment/ risk management

sible for implementation of the Protocol was indicated in the records, it was consulted and relevant information too was incorporated in Tables 1 and 2.

X. ANALYSIS OF THE STATUS OF BIOSAFETY AND PROTOCOL IMPLEMENTATION IN ARAB COUNTRIES

A paucity of information on environmental activities, taking a holistic concept for the environment, is common in developing countries. Thus the concept of environmentally sustainable development, for example, is not fully appreciated or understood by decision-makers and by the public. Reasons often cited include: pressing economic and political issues and weak civil society. The environment thus largely remains a genuine concern only for the elite and a few scientists. Only when qualities of air and water deteriorate, along with accumulation of domestic wastes – elements of classic pollution – becoming a health hazard does the public get involved. Arab countries, even the affluent ones, are no exception. Many environmental issues draw the concern of decision-makers and the public as a result of "environmental agitation" in developed countries, especially when their impact on the global environment necessitates international action. Issues of climate change are a case in point. This is especially true with the current advances in communication and closer contact between different peoples and cultures. Interest in biosafety, and even in the broad area of biodiversity, in Arab countries typically reflects the observations made above.

Analysis of the information presented above suggests the following:

Achieving inter-agency cooperation on inter-sectoral environmental issues

The environmental dimension impacts practically all human activities and hence needs to be tackled by joint team action of several actors. Such team action requires both a political will and strong public pressure to force the isolated islands of governance to cooperate. The political and popular (and possibly even cultural) environments in Arab countries do not seem to be conducive to this approach of inter-agency team work. In fact, different government agencies tend to deal with their environmental concerns separately and individually, if not with some inter-agency rivalry, regarding the environmental

Morocco	Qatar	Syria	Sudan	UAE
No	No			No
Technical & financial support	RA/RM Detection, Legislation	RA/RM, BCH, Legislation Administration	RA/RM Detection, Training Biosafety research	Technical support, Training, Public participation
Draft by Dept. of Environment	Under discussion at NFP	Being drafted	Law being discussed	Only Federal Law 24/1999 on Environment
No information	No	No	Yes	No
No information	No	Limited	Yes	Yes
No	No	Only in the Draft Law	Yes	Yes
No	No	Being drafted	Yes	Yes
No	No	No	Yes	No
No	No	No	No	No
Useful	Urgently needed Workshops planned	Not practical	Useful	Useful

dimension as a hindrance and exhibiting a desire to protect their little empires! Needless to say, each agency has a primary clientele with interests focused on the main sector rather than inter-sectoral approaches and concerns, such as the environment. The establishment of a coordinating national environmental agency did not prove to effectively outwit this attitude and ministries of environment in Arab countries did not present novel mechanisms for the environment to escape sectoral emphasis and rivalry.

In developed countries, mechanisms, expertise and resources exist for achieving coordination between agencies and each is held accountable for inability to respond to needs for coordination.

Public attention to and involvement with the issues of biosafety and biodiversity

In Arab countries, common citizens are often preoccupied with concerns of immediate everyday impact (such as how to make a decent living) that over-shadow concerns for the medium or distant future. Biodiversity by its nature is a long term concern, obscuring the direct benefits to the individual of supporting it. Surprisingly, and because of the reflection of the hot international debate on biosafety in the local media, certain aspects of biosafety (mainly health implications) attracted some public attention. The safety of food produced by biotechnology caught the attention of certain media actors, and hence furnished the public with (mostly inaccurate) claims. Thus GMOs were blamed for food poisoning, reduced flavour of vegetables and fruits, causing cancer etc, elements in which GMOs are in fact not implicated (see also chapter 10). As a result, food biosafety acquired a much larger sector of the public debate in Arab media than the most important concern which is impact on biodiversity. In public discussions the impact of GMOs on biodiversity was consistently overshadowed by the health impacts. The conspiracy theory was quickly recalled accusing GMOs of being a hazardous product to be tested on peoples from developing countries using them as guinea pigs. However, genuine socio-economic considerations were often raised too.

In developed countries, concern for biosafety was raised, as early as 1971, by scientists, environmentalists and religious leaders. Wider spread concern was strongly evident during the negotiation stage of the CBD in 1992 and this was reflected in Articles 8(g) and 19. The debate continued in developed countries and inter-agency

THE CASE OF EGYPT

The case of Egypt is illustrative of the general sluggishness of progress in the Arab region: despite a head start and obvious enthusiasm, not much has progressed to its logical conclusion in practice. Thus, while technical expertise in biotechnology allowed laboratories in Egypt to become affiliates of the ICGEB as early as 1983, to date, biosafety research publications are scarce. Egypt's effort to address biosafety was set in motion in 1992 by the terms of collaboration between Agricultural Genetic Engineering Research Institute (AGERI) and the Agricultural Biotechnology Support Project (ABSP). A biosafety system was formally instituted by the Ministry of Agriculture through two ministerial decrees: No. 85 (January 25, 1995) establishing a Biosafety Committee, later re-designated National Biosafety Committee (NBC); and No. 136 (February 7, 1995) adopting biosafety regulations and guidelines under the Central Administration for Seed Testing and Certification of the Ministry. This, rather than the much more relevant Law 4 of 1994 on the environment, was the umbrella law for the decrees, for reasons related to the activity being initiated by the Minister of Agriculture (to cater for specific research activities by the Ministry) rather than by a concerted decision of the government as a whole. In fact, other ministries (such as those responsible for scientific research, higher education, environment, health, trade, finance, justice, foreign affairs etc) were neither consulted nor informed in advance of the Decrees.

These described the modalities of use, handling, transfer, and testing of *all* GMOs – but in fact were designed for seed certification. They addressed laboratory practices, greenhouse containment, and small-scale field testing including conducting risk assessments and issuing permits, and called for establishment of Institutional Biosafety Committees at *all* institutions conducting recombinant DNA research. In practice, no functional institutional biosafety committees were established. The NBC does not meet on a regular basis but rather occasionally (at best once or twice a year) and has to deal with tens of applications for field testing of GMO seeds as well as for other research on GMOs, within a couple of hours. It has no secretariat, government financial resources or a technical-administrative system to screen information provided by the applicant – which is often a open-page resume. No formal signed permits are issued: only a decision is recorded in the minutes of the committee meeting. The NBC does not experimentally check the claims made by the applicant or conduct risk assessment. The NBC did not constitute the sub-committees (on health, agriculture, industry and environment) it decided will screen applications or examine those referred to it by the NBC. The contradiction was evident when the Ministry of Health issued Decree No. 242 in 1997 prohibiting the import of any foodstuff produced through the use of GMOs "unless safety is confirmed" and requiring that any imported seeds be accompanied by a certificate from the country of origin confirming that these seeds were not produced from "untested GMO crops." This Decree too did not specify procedures, responsibilities, enforcement or penalties and did not mention how to deal with locally produced foodstuff or seeds.

discussions were initiated, along with public consultation, in order to formulate positions. The public was heavily involved in the debate which was often influenced by interest groups, business, NGOs and a general mistrust of scientists and regulators after the mad cow disease fiasco. By the late 1990s, when negotiations for the Protocol were approaching their conclusion, consensus was established and genuine positions of developed countries gelled – often reflecting popular demands aired by voters. Biosafety became a political issue.

A somewhat similar approach developed in those developing countries where the political environment allowed it, such as in India and some Latin American countries. This did not take place in any Arab country, and the issues only trickled into the media as a ripple effect of the actual negotiations for the Protocol. Governmental consideration was limited, at best, to following positions of others during the negotiations. This explains the fact that, to date, not a single Arab country party to the Protocol has the national legislation, called for in Article 2, which is necessary for implementation while several other developing countries already have legislation and operative regulatory systems in place.

The importance of political will

A notable observation in the above tables is that country preparedness is not seriously influenced by the level of affluence or availability of expertise, a reflection of the fact that lack of political will is a more decisive factor in the state of affairs of biosafety in Arab countries. Thus, none of the eight affluent Arab countries which do not qualify for GEF financial support sought technical assistance of relevant UN agencies to develop an NBF or relied on national expertise for this purpose. A related observation is that countries which received financial support to develop an NBF, and concluded or are close to concluding it, did not then fully develop national mechanisms for implementation but sought or are seeking further financial support for implementation, despite the fact that the cost of development and approval of appropriate legislation is minimal.

Some contradictions within the responses of some countries to the questionnaire were recorded, which again reflect a lack of political will and coordination rather than resources. Thus, while some countries reported availability of "GMO detection facilities" and "risk assessment capability," the same countries reported that it is not known whether shipments of GMOs have been received or not. In some ways, this also applies to reporting availability of liability and redress provisions and the requirement of special shipping documentation for GMO products by some countries which in fact reported lack of legislation regulating the handling and release of such products. Similarly, most Arab countries did not notify the Protocol Secretariat of their capacity building needs, in response to a request to this effect made in 2005, while an expression of such needs was made in responses to the questionnaire.

In the example of Egypt, and in general, one can detect a level of *personification* rather than *institutionalization* of actions relating to biosafety in Arab countries. In many cases, one can conclude that the basic question of who takes responsibility for implementation of relevant regulations is still not settled. In almost all countries, primary responsibility is entrusted to an office responsible for environmental concerns (probably because the mother treaty, the CBD, is an environmental treaty). However, when it comes to implementation which necessarily also touches on health, agriculture, trade, scientific research etc, the question becomes more difficult to answer. One interesting example is in Syria which designated three (in some reports even four or five) independent CNA for the protocol despite the obvious fact that relevant decisions will have to take *all* interests into consideration with a coordinating mechanism based in the environmental agency – as is the case with the vast majority of parties to the Protocol. This is also an example of lack of political will hindering development of effective coordination mechanisms to deal with biosafety.

Positive signs for the future

Despite these negative observations, it is safe to conclude that the international debate on biosafety along with the initiation of GEF-supported activities in several Arab countries has catalyzed action by government agencies and are encouraging the question of national coordination to be considered and settled. The surveys and workshops conducted during the course of

the GEF projects raised both governmental and public awareness of the issues. Even some countries which did not qualify for GEF support carried out somewhat similar activities on their own which were instrumental in satisfying similar objectives. Some more are being planned. The Arab League organized a workshop to review the status of implementation of both the CBD and the CPB in 2006 and a network for concerted action was proposed to be hosted by the Arab Center for Semi-Arid Dry-lands (ACSAD) but did not yet effectively operate. In September 2007, a preparatory meeting was convened by UNEP, FAO and ICARDA (The Regional Consultation on Biotechnology and Biosafety for Agriculture and Environment in the West Asia and North Africa Sub-region), which included also certain non-Arab countries of the region, to draft a regional project on biosafety to be submitted to GEF. The objective of this workshop was "to develop, through a participatory approach, a proposal for an integrated regional framework on biotechnology and biosafety involving major stakeholders." Biosafety regulation is recognized here as "an integral part of the development of any transgenic variety."

In a number of countries, there are strong influences of trade partners and foreign interests with their own positions on biosafety issues. This is evident from the unexplainable delays in taking national actions which at one point seemed to be sailing through. It is known, for example, that the USA, which is by far the biggest producer of biotechnology commodities and seeds, took the European Union members to the World Trade Organization with claims for damages resulting from an EU de facto moratorium on approval of GMOs, since the two trade giants hold opposing views on the regulation of GMOs. At one point, one Arab country announced it would file suit on the side of the USA, and this was denied by higher authorities only after the EU expressed serious displeasure.

The Arab countries' positions on GMOs

Except for a few products for health care, none of the Arab countries currently produce their own biotechnology products – especially commodities. Some have active research programs for developing such products, but, unlike countries such as Brazil, China, India and South Africa, there are no indications that such production could take place in the near future, say the next five to ten years. Thus, apart from the health care field, Arab countries are potential importers rather than exporters of biotechnology products. In fact, the position of the Arab world (being a major world importer of food, especially cereals) on GMO wheat was instrumental in convincing the wheat industry in North America to delay commercialization of GMO wheat in 2004 and until now. With the recent sharp rise in the prices of cereals and vegetable oils in world markets, as a result of moves to use them for producing biofuels, the situation may in fact change. On the other hand, some Arab countries export certain agricultural products such as vegetables and fruits, especially products of organic farming, to the EU which maintains strict biosafety regulations. Since these exports represent significant components of the balance of payment for these countries, they are careful to institutionalize national regulations in conformity with those of the importers.

Independent studies indicated that several imported GMO commodities are in the markets of Arab countries, un-declared and un-labeled. These include corn and maize (sometimes containing the Starlink variety which is not approved for human consumption), long grain rice (which was contaminated with a variety not approved for commercialization) and soybean seeds, oil and cake.

XI. CONCLUSIONS

1- Biosafety is still not a major public or policy-makers issue in Arab countries, except from a food safety perspective.
2- Biosafety is essentially entrusted to the environmental agencies but with several other actors intervening rather than cooperating.
3- Arab countries are potential importers, rather than exporters, of most biotechnology products and this situation is not likely to change in the near future, especially in field of commodities.
4- Despite financial and technical support to developing Arab countries all still lack legal regulatory mechanisms in place and their participation in the Protocol's BCH is extremely weak.

5- Some GMOs commodities gain access to Arab countries un-declared and un-labeled due to lack of legislation, enforcement mechanisms and appropriate administrative structures.
6- Directing resources to the areas of biotechnology development and public communication will basically means that skills in areas such as risk assessment, which is essential for importing countries to be able to make informed decisions under the AIA procedure of the Protocol, would not be well developed. Without external assistance, capacity in risk management would be overlooked and Arab countries would not be able to effectively manage risks to the conservation and sustainable use of biodiversity within their territory or protect their trade interests.
7- Other efforts needed are: training of the representatives of different ministries and customs staff in the field of GMO identification, AIA procedures, risk management, producing manuals for private companies, which detail their obligations under the biosafety legislation, and building scientific capacity to monitor longer-term impacts on environment, human health and biodiversity through a risk management program;
8- Activation of biosafety issues must await political will and a role for civil society. Unless this takes place, biosafety activities in Arab countries will not be sustainable and they will continue to receive biotechnology products un-declared and un-labelled. Negative impacts on development of indigenous biotechnology, biodiversity, competitive trade advantages, socio-economic norms and health would be significant.

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Environmental Impact of Wars and Conflicts

Hassan Partow

I. INTRODUCTION

Middle Eastern history is scarred by war. At the time of writing, this includes two major ongoing international conflicts (the Arab-Israeli conflict and Iraq), and at least five internal conflicts (Algeria, Somalia, Sudan, Western Sahara/ Morocco and Yemen). Lebanon suffered a short but major war in summer 2006 and since then has been in turmoil. Several countries have a combination of both international and civil conflict, including Iraq, the Palestinian Territories and Somalia. In addition, a wave of international terrorism has swept across the region. While the human horror and agony of war is more or less captured by the media, the environmental consequences – the "collateral damage" – is scantily or selectively covered, if at all. Likewise, Arab countries' policies and decision makers have made limited progress in recognizing and addressing the complex environmental dimensions and impacts of conflict. This chapter aims to shed light on both the environmental causes and costs of armed conflict in the Arab world, and what has been and could be done in response.[1]

II. ENVIRONMENTAL LINKAGES TO CONFLICT

Conflicts are typically made up of complex and multiple layers of causality, ranging from ideologies, politics and personalities to economics and trade. Natural resources, or in environmental parlance "ecosystem goods and services," have also been recognised as one of the potential drivers of conflict. Scholarly debate on the role of the environment as a contributory factor in instigating violent conflict is generally framed around two main precepts: (i) the "resource curse" or paradox of plenty and (ii) resource competition under conditions of environmental scarcity, degradation and long-term change. Whether from the perspective of resource abundance or scarcity, it is important to emphasise that the environmental link to conflict is largely indirect and works in combination with other social, political, and economic stresses. These concepts are discussed below within the context of recent conflicts in the Arab world.

The Resource Curse

Oil is modern civilization's prized and master natural resource. Geography has it that the Arab region holds at least half of the world's proven oil reserves.[2] Although one would expect oil wealth to be a blessing, in some countries it has proved an impediment. The curse of oil is a multi-faceted predicament. According to this theory, the windfall of wealth generated by oil revenues may undermine good governance by fomenting corruption, adventurism and violent conflict. Furthermore, an economy dominated by oil has a damaging impact on other sectors (particularly agriculture) by squeezing them into the periphery and stifling potentially innovative activities that may have been the best means for technological progress and a more sustainable path to development. The Gulf states with their small populations are an exception as they are able to guarantee their citizens high standards of living and generous consumer wealth. Consequently, governance in the moderated form of "fatherly" rule is generally the norm. It is larger, more populous, middle-income countries such as Iraq, however, that may be vulnerable to being trapped by the oil curse. This is because the likelihood of diverting oil wealth in favour of security measures for military purposes and to subdue social unrest is relatively high.

In addition to amplifying the risk of violent conflict, bad governance in some oil producing states undermines sustainable environmental management, as this is built upon the principles of information accessibility, public participation, transparent decision-making based on cost-benefit analysis and accountability. These checks and balances are difficult to achieve under weak governance and hence without restraints big oil operations are prone to having negative environmental impacts. To cite an example, although Environmental Impact Assessments (EIAs) are required under Sudanese law, these are not enforced in practice. The consequent failure of the oil industry to adequately integrate environmental considerations in their projects, has spurred resentment from local communities, particularly in non-Arab South Sudan, (mainly due to the impacts of untreated produced water on pasturelands). Coupled with growing disputes over benefit-sharing, the industry's poor environmental performance has further aggravated disputes over oil in Sudan. It should equally be noted that an absence of or inadequate environmental governance can also be a potential source of conflict for other major infrastructure projects. For example, the ongoing construction of the massive Merowe dam and other planned dams in northern Sudan has been a source of tension, erupting on more than one occasion into violent confrontations. While Merowe is the first dam project in Sudan for which an EIA was prepared, the EIA license was delivered two years after the project physically started and no consultations were held with local representatives and communities on its findings.

At the same time, international competition over the sources of oil has placed the Arab world at the crossroads of a global resource conflict. The last Gulf War in 2003 is arguably partly motivated by the desire to secure the safe flow of oil from the region. There is also scepticism that the international crisis over Darfur is to some extent driven by a contest over energy sources. At the national level competition for oil revenues, whether in the form of budget allocations between government ministries or fighting between militias, fuels and prolongs conflict. Although the North-South conflict in Sudan predates the discovery of oil, competition for ownership of the country's oil reserves was a driving force sustaining the conflict. Wrangling over the division of oil wealth has contributed to worsening sectarian violence in Iraq. At the local level the ongoing struggle in Basrah to control its major oil industries and the smuggling trade is another case in point.

Environmental scarcity, degradation and long-term change

Although not in diametric opposition to the "resource curse" paradigm, the other end of the debate focuses on environmental scarcity and degradation as a cause of conflict. The underlying premise is that resource scarcity has the potential to trigger social breakdown and violent conflict, the foremost example being the age-old struggle between pastoralists and farmers, religiously symbolized in Cain's (the farmer) slaying of his brother Abel (the shepherd). In ecozone terms, this is sometimes referred to as the "desert versus the oasis" syndrome.

In the predominantly semi-arid environment of the Arab world, the most prominent environmental drivers of local conflict are pastoralist and sedentary competition over agricultural and grazing lands and water sources. It is important to note, however, that conflict over these resources is largely limited to specific environmental settings, and is overall linked to conflict in a minority of cases in the Arab world. For instance, in the populous, irrigated Nile and Tigris-Euphrates valleys clashes between pastoralists and farmers are comparatively rare due to the regularity of water flows and limited overlap of pasture and irrigated lands. Historically conflict between the two groups had less to do with resource scarcity and was largely a result of pastoral and state rivalry over political and economic domination, which in the modern Middle East has virtually ceased.[3] The strong presence of central government, the steep decline in nomadic populations and the reliance on artificial water sources are some of the factors reducing such friction.

On the other hand, clashes between pastoralists and farmers are more frequent in environments where both pastoralism and agriculture are dependent on rainfall and water is primarily drawn from naturally occurring point sources. The critical factor is therefore *rainfall*. Extreme fluctuations in precipitation regimes, characteristic of arid and semi-arid regions, render farmers but particularly pastoralists highly vulnerable to

water scarcity, as their entire livestock herds are at risk of being wiped out. The aim of pastoralism is to adapt to this non-equilibrium ecology through mobility. It is particularly during periods of drought that the relationship between pastoralists and farmers begins to strain and risks falling apart. In the past, environmental stress and social tensions could be alleviated as land was relatively plentiful and pastoralists could migrate to new areas. With artificial borders restricting nomadic movement, large increases in human and livestock populations and the expansion of mechanized agriculture on marginal lands, mobility options have significantly diminished, increasing the likelihood of conflict between pastoralists and farmers.

The abovementioned scenario is prevalent in the sub-Saharan limits of the Arab world, namely in Somalia and Sudan. Specifically it is in the Sahel and Savannah zones that this situation has become most acute, due primarily to their suitability to both pastoralism and rain-fed agriculture. The most notorious example of a conflict occurring in such context is the ongoing crisis in Darfur. Clearly, the war in Darfur can not be simply reduced to a resource conflict and its highly political, economic and ethnic aspects among others need to be fully acknowledged. At the same time, in order to adequately understand the nature of the conflict it is important to recognize that environmental conditions played an important role in precipitating localised conflicts between black Arab pastoralists and African farmers, which became increasingly frequent with the onset of the prolonged drought of the 1970s and reached new heights in the 1990s. Recent studies on conflict in Darfur reveal that competition over grazing and water rights accounted for 30 of the 41 clashes recorded in the period from 1930-2000.[4]

Simply described the Arab tribes (as well as non-Arab Zaghawa) attempted to escape prolonged drought by seeking refuge in the lands of the Fur and Masalit which are rich in water and pasture, such as in the highlands of Jebel Marra. Previous mutual agreements between pastoralists and farmers began to unravel as the former began to turn up earlier than normal (before or during harvest time) and would overstay for undetermined periods. Confrontation became inevitable. The violence escalated to such an extent that casualty figures rose to an estimated 200,000-500,000 deaths in addition to two million displaced. This environmental predicament is not unique to Darfur but shares many similarities with other conflicts between pastoralists and farmers in dryland central Sudan, such as in Southern Kordofan. Except that in Southern Kordofan, mechanized agriculture had a greater role than rainfall vagaries and drought in the instigation of conflict. The horizontal expansion of mechanized agriculture on the clay plains in the high rainfall savannah belt, the traditional winter grazing lands of Hawazma Baggara (cattle herders) and Shanabla camel nomads drove them deeper into the Nuba Mountains in search of water and pasture for their livestock. Again, large-scale armed conflict broke out between pastoralists and the indigenous Nuba farmers. Disorganized and poorly managed mechanized rain-fed agriculture, covering an estimated 6.5 million hectares of which 45-66 percent comprises unauthorized holdings, continues to be a major cause of violent clashes between pastoralists and farmers in central Sudan.

Another variant of the conflict between pastoralists and farmers sees both groups encroaching on forest and wildlife reserves due to scarcity in agricultural and grazing lands, such as in the Dinder National Park (DNP) that is the size of Lebanon,

CLIMATE CHANGE AND CONFLICT

Environmental degradation is further aggravated by climate change, which is essentially acting as the motor spinning the scarcity-degradation-conflict cycle ever faster. In Darfur, for example, a major and long-term drop in precipitation, ranging from 16 to 34 percent in over 80 years, has been recorded with obvious impacts on rangeland quality. Climate change forecast models predict that compared to the 1961-1990 'baseline climate', areas fringing the Sahara such as Northern Kordofan, are set to experience a 0.5 to 1.5°C rise in average annual temperatures by 2030 and 2060 respectively, with an average rainfall decline of five percent. The impacts on agriculture are likely to be disastrous with an estimated 70 percent drop in crop yields. Due to declining rainfall, the spread of the desert which has shifted southwards by an estimated 50 to 200 km since 1930 is expected to continue. Clearly, climate change is a major stress factor that has the potential to create an overwhelming environmental crisis in the Sahel and accelerate the severity, scale and pace of conflict dynamics.

and which is Sudan's largest. In such cases, the conflict which often erupts into violence is between pastoralists and farmers on the one hand and government officials on the other (forest rangers and game wardens who are part of the Sudanese unified police force). As the DNP flanks Ethiopia, border forces have also occasionally been caught up in the fighting due to cross-border pastoral incursions from both sides.

Competition between pastoralists and farmers is further propelled into a negative spiral by environmental degradation. The two principal factors are on the one hand overstocking and overgrazing depleting rangelands, and on the other expansion of both traditional and mechanized agriculture into marginal lands that often encroach on livestock migration corridors and lead to extensive vegetation clearance and deforestation. Combined these pressures accentuate desertification, soil erosion and soil exhaustion. As the natural resource base degrades and dwindles, demands on ever scarcer pastures and water continue to rise due to the high human and livestock population growth rates. For example Sudan, which has the second largest herd on the continent, saw its livestock population increase more than six-fold in less than fifty years; from 22 million in 1959 to 135 million in 2004. Concurrently at the national level, rangelands have shrunk by an estimated 20 to 50 percent, largely due to conversion into mechanized rainfed agriculture. Consequently, the struggle between pastoralists and farmers is gridlocked in a self-reinforcing vicious circle of growing scarcity that ultimately increases the likelihood of violent conflict and reduces the chances of compromise.

In a similar light, an environmental scarcity analysis provides deeper insight on the nature of the Arab-Israeli conflict. The delimitation of borders in the region has at least in part been inspired by the aim to secure command over hydrostrategic territory. For instance, the extension of the boundaries of mandate Palestine northwards was partly motivated by the aim of incorporating Lakes Tiberias and Huleh as well as some of the Jordan headwaters.[5] Securing control over the Jordan River's upper catchment is considered one of the key factors behind Israel's occupation and annexation of the Syrian Golan Heights. Expansion of settlements and the course of the Separation Wall have also been linked to Israel's interest to retain control over the West Bank's strategic recharge zones and rich aquifer reserves.[6] In Gaza, which relies predominantly on wells, the problem is that of seawater intrusion from over-pumping of groundwater. And finally, suspicion over Israeli intentions to tap the Litani River in Lebanon is another source of contention.[7] Although not necessarily the sole or prime impetus of war, water scarcity and gaining command over water producing areas is an integral part of the Arab-Israeli conflict.

III. ENVIRONMENTAL IMPACTS OF CONFLICT

Scientific assessment of the environmental effects of conflict are generally categorised as direct and indirect impacts. Direct impacts relate to those whose occurrence may be physically and lineally linked to military action and which typically arise within the immediate short-term (up to six months), whereas indirect impacts are those that can be reliably attributed to the conflict but which usually interact with a web of factors and only become fully manifest in the medium to longer run. Some examples of direct impacts include environmental contamination from bombing of industrial sites, deliberate natural resource destruction, and military debris and demolition waste from targeted infrastructure. Indirect impacts include the environmental footprint of displaced populations, collapse of environmental governance and data vacuum, and lack of funding for environmental protection. This section provides a brief synthesis of the environmental fallout of conflict in three Arab countries: Iraq, Sudan and Lebanon.

Iraq

Given the magnitude of military conflict in Iraq, it is no surprise that its environment has sustained greater war damage than any other country in the Arab world and indeed perhaps worldwide. Over the past three decades the country has leaped from one major war into another and this for the most part in a context of internal civil strife and stern international sanctions.

The Arab world's longest war in the 20th century was Iraq's eight year war with Iran (1980-1988), whose hallmark of trench warfare and

chemical weapons recalls World War One. The heaviest fighting took place in the area of the Shatt al-Arab estuary and the Mesopotamian marshlands (*Al-Ahwar*). At the same time, the entire ~1,500 km length of the Iran-Iraq border, which remains heavily mined to this day, was an active front in which chemical weapons were deployed by the Iraqi Government both against Iran and Iraqi citizens. Despite the lethality of the chemicals employed, their relatively short environmental persistence (ranging from 30 minutes for tabun to 2 years for mustard gas) means that any remaining residue represents a low risk today. Despite occasional raids on cities, the rest of the country was largely spared from military action and hence direct environmental impacts. From space, the heavily scarred landscape of the Iran-Iraq border, with its trenches, bunkers, weapon pits, moats and mine fields, is today reminiscent of a cratered lunar landscape. The physical disturbance of the landscape (wetland and semi-desert) by major earthworks has been so severe that old topographic maps are simply no longer valid. The construction of defensive works and military causeways inside the marshlands contributed to their desiccation, whose surface area had reduced by 20-25 percent in 1990. The extensive date palm plantations fringing the Shatt al-Arab estuary were devastated on both banks of the border, with millions of trees destroyed by shelling, fire and deliberate clearance. The marine environment of the Gulf suffered considerable damage during the so-called "tanker war" in which over 500 commercial vessels were destroyed and major oil installations targeted; the worst incident being the bombing of the Iranian Nowruz platform where almost 2 million barrels of oil were spilled. The conflict's shipwreck legacy remains an important problem to this day with potentially significant environmental implications that need to be considered in future salvage operations. Finally, the last stages of the war also witnessed the Anfal campaign, in which an estimated 4,000 Kurdish villages were destroyed with evident environmental impacts ranging from large-scale population displacement and destruction of orchards, cropland and pastures. At the end of the war, Iraq's economy was bankrupt and the work of the environment department, established in 1972 under the Ministry of Health, was now essentially limited to routine sampling of drinking water quality.

It is in this context that Iraq entered into another war with its invasion of Kuwait in 1990. Although the war lasted less than six weeks, the air campaign targeted all types of infrastructure, military and civil, including sewage and water supply plants, power stations, bridges, oil refineries, the manufacturing and petrochemical industries as well as nuclear, biological and chemical weapon facilities. Over 290 metric tons of depleted uranium projectiles were fired into Iraq during the 1991 Gulf War (compared to 9 tons in Kosovo and 3 tons in Bosnia and Herzegovina). It can be assumed that the environmental fallout of such a massive bombing campaign is potentially significant although it was never scientifically assessed. Immediately thereafter Iraq was placed under strict UN sanctions and made to pay compensation for war damages including environmental ones. At the same time it was denied the right to restore key social services and infrastructure, including importation of spare parts to rehabilitate wastewater treatment plants such as that of Al-Rustamiyah in Baghdad which was releasing 300,000 m^3/day of untreated sewage into the Tigris River with grave humanitarian and environmental consequences.

Meanwhile, the UN Compensation Commission (UNCC) required Iraq to pay US$ 243 million to Kuwait, Iran, Jordan, Saudi Arabia and Syria to assess environmental damages allegedly sustained. With more than 600 oil wells detonated producing up to 500,000 metric tonnes of pollutants per day, 25-50 million barrels released on land and the largest marine oil slick in history (6-8 million barrels), the devastation wrought on Kuwait and the Gulf's marine environment was colossal. The most readily visible sign of environmental damage were the thick clouds of black smoke billowing from the burning well fires for over a month that blanketed the sun and affected air quality in several countries. In the case of Kuwait alone, the damage was estimated at US$ 40 billion representing 16 percent of its total war claims. Today, the volume of scientific environmental literature on the war's impacts on Kuwait and the other countries (excluding Iraq) is unrivalled when compared to other conflicts. Finally, the UN Special Commission (UNSCOM) charged with neutralizing Iraqi weapons eliminated hundreds of thousands of litres and over one thousand metric tonnes of chemical warfare

agents and munitions. Environmental contamination generated from such destruction has not been scientifically assessed.

Soon after the declaration of the 1991 ceasefire, Iraq was engulfed in a major popular uprising that was ultimately quelled by the government. Driven to punish their opponents who had sought refuge in the Mesopotamian marshlands, the Iraqi Government launched a massive engineering campaign to drain the second largest wetland system in the Arab world (after the Sudd in Sudan). Huge canals and earthworks were constructed to divert the waters of the Tigris and Euphrates around the marshes and into the Gulf. The net result was that 93 percent of the marshlands had vanished by 2002, shattering the indigenous Marsh Arabs' millennial way of life. Although the destruction of the Mesopotamian marshlands with its substantial biodiversity wealth represents the single largest ecosystem loss in the Arab world in recent times, it has not expressed real concern over this major disaster despite its wider regional ramifications.

Crippled by sanctions, Iraq was in a state of sluggish atrophy when war broke out in March 2003. Although the bombardment was significantly greater than that of the 1991 Gulf War, it was mainly targeted at military facilities, and civil infrastructure was largely spared. In fact, the principal cause of environmental damage emanated from extensive looting and sabotage of military and industrial facilities as well as oil installations and pipelines. Of the five sites identified by the United Nations Environment Programme (UNEP) as priority contaminated "hotspots", four were looted and one was a military scrap yard. There is ongoing debate on whether the looting was caused by poor planning or is the result of negligence in which case damage sustained should be classified under direct environmental impacts. In any case, the failure to secure such critical installations as the largest Iraqi nuclear programme at Tuwaitha reveals the extent of carelessness and low priority attached to the environment. The net result is that Iraq is littered with thousands of contaminated sites which are continuing to grow every day due to incessant sabotage and military operations. It will only be possible to scientifically assess and quantify the full environmental magnitude of this latest war when the security situation allows for scientific fieldwork to take place.

Several media reports as well as some scientists inside Iraq have been linking depleted uranium (DU) with a reportedly growing incidence of cancer and birth defects, which is grounded more on anecdotal cases and rumour than scientific evidence. For such a connection to be made Iraq would first need to establish national cancer and birth defects registries that it presently lacks. This is not to say that the potential impacts from DU are insignificant but that such claims are unsubstantiated and risk compromising the credibility of future scientific studies. The total amount of DU used in the 2003 war is unknown, but speculative figures from various studies range between 170 to 1,700 metric tons. The United States, while admitting to using DU, has not disclosed how much and where it was used, while the United Kingdom has reported firing 1.9 tons. Limited studies conducted by the Iraqi Radiation Protection Centre in collaboration with UNEP in four selected areas indicate that radiation levels are within natural background levels and well below threshold levels requiring remedial intervention. This would suggest that there appears to be no special threat to the general population and that such risks where they do exist are localised. Persons at greatest risk of radiation exposure are those who may come into direct contact with DU munitions and DU contaminated equip-

ment, particularly those working in scraping operations. It is therefore important that DU contaminated areas be identified and assessed and a monitoring programme for potentially affected populations established.

At the same time, it is important to highlight some of the positive environmental developments that have taken place following the 2003 war. These include the re-flooding of 60 percent of the marshlands mainly from actions taken by local communities which have been reinforced by interventions from the Ministry of Water Resources and Irrigation. A fully-fledged Ministry of Environment has been established and the country has finally opened up to the wider world enabling the transfer of environmental knowledge and technology as well as allowing Iraq to actively engage with international environmental agreements. Indeed Iraq's first accession to an environmental treaty was to the Ramsar Convention on Wetlands in 2006 with the designation of the eastern Mesopotamian marshlands (Hawizeh) as its first protected site; this reflected a full turnaround from its previous policy to drain wetlands.

Sudan

The direct environmental impacts of Sudan's civil war (1962-1972; 1983-2002), Africa's and the Arab world's longest, have been relatively limited. It is in reality a highly complex mosaic of conflicts, the main one being the long-standing war in South Sudan that over time evolved to encompass the Nuba Mountains, southern Blue Nile, eastern Sudan and most recently Darfur, which is presently the only remaining active combat zone. Geographically, armed conflict has been confined to the aforementioned areas, meaning that up to 60 percent of the country, with the exception of the North and most of the centre, has witnessed fighting at one time or another. The main reason why the conflict despite its duration has not had a major direct impact on the environment is because it was essentially a guerrilla war fought with light weapons such as the AK 47 rifle. Moreover, the country's small industrial base, particularly in the underdeveloped and marginalised areas where fighting occurred, meant that there were few military or civil targets that could create significant physical damage or generate a hazardous waste stream. This is borne out by the fact that the single most significant "industrial" target in Sudan's conflict to date is the Jonglei canal excavator sabotaged at the inception of the second phase of the civil war in 1983, the environmental impact of which is negligible.

The greatest military legacy of the conflict is that of landmines and other explosive remnants of war, affecting 32 percent of the country mainly in southern Sudan. While landmines in and of themselves are generally of minor environmental concern, their main impact is to impede access to land and natural resources such as pastures on which the rural population is highly dependent. In Sudan, some areas have been out of bounds for decades, diminishing the population's resource base and thereby potentially setting in train a cycle of scarcity and environmental degradation. On the other hand, reduced access and depopulation can have positive impacts such as in the Nuba Mountains where there has been extensive regrowth of woodland. Similarly, the Sudd wetlands became an impenetrable "buffer zone" during the conflict, providing refuge for wildlife from poachers. Recent surveys in 2007 in the area of the Sudd have revealed the existence of various wildlife species such as elephants, ostriches, lions, leopards, hippos, buffalo and large populations of migrating antelope species.[8] Finally, in Darfur there have been consistent reports from local communities as well as by other observers that militias have been using "scorched earth" tactics destroying trees, crops and pastures. Deliberate deforestation and vegetation clearance could have important impacts on the land, water and biotic regimes but it is not possible to quantify the significance of such damage due to a lack of data. Such destructive actions are also likely to strengthen the aforementioned feedback loop of environmental degradation, scarcity and conflict that is already underway in Darfur.

The prolonged length of the civil war has meant that indirect secondary impacts of the conflict are significant. The most severe environmental consequences have been caused by the displacement of an estimated five million people, which is continuing to rise due to the ongoing conflict in Darfur. Representing the largest displaced population worldwide, it has led to deforestation and devegetation around camp areas, unsustainable

groundwater extraction in camps and the development of a relief economy that may exacerbate demands on natural resources. Darfur, with some 2.4 million displaced, may be the most environmentally significant displacement case in the world today due to its fragile dryland conditions. Looting of natural resources in conflict zones by all sides was widespread, the most significant being the extraction of high value timber in the south and fuelwood for charcoal in the Nuba Mountains. Ivory poaching decimated elephant and rhinoceros populations in southern Sudan and bushmeat was hunted for food by the warring parties. Environmental governance collapsed not only in active conflict zones but nationwide and both the military as well as civilians took advantage of the opportunity to act with environmental impunity. The conflict also meant that most of the country was inaccessible for science-based data collection further limiting rational decision-making for resource management and conservation. Finally, the war economy created a funding crisis as provisions for sustainable environmental management practically did not figure in the government's fiscal budget.

Lebanon

Lebanon has been the scene of both civil conflict and international proxy wars since the mid-1970s and remains the only active battlefront in the Arab-Israeli conflict. In July 2006, a 34-day war broke out between Israel and Lebanon causing wide-ranging damage to its civil infrastructure and significant environmental damage. One of the most enduring images of this conflict is the estimated 10,000 - 15,000 tonnes of oil released into the Mediterranean from the bombing of the El-Jiyeh power plant. Affecting 150 km of the 220 km Lebanese coastline and extending partly into Syria, the oil spill severely impacted its sandy beaches and rocky headlands.[9] Given the heavy type of oil contained in the storage tanks, a considerable proportion sank within the vicinity of the power plant, where it "smothered biota and significantly impacted the seabed."[10] UNEP analysis of seawater quality, marine sediment and biological indicators such as oysters revealed that hydrocarbon contamination levels are generally within background levels for the region. On the whole, therefore, marine life appears to have largely escaped the worst of the disaster. Nevertheless, given the risk of the oil's remobilization it is important that a monitoring system be established to check pollutant concentrations. In the bigger picture, the main threat to the quality of Lebanese coastal waters continues to come from the 53 wastewater outfalls dumping untreated sewage into the sea (which can be partially attributed to the lack of investment due to past conflicts).

The war's main environmental impacts relate to the substantial volumes of waste generated. The most serious has to do with the vast amounts of demolition rubble generated from the destruction and damage of 30,000 housing units as well as other infrastructure such as bridges and manufacturing facilities. There is generally a low risk of contamination from such inert debris and the main issue here is that of waste handling and disposal, particularly as it is overwhelming existing dump sites. The other principal challenge stems from the disposal and treatment of the collected waste oil spill including contaminated soil, especially as Lebanon lacks remediation facilities. Contamination from targeted industrial sites was generally low and localized, but a handful of these require clean-up. Wide-spread damage to Lebanon's water supply and sewage networks also occurred amplifying the pre-conflict acute deficiency in wastewater treatment capacity, which had recently been undergoing comprehensive upgrading and modernisation.

Despite unsubstantiated press reports that DU had been used in the conflict, UNEP in collaboration with the Lebanese Government conducted an extensive field survey using state of the art equipment and found that there was no evidence of their use. One of the major indirect impacts of the war stemmed from the legacy of up to one million unexploded cluster bombs dropped in South Lebanon. Agricultural land was hardest hit accounting for 62 percent of the total cluster bomb contaminated area. This not only led to major losses in the 2006 harvest season, but effectively rendered a large swath of South Lebanon out of bounds for the local population. Again, the resulting scarcity in farmland from cluster bomb infestation has the potential to generate a new socioeconomic dynamic and set in train a cycle of poverty and environmental degradation. Finally, the conflict led to the outbreak of fires and the loss of economically valuable tree species in southern Lebanon impairing the government's fledgling reforestation programme.

IV. RESPONSES TO THE ENVIRONMENTAL IMPACTS OF WAR

At the country level, national response has been variable but on the whole weak. It was rapid and effective in Lebanon where a coordination cell was established to deal with the oil spill and international support was successfully mobilised for the environment sector. While in Iraq and Sudan the response has been slow and limited due to weak capacity, it is gradually developing. There has been no coordinated regional reaction and each country has essentially had to rely on its own resources.

At the international level, the main response to the environmental consequences of conflict has come from the United Nations Environment Programme (UNEP). The Gulf War of 1991 was the first time that UNEP examined the environmental risks of a conflict, producing a series of desk studies which, however, were curtailed by lack of empirical fieldwork. The defining milestone for UNEP came in 1999 with the publication of its groundbreaking scientific assessment of the Kosovo conflict, which also included for the first time a detailed field-based evaluation of DU contamination. Catalysed by its successful experience in the Balkans, UNEP institutionalised its work in this field by establishing a dedicated Post Conflict and Disaster Management Branch in 2001 with a global mandate to address the environmental impacts of war.

UNEP's scope of work on environment and conflict is centred on supporting post-conflict countries in four main areas: (i) scientific assessment of environmental impacts; (ii) remediation of contaminated "hot spots"; (iii) building and strengthening environmental governance capacity; and (iv) integrating environmental considerations in post conflict reconstruction and development. Most recently, in early 2008, UNEP launched a new programme on the role of the environment in peacebuilding which aims to address the environmental causes of conflict. It will also entail an "environmental diplomacy" component that will actively seek to promote internal reconciliation within conflict affected countries, as well as catalysing re-engagement with neighbours through dialogue and cooperation on shared ecosystems and resources.

Of UNEP's twelve post-conflict assessments, slightly under half have been in the Arab world including Iraq, Lebanon, the Occupied Palestinian Territories, Somalia and Sudan. These flagship reports have by and large succeeded in raising the environment's profile within high-level political agendas, both nationally and internationally. Presenting a synoptic overview of the key environmental challenges facing post-conflict countries, the assessments address the concept of 'environment' in its broadest sense to include issues that may otherwise be classified under energy, forestry, public health, agriculture, transport, education, etc. It also looks through the lens of time at the environmental history and chronic problems pre-dating the conflict. Furthermore, strategic and prioritised recommendations for remedial action are also provided. All the reports have been wholly or partly translated into Arabic and published within a relatively rapid timeframe in both hardcopy and electronic formats, ensuring wide dissemination. For example, the Lebanon report was published five months following the end of hostilities, while for Gaza it was completed within six months of Israel's disengagement.

There is no standardised template for conducting these studies as each assessment is tailored to the nature of the conflict, the priority thematic issues under consideration and the operational constraints within the country concerned. For example, in Lebanon and Gaza the assessment heavily relied on detailed laboratory analysis, while given the size of Sudan it was based on rapid but extensive field visits, satellite image analysis and intensive consultations with a wide range of stakehold-

ers, including civil society. In the case of Iraq, as UNEP was unable to field its experts on the ground due to security restrictions, it trained national partners on sampling methodology and field verification to backstop satellite image analysis. Samples were then taken to international laboratories for independent analysis.

Overall, the common hallmark of UNEP's reports is their timeliness, accessibility to the non-environmental expert and their attractive visual layout combining photographs, satellite images, maps and graphics. The assessments are also distinguished by the rapidity with which UNEP's scientific team is deployed to the field working under a military setting and the international credibility of its scientific findings which are conducted in a transparent manner with the full engagement of national partners. Finally, another practical benefit of these reports is their proven track record in mobilising donor interest and funding to implement follow-up projects and activities.

Drawing on the findings of its assessments, UNEP has designed and delivered environmental clean-up and mitigation measures to reduce direct risks from conflict, such as in Iraq where it collected and secured highly hazardous materials. In Lebanon, UNEP is in the process of strengthening the government's environmental monitoring system to track contamination levels that may have been generated by the conflict. In Darfur work is underway to replant three million trees to help combat land degradation and alleviate fuel wood shortages around Internally Displaced Persons camps as well as help create the necessary conditions for an eventual return process.

Strengthening environmental governance has been UNEP's core activity in post-conflict countries. This has involved capacity building programmes covering a wide spectrum of topics ranging from law and policy development to laboratory training such as in Iraq and Sudan, as well as targeted technical support on specific issues (e.g. hazardous waste) for Palestinian officials. In view of the rapid economic growth rates that are characteristic of countries emerging from conflict such as Sudan and Iraq, UNEP has been providing technical expertise both to the humanitarian community and national authorities to help ensure the environmental sustainability of their interventions and reconstruction investments. Finally, UNEP has brokered technical cooperation between Iran and Iraq, Iraq and the Regional Organization for the Protection of the Marine Environment (Kuwait Action Plan), the Palestinian Authority and Israel, and between North and South Sudan.

Other international organisations have also been extending their support to post-conflict countries to include an environmental component, particularly the United Nations Development Programme and the World Bank. On the whole, however, these interventions have largely been on a case by case basis and are typically designed with a specific thematic focus (e.g. solid waste, forestry); where the environment in its wider sense is not the driving concern. Moreover, these organisations have a very large portfolio and so do not carry the "environmental flag" in the same way that UNEP does. Nevertheless, they do bring significant resources and expertise to the table and their long-term in-country presence adds continuity and sustainability to their efforts. In 2005, the UN established a Peacebuilding Commission which has begun to consider the environmental connection to conflict in its development of integrated recovery strategies. Environment as a sector has also been incorporated in various coordination mechanisms set-up to consolidate the work of international organizations in post-conflict transition settings, such as the UN Development Group and Inter-Agency Standing Committee at the global level, and the UN Country Team at the country level.[11]

Both environmental and conflict-resolution non-governmental organisations have also been responding to the specific environmental needs of post-conflict countries and in some cases have proven to be important sources of data and expertise. Some of the key players include, Green Cross International, Greenpeace, International Union for the Conservation of Nature (IUCN) and the World Wide Fund for Nature. For instance, Green Cross conducted scientific environmental analysis of the Gulf Wars, while Greenpeace has been monitoring the depleted uranium issue and was the first to raise the alarm about the environmental fallout from the ransacking of the nuclear facility in Tuwaitha. Greenpeace was also very quick to deploy assessment teams to Lebanon and Iraq immediately

following the conflict. Conservation organisations such as IUCN and Birdlife International have supported biodiversity conservation work in Kuwait following the 1991 war and more recently in Iraq, while the Wildlife Conservation Society has undertaken some pioneering wildlife surveys in southern Sudan. At the same time, national NGOs have been actively engaged, for instance by playing a lead role in the clean-up of the oil spill in Lebanon and in articulating the linkages between conflict and environment in Sudan. In Iraq, civil society has generally been struggling but a few environmental NGOs have emerged after 2003. Finally the role of the media in drawing public attention to the environmental impacts of conflict has also been growing. In the Arab world, *Environment and Development Magazine (Al Bi'a Wal Tanmia)* has been systematically covering the topic in Iraq, Lebanon, Palestine and Sudan.

V. WHAT SHOULD BE DONE?

The Arab world's foremost conflict traps today – Iraq, Palestinian Territories, Somalia and Sudan – as well as the 'swing states' of Algeria and Lebanon, represent the ultimate challenge to its future. For their predicament will not be limited within their borders but will also in a major way define and shape the prospective outlook of the entire region. The present status quo of these war-torn societies living in miserable conditions is a harbinger of future problems for the whole Arab world. Along the same lines, the environmental fallout of conflict ranging from the impacts of refugees to transboundary pollution, as epitomised in the Gulf Wars, will continue to inexorably worsen.

What should the Arab world do to protect its environment from the furores of war? There are two possible entry points for intervention: addressing the environmental links to conflict and responding to post-conflict environmental impacts. More often than not under appropriate circumstances, shared ecosystems and natural resources are more likely to provide the potential seeds of cooperation than conflict. This is poignantly illustrated by the "Picnic Table Talks" over the allocation of Yarmuk waters between Israel and Jordan in the 1950s and by the fact that "water, energy and environment" was one of the key tracks in the negotiations culminating in their 1994 peace treaty.[12] One of the few areas where there continues to be regular contact between Israeli and Palestinian experts is on water, which has also been included as a "core issue" with the resumption of talks in early 2008.[13] This demonstrates the potential role of the environment as a neutral concept in providing a platform for dialogue and confidence building for some of the most complex crises facing the world today.

Tackling the "resource curse" that characterizes countries such as Iraq and Sudan requires the development of novel policy and legal frameworks and instituting practical mechanisms for more robust and accountable oversight. Subscribing to international norms, such as those established under the Extractive Industries Transparency Initiative (EITI) and translating them into national laws, is a good starting point for oil producing Arab countries. Both the EITI and similar initiatives such as the Kimberley Process have demonstrated that even very modest steps can go a long way towards improving natural resource governance.

Equally, environmental scarcity, degradation and long-term change should not be taken to convey a message of hopelessness that environmental decline is inevitable. There are always numerous opportunities for contingency including risk reduction, preparedness and early warning. Indeed with the right policies and strategies, environmental scarcity could be a stimulant to technological innovation and institutional reform, as in the cases of Israel, Japan and Switzerland. In places such as Darfur, resources are indeed scarce under prevailing socio-economic circumstances. This, however, is not necessarily because there is an absolute shortage in arable land and water but rather due to ineffective policies, mismanagement and development politics that have marginalised the region. Although Darfur is a major headwater catchment for both the Nile and Lake Chad basins, there is a major data vacuum and underinvestment in tapping its relatively rich water resources. Clearly, development policies based on sound information, investment and maintenance of critical infrastructure and human ingenuity can go a long way in reducing the likelihood of conflict in regions such as Darfur.

In responding to the environmental impacts of conflict, the Arab world through the Council of Arab Ministers Responsible for the Environment (CAMRE) and regional environmental organisations may consider pursuing a combination of the following practical measures:

(i) Funding for the environment

National budget allocations for the environment in all Arab countries is without exception well below one percent. In comparison, both as a share of GDP and in per capita terms Arab countries have the highest military spending rates in the world. Average defence expenditure stands around 7-8 percent of GDP, well above the world standard of 2-2.5 percent.[14] This imbalance in budgetary spending needs to be redressed.

The abovementioned statistics illustrate that rising military expenditure by Arab countries is not only diverting funding from the environment, but also jeopardising the prospects for effective environmental management and protection. The Arab world needs to substantially raise budget allocations for the environment to a minimum target of two to three percent. In this context, environmental management and protection should be considered as a conflict prevention and peacebuilding tool. To minimize the risk of relapse into conflict, it is proposed that an Arab fund be launched to help countries in the region address the environmental root causes of conflict as well as the most immediate impacts of war (e.g. oil spills, chemical contamination, etc.).

(ii) Improve environmental governance

Post-conflict countries tend to have some of the fastest growing economies. According to the International Monetary Fund, Sudan experienced a real GDP growth rate in 2007 of twelve percent, making it the second fastest growing economy in the Arab world.[15] As for Iraq, the IMF foresees its economy to grow by seven percent or even higher in 2008-2009.[16] Rapid economic growth, dependent in these cases almost entirely on the oil boon, imposes great pressures on the environment unless adequate safeguards are introduced. Post-conflict countries are especially prone to overlooking environmental legal requirements and standards given the immediate needs of reconstruction, but this risks undercutting sustainable development and the fragile peace. Good environmental governance based on tested and credible methods such as Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) can play an important role in helping ensure that reconstruction and development is economically and environmentally balanced. EIA's and SEA's multi-stakeholder consultative approach also carries a conflict resolution element as it seeks to maximize transparency, public participation and equitable benefit sharing.

(iii) Strengthen capacity and cooperation on environment and conflict

It is suggested that an Arab multi-disciplinary expert committee on environment and conflict be established under the auspices of the League of Arab States to examine conflict-environment linkages and improve early warning and assessment capacity. In this undertaking, Arab governments should capitalise on growing international expertise in this field and actively engage with international organisations, particularly the United Nations, to draw on their scientific, technological and financial resources in analysing and mitigating the environmental impacts of war.

Preferably the abovementioned courses of action will be considered before a new war breaks out and creates additional environmental damage.

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NOTES

1 The views expressed in this chapter do not necessarily reflect the views of the organization where the author works (UNEP).
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Environmental Legislation

Mohamed Abdulaziz El-Gundy

I. INTRODUCTION

Since the second half of the twentieth century, the environment has become a focus issue at the global level. This was largely an attempt to control the unabated environmental degradation resulting from disorganized contemporary economic and social development, which produced ecological imbalance. This interest in the environment has typically featured in successive international conferences convened to deliberate on environmental issues. The first global conference on Human Environment, which was held in Stockholm in 1972, was followed by the creation of the United Nations Environment Programme (UNEP). Many gatherings have taken place since then, culminating in the United Nations Conference on Environment and Development, which convened in Rio De Janeiro in 1992, which became known as the Earth Summit. This landmark event saw the introduction of several international environment-based conventions, including the adoption of Agenda 21.

Despite this apparent world interest in environmental issues, most of these issues still remain effectively unresolved. Consequently, the international community held a Third World Conference on Environment and Development in Johannesburg, South Africa, ten years after the Rio Conference. The international community felt that it was on the threshold of a drastic fate-determining crisis if the global environmental situation was not addressed as promptly as necessary. A necessary provision was that the redress must be conclusive to involve sustainable development, reconstruction, poverty reduction, pollution-combating, conservation of natural environmental resources and ecological balance.

The world realized that scientific and technological expediencies alone would provide the necessary protection neither for the environment nor its resources, unless binding controls were applied to ensure the application of protection. Controls should also exist to obligate individuals and groups to steer clear of environmentally harmful practices and show commitment to protect environmental safety and resources.

For legislation to be become functional, it has to be sufficiently flexible and dynamic to prove congruent with rapid development and keep

pace with new and advanced scientific and technological innovations. These systems will otherwise remain ineffective and sluggish, creating a recipe for failure to accomplish environment protection and development goals. In addition, for legislation to be observed in a given society, its requirements must be in conformity with the needs and unique character of the society in question. That is, the legal text must be seen as the product of research, testing and experience to cope with the social, economic and environmental circumstances of the society. In short, it must be relevant.

In light of these considerations, and as the international community has been perfectly aware of the importance of introducing legislative systems as an essential component of environmental protection, it took the lead to envisage international legislative tools (conventions, treaties, protocols) aimed at mobilizing international efforts to address environment issues of general nature. Arab countries, like others, participated in negotiations of such international instruments, and later undertook the requisite efforts towards acceding to, signing and ratifying procedures for the majority of them. The next step was the national implementation of legislation conforming and enacting these international agreements.

The Arab countries enacted and produced in time a set of legal texts partially addressing environmental issues within the framework of public laws. These public laws had been issued at an earlier stage without a central focus on envronmental issues. As a reflection of this world interest, they also promulgated a battery of laws on environment protection; in this chapter, we will deal with these in their different international and national manifestations.

After going through an overview of major international pieces of legislation, as well as national Arab pieces of environmental legislation, this chapter will offer a critical analysis of the deficiencies of environmental legislation in the Arab region, and will propose means of improving on this situation.

II. INTERNATIONAL ENVIRONMENTAL LEGISLATIVE INSTRUMENTS

The international community expressed its interest in the environment and the preservation of environmental resources through the conclusion of a gamut of international conventions and treaties covering principal environment issues with a view to protecting human health, maintaining and developing environmental resources and mobilizing international efforts to help achieve these goals. These international and regional conventions, treaties and protocols exceeded 150 in number, the enumeration of which goes beyond the scope of this chapter. We will exclusively deal with the most crucial environmental issues, such as the transboundary movement of hazardous substances and waste, climate change, ozone layer protection, desertification and bio-diversity conservation.

In what follows, we provide a brief overview of a number of important international conventions in certain key fields. Most of the conventions are discussed in more detail in the relevant chapters of this report.

Transboundary Movement of Hazardous Substances and Wastes

- The Basel Convention was adopted in Basel in 1989, with the purpose of the Control of Transboundary Movements of Hazardous Wastes, scaling down the volume and poisonous effects of generated waste and exercising effective control on transport processes across borders, especially to developing countries, while at the same time minimizing these processes. The Convention entered into force in 1992. An amendment was introduced but never entered into force to the effect of prohibiting all hazardous waste export processes for eventual disposal in developing countries. The Basel Convention was amended on 22 September 1995 and re-amended in on 10 December 1999.

- The Rotterdam Convention was adopted on 10 September 1998 with interest centred on bio-safety especially in the field of international trade and development. Prior approval procedures relating to some hazardous chemical substances and pesticides in international commerce (PIC) were endorsed in December 1998. This Convention was designed to ensure the protection of human health by encouraging co-responsibility and cooperative efforts by member parties regarding trafficking in specific hazardous chemical substances while contributing to the environmentally sound use of some of these substances through the facilitation of related information exchange and streamlining of decision-making in terms of their import or export at the national level.

- The Stockholm Convention on Persistent Organic Pollutants was adopted in Stockholm on 22 May 2001 and entered into force on 17 May 2004. It aimed to provide protection of human health and environment against persistent organic pollutants, take measures to prevent their injurious effects in all stages of their lifecycle, underlie the principle of defrayal of pollution cost by the party responsible for causing it, and highlighting the importance of developing and utilizing alternative environmentally sound chemical processes and materials.

Ozone Protection

- The Vienna Convention on the Protection of the Ozone Layer was adopted in Vienna on 22 March 1985 as a framework of international cooperation to salvage the ozone layer. It emphasized the necessity of taking effective steps towards preventing emission of ozone-depleting substances, reducing and defining human activities involving relevant adverse effects and necessarily extending technical assistance to developing countries to enable them to use alternative materials and technologies, with the ultimate aim of protecting human health and the environment against negative implications of ozone-related changes.

- The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in Montreal on 16 September 1987 and entered into force on 1 January 1989. The Protocol was tailored to spur the world's commitment

towards taking preventive measures to curtail the aggregate volume of emissions of ozone-depleting substances, with the eventual objective of their elimination.

Several amendments were made to the Montreal Protocol:

- The first was the London Amendment of 1990, targeting the promotion and expansion of control procedures set forth in the Montreal Protocol to include new materials and establish respective financial mechanisms.

- There was also the Copenhagen Amendment of 1992, with the aim of endorsing changes and reductions in the production and consumption of matter subject to control as provided for in the Montreal Protocol appendices.

- This was followed by the Montreal Amendment (1997), whereby each party was committed to establish and operate a licensing system with regard to the import and export of materials cited in the Protocol's appendices, by 1 January 2000. Further, it obligated each party to take legislative and administrative measures including labelling of products, equipment, components and technologies. Parties were also to assist in preventing illegal trade in banned and illicit materials, equipment, and machines through control and licensing applications based on double checking of data by exporting and importing countries.

- The fourth amendment of the Protocol was the Beijing Amendment, on 30 December 1999.

Climate Change

- The UN Framework Convention on Climate Change (UNFCCC) was adopted in New York on 9 May 1992. It was devised to ensure keeping heat-retaining gas concentrations in the troposphere at acceptable levels, thus hoping to limit climate change and allow adaptation. The Convention calls for national and regional programs providing for measures to mitigate climate change impacts. It also calls on Parties to collaborate to develop, apply and disseminate technologies likely to reduce or prevent human-caused emissions.

- The Kyoto Protocol was adopted in Kyoto (Japan) on 11 December 1997 and entered into force on 16 February 2004. Its aim was the fulfilment of the final goal of the UNFCC. Annexed to this Protocol were two supplements, one about heat-retaining gases as well as sectors, sources and sink categories; the second pertinent to the commitments of 39 countries to reduce emissions in their territories. These were developed countries and others with in-transition economies. Those countries had undertaken to work on curbing global warming gases by around 55% during the period from 2008-2012, compared to their recorded gas emissions in 1990.

UN Convention on Combating Desertification in Countries Suffering Severe Drought or Desertification Especially in Africa

- This Convention was adopted in Paris on 17 June 1994 and entered into force on 10 October 1997. It was drafted with the goal of combating desertification and managing drought impacts in worst-hit countries especially in Africa, through taking effective measures at all levels and to promote international cooperation within the framework of an integrated approach attuned with the agenda 21, with a view to achieving sustainable development in affected regions.

Biodiversity Conventions

- The Convention on Wetlands of International Importance Especially as Waterfowl Habitat, concluded in Ramsar, Iran, was aimed at (i) halting trespasses and invasions on wetlands; (ii) the acknowledgment of basic bio-environmental functions of wetlands and their economic, cultural, scientific and promotional value; and (iii) ensuring maintenance of wet lands including plants and animals by way of combining national policy and harmonized international action.

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), was adopted in Washington on 3 March 1973 and entered into force on 1 July 1975 with amendments introduced in Bonn

on 22 June 1979 and on 30 April 1982. It was chiefly designed to provide protection to certain animal and plant species threatened with extinction due to excessive exploitation through international trade by enforcing an import-export licensing system and taking appropriate measures.

- The Convention on Biological Diversity, which was adopted in Rio De Janeiro on 6 May 1992 and entered into force on 29 December 1993, had the aim of preserving and maintaining bio-diversity and employing its elements in a sustainable way. Other objectives of the Convention are the fair sharing of benefits accrued from the use of genetic resources among countries of origin and state beneficiaries and the transfer of appropriate technologies through providing adequate financing, alongside observance of all rights of accessing substances and technologies.

- The Cartagena Protocol on Biosafety (CPB), which was adopted in Montreal on 29 January 2000, was intended to guarantee protection in the domain of transporting and using banned organisms developed by bio-technology.

The above conventions and protocols address the most critical environmental issues at the world level, each comprising commitments undertaken by states in the bid to advance enforcement of their provisions. Included as part of these commitments were the goals of fulfilling legislative and administrative procedures to meet implementation requirements and translate their provisions into national legislative instruments.

It is noteworthy to indicate that such environment-based international conventions and instruments – once acceded to, signed and ratified by states and published as legally-established conditions in conformity with the constitutions of most Arab countries – attain the force of national law. An example of this is Article 151 of the Constitution of the Arab Republic of Egypt, citing that treaties concluded by the President of the Republic and referred to the People's Assembly, shall, upon their conclusion, ratification and publication, have the force of law.

III. ARAB ENVIRONMENTAL LAWS AND INSTITUTIONS

Against the backdrop of a heightened world interest in the environment, world conferences on related issues, and international and regional conventions, treaties and protocols concluded to redress these issues, it was imperative that state parties have parallel interests in these international instruments on the environment. This parallel interest could be achieved by undertaking the legislative and administrative procedures for the translation of the provisions of these instruments into national legal systems.

The Arab countries were not detached from this process, and undertook necessary administrative and legislative procedures and placed environmental concerns on their agendas. This was reflected in the establishment of cabinet portfolios for the environment and instituting relevant administrative authorities and competent councils. These eventually issued a set of legal instruments partially addressing environmental issues within the framework of public laws passed at an earlier. With this growing interest in the environment issue and the importance of preserving it, developing its resources and honouring international commitments resulting from accession to international environment conventions and agreements, the Arab countries also promulgated a series of laws on environmental protection and resource management.

Thus we have two types of legislation concerning the environment:

- Legislation involving environmental issues and concerns, including several laws with provisions addressing matters of environmental dimension without explicitly stating that environmental protection is the underlying purpose for their promulgation.

- Laws enacted specifically for the protection of the environment.

Legislation addressing environmental concerns

These laws contain provisions addressing environment-related matters without the environment being the main purpose for their issuance.

A case in point is the Traffic Law which, in fact, governs issuing licenses for vehicles and other means of transport, driving, security and other conditions related to traffic regulation. However, it includes provisions preventing the operation of vehicles emitting smoke, spilling fuel or producing noise, as well as provisions regulating the use of horns and sirens. In addition to provisions governing buildings and public shops, types, license procedures, and duly observed architectural and sanitary requirements, there are other provisions relating to ventilation and height to preserve urban and health environment for residents and surrounding habitats.

In what follows, a number of examples will be given from three Arab countries.

Egypt

Since the first half of the twentieth century, Egyptian legislators have come to realize the importance of preserving the environment and maintaining its resources. Environmental dimensions were included in penal codes. The Egyptian Penal Code issued in 1883 stipulated in Article 23 a punishment of a 3 months to 3 years prison sentence for whoever kills or poisons animals or livestock or fish in rivers, canals, small streams or swamps. Moreover, Law no 58/1937 contains provisions that entail punishment for whoever proves careless about cleaning or repairing fire-using chimneys, furnaces and laboratories. It also stipulated punishing whoever is responsible for noise that discomforts people at night or who places on the roof or walls of his residence compound substances, whether residues or farm yard manure or others which prove harmful to sanitation.

A number of laws have also been issued on cleanliness, the latest of which was Law no 38 of 1967 regulating garbage collection, hazardous waste transfer, treatment and disposal. Other laws include Law no 93/1962 on liquid waste drainage; Law no 45/1949 regulating the use of microphones; Law no 59/1960 regulating ionized radiation performances; Law no 52/1981 on preventive measures against smoking risks; Law no 57/ 1978 on pond and swamp filling and digging prevention; Law no 116/1983 on the inviolability of agricultural land and preservation of its fertility, forbidding soil scraping of cultivable land or directing it for non-agricultural uses and banning deliberate erosion of arable land or building thereon.

Bahrain

A number of environmental laws have been promulgated in Bahrain, some of which are:

- Law no 3/1975 on Sanitation;
- Law no 112/1967 modified by Law no 12/1980 on Regulation of Underground Water Uses;
- Law no 13/1977 modified by Decreed Law no. 15/1993 on Building Regulation ;
- Law no 5/1981 on Fishing Regulation;
- Law no 20/1983 on Palm Protection;
- Law no 11/1989 on Pesticides ;
- Law no 11/1991 on Regulation of Sanitary Wastewater and Surface Water Drainage;
- Law no 2/1995 on Protection of wildlife.

Algeria

Several laws of environmental purport were enacted, including:

- Order no. 75-4, 76-4 in September 1975 relating to laws applicable to security against fire risks and the establishment of committees on safeguards and civil protection;
- Law no. 82-10 / 1982 on Fishing;
- Law no. 83- 16-17 July 1983 on Water;
- Law no. 84 -12/1984 on Forestry Order;
- Law no. 88- 8-1988 on Veterinary Medicine Activities and Protection of Animal Health;
- Law no 1-19 /12/2001 on Waste Movement, Control and Disposal;
- Law no. 2- 2 – 5/2/2007 on Coast Protection and Development.

Arab Legislation on Environment Protection

In addition, a number of laws promulgated in the Arab region concerned specifically with the environment. These laws contained provisions stipulating a full-fledged legal system of environment protection. Concurrently, different Arab countries were prompt in setting up cabinet portfolios for environmental affairs, in addition to their realm of activities including issues like water, electricity, agriculture and

health. A case in point was the experience of some Arab countries assigning the environmental responsibility to ministries of water, electricity, agriculture and health. Not only portfolios were established but also other bodies, councils and institutional entities concerned with the environment either pursuant to independent decisions or by providing for their establishment within the context of environment protection codes.

As part of this legislative interest in environment affairs in the Arab world, a broad-based spectrum of laws was enacted, including:

- Law no. 4/1994 on Environment Protection in Egypt;
- Law no. 26/1995 on Environment Protection in Yemen;
- Law no. 3/1997 on Environment Protection in Iraq;
- Law no. 24/1999 on Environment Protection and Development in the United Arab Emirates;
- Law no. 21/1995 modified by Law no. 16/1996 on Environment Protection in Kuwait;
- Law no. 21/1996 on Environment Protection in Bahrain;
- Law no. 114/2001 on Environment Protection in Oman;
- Republican Decree no.34 on 28/7/1422 Hij on the Environment System in Saudi Arabia;
- Law no. 30/ 2002 on Environment Management in Qatar;
- Law no 50/ 2002 on Environment Protection in Syria;
- Law no. 444/2002 on 29/7/2002 on Environment Protection in Lebanon;
- Law no. 15/2003 on Environment Protection and Improvement in Libya;
- Law no. 52/2006 on Environment Protection in Jordan;
- Law no. 11-3 relating to Environment Protection and Reclamation issued by Royal Decree no. 50-3-1 on 15 Rabei Awal 1424 Hij corresponding to 12 May 2003 in Morocco;
- Law no. 3/10 on Environment Protection Within the Framework of Sustainable Development in Algeria;
- Law no. 7/1999 on Environment Protection in Palestine;
- Law no. 91/1988 on Establishment of a

National Agency for Environment Protection in Tunisia, modified by two Laws no. 115/1992 and 14/2001 and further laws pertinent to different components of the environment.

In addition to passing legislation on environment protection in general, Arab countries were well-disposed to enact other environment-driven laws relevant to different environment issues, mainly laws on natural reservations. In Egypt, Law no 102/1983 on natural reserves was issued; Qatar passed Law no 19/2004 on natural life and its characteristics; in Bahrain Law no 2/1995 on wildlife protection was promulgated as well as decreed Law no. 12/2000 on the Establishment of the National Agency for Natural Life Protection; Oman passed Law no 6/2003 on Natural Reservations and Maintenance of Natural Life; while in Jordan Law no 29/2005 on Natural Reservations and National Recreational Places was issued. Legislation also exists in a number of Arab countries on the protection of water resources and the protection of coastal regions.

Though each of the above laws has its own specificity, Arab laws mostly share common grounds. The most relevant of these features are set out below.

IV. MAJOR FEATURES OF ARAB LAWS ON ENVIRONMENT

The following are general features of Arab countries' national environmental legislation.

(i) Arab environment laws, in their preambles, lay out definitions of environment-related phrases, terminologies and concepts. They do so by designating a chapter to explain what these phrases, terminologies and concepts imply with the aim of unifying the meaning of each term according to universally-acknowledged connotations, and in conjunction with international environment conventions.

(ii) Arab environment laws, in large part, tend to devote a preliminary chapter to general principles underlying legislation relevant to the environment. The primary assertion is the right of humans to live in a healthy, clean and balanced environment. This chapter also provides for the responsibility of the official state authorities, public and private institutions and individuals for keeping the environment safe, safeguarding its natural resources, fighting pollution and protecting land and marine life. This chapter also includes a definition of objectives that the relevant legislation attempts to achieve and a statement of fundamentals whereby competent authorities are assigned to carry out tasks entrusted to them in this respect.

Among these, the following goals can be singled out: protection of the national environment against the negative impact of activities conducted beyond the borders and waters of the national region, and implementation of commitments vis-à-vis global environment protection such as biodiversity, ozone protection, climate change, combating desertification, and others. Furthermore, obligations are placed on state authorities, especially those charged with developing plans of economic development, to take into account environment considerations in all stages of economic development and at all levels of planning. This is to ensure that development planning embraces environmental concerns as part of overall planning, be it industrial, agricultural, urban, or tourist. This principle can best be illustrated in Articles 3 and 4 of Law no 26/1995 on Environment Protection in Yemen.

(iii) Arab legislation on environment is an integrated legislative system ensuring environment protection through integrated regulations providing for the establishment of public organizations, councils or institutions for environment protection. These are affiliated to cabinets or environment ministries, with tasks delegated to them in a manner securing the development of environmental policies and plans, and setting of pollutant standards and rates while monitoring and following up compliance. Accordingly, this legislation attempts to streamline these bodies' interaction with planning and sectoral institutions, centrally and regionally, by way of opening regional field offices in governorates (or provinces) and coordinating with other relevant entities. The formation of such organizations, councils or institutions in Arab countries differs, though they mostly depend on an administrative composition of ministries and executive authorities concerned to ensure synergy.

(iv) Concerning development-environment linkage, Arab legislation is based on mandating assessment of the environmental impact of projects that need to be licensed as a precondition for their approval. It conditionally underlines that this assessment covers all negative implications likely to ensue in connection with the project concerned and how to get rid of or reduce them to environmentally permissible bounds. Some of these laws may also refer to the positive effects of the given project, such as evaluating the environmental impact of the built-in monitoring system of the facility, as well as methods and dates of sample-taking to oversee compliance of existing establishments with regard to the implementation of projects and in accordance with legally established standards and norms. These laws further mandate that a copy of this evaluation be sent either to the relevant Agency or Council.

Arab legislation on the environment obligates facilities subject to such an environmental impact assessment procedure to register their emissions and whether or not they comply with permissible standards and rates, and to report any deviations or breaches in this respect. It allows environment protection agencies to inspect these facilities to ensure conformity with data recorded in the register and take legal action against violating facilities.

(v) Most of the Arab laws on environment include provisions ensuring protection of water sources – be they wells, rivers, or surface water – against pollution and regulating the usage of these waters in a manner that guarantees their preservation and protection against contamination or depletion. These laws are also concerned with protecting soil from desertification or pollution, bearing in mind the protection of plantations, forests, trees and pastures and guarding against arable land erosion or turning it into waste land.

Arab legislation, in its entirety, focuses on protecting natural life and bio-diversity as well as living organisms threatened with extinction, migrant birds within the framework of obligations of international environment-related conventions on bio-diversity and to Cartage Protocol on biosafety. The Libyan Environment Law offers a useful example by virtue of its regulations in relation to the latter.

PUBLIC PARTICIPATION IN EGYPTIAN ENVIRONMENTAL LEGISLATION

Egyptian environmental legislation no 4/1994 adopted the principle of popular participation in designing environmental plans and policies and decision-making with regard to environment issues by providing a three-member representation in the Egyptian Environmental Affairs Agency's (EEAA) Board of Directors of non-governmental organizations interested in the environment, in addition to three other members representing the business sector and two representing the scientific centres and institutes concerned with environment affairs and two environment experts who not necessarily civil servants. This composition of the board ensures that half the board members are non-state employees, guaranteeing the concept of public participation in the management of environment affairs and decision-making. Individuals and civil societies may report crimes committed in breach of environmental laws and also have the right of recourse to administrative and judicial authorities to have these provisions complied with. This is in tandem with the stipulation set out in the Egyptian Constitution stating that environment preservation and protection is a shared responsibility of state authorities and individuals.

(vi) Environment-based laws, in separate chapters, tackle air pollution, thereby obligating facilities to ensure that established air pollution standards and rates are not exceeded and that closed public places are well ventilated and protected against noise, smoking, unpleasant odours and exhausts. These laws regulate pesticide spraying and circulation and the use of hazardous chemical substances, as well as the circulation of hazardous waste and the transfer and disposal of solid waste.

It should be noted that in this field most, if not all, of the Arab laws are perceptive to pollution scales on the basis of concentrations rather than environmental pollutant loads, notwithstanding the significance of these specific loads in curbing and reducing pollution being associated with the quantity, volume and weight of pollutants.

(vii) Relevant Arab laws also focus on the protection of marine environments against pollution caused by maritime sources such as vessels, oil platforms, and other maritime facilities as well as land-based sources erected along or nearby coasts which discharge their effluents into the marine environment. Protection in this area has been extended to cover regional waters and special exclusive economic zones. These laws further

specify timely pollution-eliminating procedures, name authorities concerned with maritime environment protection and regulate the integrated management of coastal regions in response to requirements cited in international environment conventions on seas protection.

(viii) Arab legislation on environment on the whole tends to disregard the use of economic tools as an expedient to ensure environmental compliance, with only a few laws making reference to the utilization of financial incentives. It is worth mentioning that Tunisian laws on the environment are responsible for making Tunisia the first Arab country to accord the environmental label on its products to indicate highest-level quality in terms of environment preservation, bringing to light well-perceived efforts towards the employment of clean technology which involve, when necessary, optimal sustainability prospects. It should also be noted in this respect that the environment public order in Saudi Arabia mandated compliance with environment protection systems and measurements as a prerequisite for project-loaning.

V. COMPLIANCE WITH AND ABIDANCE BY ARAB ENVIRONMENT LAWS

Factors affecting environmental compliance vary substantially from one country to another, and even from one part of a country to another. These differences are the result of economic conditions of target facilities in terms of environmental control or the prevailing individual behavioural traditions in the society and how far the importance of environment protection and pollution reduction is assimilated.

In a study taking stock of the adequacy of legislation on the environment and the promotion of its implementation mechanisms in the ESCWA region in 1999, it was shown that the industrial sector in Egypt, Syria and Jordan had experienced radical transformations coupled with relative improvement of the environmental conditions of industrial facilities. Despite the fact that major industrial zones had undergone positive developments in this concern, the majority of these zones still sustain degrading environmental conditions because of insufficient handling of hazardous waste treatment, deficient attempts of curbing polluting gas emissions and due to discharging industrial effluents into public networks and central treatment stations sourced by some facilities that are not subject to control or which fail to comply, given their dire economic conditions.

However, the study underlined that industrial management in these countries is positively directed towards environmental compliance, including adoption of the environmental aspects of industrial management, with the view of modernizing means of production as a precautionary measure, and to scale down pollution at source instead of focusing exclusively on end-of-tube approach. Some of these industries are well-disposed to voluntary compliance and to the establishment of pollution-reducing or production-promoting units to curtail the loss.

VI. IMPEDIMENTS TO THE ENFORCEMENT OF ENVIRONMENT LEGISLATION

A World Bank study in 1996, conducted in collaboration with environment agencies in six major developing countries, namely Brazil, China, India, Indonesia, Mexico and the Philippines, revealed that environment-based policies in these countries had been centred on legislation as a means of environment protection. The study also revealed that experience in these countries showed the laws on environment as being ineffective and that manifold problems were barring the operation of environment agencies and offices concerned in these countries. According to the study, these problems could be summed up as follows:

- The difficulty of sorting out and recording data and information on emissions produced by plants;
- Bureaucracy involved in contacting any of the issuing authorities with regard to recording information about air or water quality maintained at environment field offices;
- Lack of efficiency and know-how at the level of environment offices and agencies with regard to information on optional program benefits, employment of results to envisage priorities of distributing rare substances and fewer well-trained inspectors in this field;

- Lack of political support for serious implementation of environment programs, which are often politically objected to and turned down and even resisted and abandoned. Under these circumstances, it is difficult to control pollution and accordingly to raise funds to cover pollution-fighting costs and burdens.

The situation in Arab countries today is not much different from that in the six countries subject of the World Bank study in 1996. Other problems are also faced in the process of implementing environmental legislation in most Arab countries, of which the following particularly deserve to be highlighted:

- Environmental standards provided for in relevant laws have been set in conformity with effective standards in developed industrialized countries. Accordingly, they are inconsistent with the environmental conditions as well as the technical and economic potential in Arab countries. This tends to render it difficult, from the economic perspective, to abide by these standards or make them functional.

- In their definitions of liquid waste and gas emission standards, laws in most Arab countries developed more interest in pollutant concentrations rather than in pollution loads and discharge quantities. This overburdens the environment system and adversely affects its pollution-absorbing capacity.

- In many cases, these laws set uniform standards that apply to both production and service activities, regardless of pollution-combating costs and techniques. Existing businesses are not different from their equivalents in new establishments in the sense that the latter may have their own standards or need to be subjected to stricter standards.

- Absence of qualified cadres and expertise to help enforce environment-related legislation and take on responsibilities entrusted pursuant to relevant laws to environment protection agencies and their affiliates in different governorates. These laws generally stipulate that such agencies be supported by environment specialists, experts, administrative personnel, and technical equipment to meet the pressing need of putting these laws into action. There is always the need for holding training courses for these cadres to upgrade their abilities and skills and provide advanced experience in technical and administrative domains. Related to this issue is the absence of laws governing the environmental business in most Arab countries in the same way as other technical professions such as the fields of medicine, engineering and law. This actually allowed non-specialists to run environmental affairs, for example by conducting environmental impact assessment, as well as environmental reviews and plans of projects which require special skills. Egypt sought to regulate this aspect in amendments made to Law no 4/1994 on Environment Protection.

- The multiplicity of authorities in charge of executing laws and lack of coordination contribute to hindering compliance. This demands working out some kind of a synergy among ministries, existing associations and institutions concerned while assigning competence in a manner that narrows issues of overlapping and conflict.

- Dwindling environment-driven awareness at the level of managers of industrial or service facilities and projects and those assigned to effect environment laws and their inadequate background knowledge of the provisions of these laws and the powers vested in them. The staff working in these facilities are often not well-informed in terms of the environment and exposure to health risks resulting from failure to comply with established environmental standards.

- Most Arab laws on environment do not encourage making operational clean technologies and techniques and pursuing the utilization of economic tools and incentives as effective means of achieving compliance with and abidance by environmental legislation.

- Apprehension regarding the social ramifications of implementing punitive provisions stated in environment laws, and concern over the interests of staff in major industrial facilities often prevent the imposition of penalties stipulated in environmental laws on these facilities. This applies especially with regard to shutting down the facility or suspending its polluting activity, for fear that its staff will be threatened with unemployment or their wages not paid.

A BRIEF ON THE TYPICAL LEGISLATIVE MANUAL

The Secretariat of the Council of Arab Ministers Responsible for the Environment (CAMRE), the United Nations Environment Programmme, Regional Office for West Asia (UNEP-ROWA) and the Islamic Education, Sciences and Culture Organization (ISESCO), jointly carried out a study on environment laws and codes in 17 Arab states to find out to what extent they are commensurate with multi-lateral international environment conventions and modern environment concepts. This study included a model legislative manual elaborated as an Arab environment roadmap, to be used as guidance for Arab countries in enacting environmental laws in accordance with their unique environmental systems, priorities and resources as well as their economic, financial and administrative capabilities and political and legislative circumstances. A preliminary part contains a number of chapters, with the first chapter designated to an updated environment-based classification with a view to unifying connotations and meanings of terminology, phrases and concepts according to those universally-acknowledged in multilateral international conventions on environment. This is to enable officials applying these laws to more easily abide by their provisions and those in charge of enforcing them to ensure compliance.

The second chapter of the preliminary part deals with general principles of legislation in the area of environment, notably asserting the human right to live in a clean and balanced healthy environment, and allowing for human dignity as well as health, physical, mental and intellectual growth. In addition, this is to be achieved in concert with the responsibility of official authorities, public and private institutions and individuals with regard to preserving the environment, safeguarding its natural resources, combating pollution and protecting land and marine life.

This chapter also makes reference to the goals of the legislation including setting the foundations on which competent authorities are to deliver relevant services.

The third chapter is devoted to the alignment of environment management according to the form of the State and its political, administrative and legislative system. This highlights the need for an environment affairs portfolio or the assignment of related responsibilities to the ministry of health or population or agriculture or housing, as appropriate. It also provides for the establishment of an agency, council or organization for environment protection and relevant competency and constitutive regulations. Legislation on environment also regulates the scope of political partnership in environment management, environmental policy designing and decision-making through the engagement of civil society representatives in the board of directors of these agencies, councils or organizations. This chapter further provides outlines of environmental management of projects, facilities and institutions where relevant legislation mandates this kind of in-house environment management of facilities and institutions subject of environmental impact assessment. Part of the tasks authorized to these departments rests with overseeing the environmental self-control of given facilities or institutions, fulfilling environment compliance as per established standards, rates and specific loads, and dealing with environment inspection organs and recording environment register data of the said facility or institution.

The manual contains chapters addressing the following disciplines:

- Regulated business management in environment fields;
- Use of economic tools in drawing up environment policies and their implementation plans;
- Environment control;
- Environment assessment of facilities and projects;
- Protection of terrestrial ecosystem and natural life;
- Maintenance of bio-diversity and biosafety
- Natural reservations or protected areas;
- Protection of air environment against pollution;
- Protection of aquatic environment against pollution;
- Administrative and judicial procedures;
- Penalties;
- Role of civil society in environment institutions and law-making:
  - Role of civil societies in protecting the environment, its institutions and laws;
  - Role of universities and research centres in environment institutions and law-making;
  - Role of industry and businessmen in environment protection;
  - Role of municipal and local councils in environment protection.

- No specialized police ensuring environmental protection is available in most Arab countries to cooperate with environment protection agencies for the enforcement of environment laws and detection of violations in this regard.

- Media shortcomings on environment with regard to reaching out to public related issues, laws and citizens' rights, and raising awareness vis-à-vis health hazards resulting from and risks involved in environmental pollution due to non-compliance with adequate environmental requirements and provisions of environmental laws.

- Deficiency of capacities of most Arab non-governmental organizations operating in the field of environment protection.

VII. HOW FAR ENVIRONMENTAL LAWS IN THE ARAB COUNTRIES ARE CONSISTENT

Looking into the major features of Arab environmental laws reveals common characteristics in most parts, with only few differences in assessing priorities with regard to environment conditions and resources. These laws also vary with regard to legislative redresses. While some countries have exclusively issued all-embracing legislation for environment protection, others enacted several environment laws aimed to protect individual environment elements such as natural reserves, marine environment, hazardous waste and substances, forests, water, etc.

Laws also vary in terms of their compatibility with international environmental conventions, regarding both accession and ratification as well as response to their implementation requirements.

Within the context of a study conducted by the League of Arab States (Environment, Housing and Sustainable Development Department) in collaboration with the UN Environment Program, a typical legislative manual has been prepared. This has been designed as an Arab roadmap for environment protection for Arab countries to apply in charting a new pattern of environmental legislation or amending existing laws according to the indicators cited in this manual. This manual was adopted by representatives of Arab states as well as the Arab League's Joint Committee on Environment and Development. It was also adopted at the Meeting of the Council of Arab Ministers Responsible for the Environment (CAMRE) in November 2007, and will be distributed to all Arab states, with training courses organized for its initiation. It can thus be safely predicted that, guided by this manual, an accord unifying environment laws in the Arab world is more than likely to materialize.

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The Environment in Arab Media

Najib Saab

I. INTRODUCTION

It is difficult to talk about a special identity of Arab environmental media in the same way as one may talk, for example, about an identity relevant to Arab political, cultural, economic, or sports media. An information identity requires some fundamental conditions to be considered autonomous and genuine. One such condition is the existence of professional patterns concerning varieties of news collection, presentation and analysis based on a particular theoretical framework pertaining to environmental issues. Another condition is the existence of a nucleus of media professionals who are well-trained and dedicated to the environment, and capable of influencing public orientations. A further condition has to do with continuity as contrasted to sparse news and irregular comments. Indeed, all these conditions are absent in the case of most Arab media when they deal with environmental topics. The problem of Arab environmental information may be related to a larger problem concerning Arab science journalism, which is still marginal in Arab media.

In 1987, the United Nations Environment Programme (UNEP) presented a plan for Arab environmental information to the Arab League Educational, Cultural, and Scientific Organization (ALECSO) and the Council of Arab Ministers Responsible for the Environment (CAMRE).[1] If we were today, two decades later, to formulate a new plan, we would come out with the same recommendations. Much has changed during the last 20 years, with the entire face of the world becoming different, a new outlook towards environment and development having emerged, and environmental issues forcing their way onto governmental agendas. While the environment was barely alluded to in the Arab media and we had to coin terms for writing about subjects not yet raised, we find today that some Arab newspapers have dedicated sections for the environment and have exhibited concern in treating the problems of environment and sustainable development. Moreover, the environment has found its way to Arab radio and television stations, whether in news bulletins, reports, and debates, usually exhibiting reactions to international events. However, the Arab media treatment of environmental issues lacks follow-ups, and is characterized by immediate descriptive content rather than analysis and even accurate information. Such a quality of information does not help much in propagating environmental awareness.

Although the occurrence of the term "environment" and its derivatives has increased thousands of times in Arab media during the last decade, the tackling of environmental issues has, in most cases, been limited to mere news and instantaneous reactions to world events, mainly catastrophes. Major international conferences on environment and development, since the Earth Summit in 1992 with the participation of Arab countries in it and their signing of almost all the ensuing treaties of international character, have contributed towards motivating the Arab media to discuss environmental issues at length. However, this interest has been mostly exhibited in quoting bits and pieces of news exactly as transmitted by foreign news agencies. It is observed that most Arab media are satisfied in conveying addresses, often too general in character, of government officials during the opening of conferences and meetings on the environment, while they neglect what is offered by experts, which, alas, is at the heart of the matter.[2]

A study concerning media coverage of environmental issues in Bahrain found that, despite the appearance in the six dailies of the country during 2004 of over 2000 articles on local environment issues, most of them constituted mere news and interviews, while only 4 percent belonged to reports, news analyses, and comments.[3]

What this study of Bahrain has concluded applies to all the Arab countries covered by a survey of the leading Arab environmental monthly *Al Bi'a Wal Tanmiya (Environment and Development)*, which has come out with the following remarks:[4]

1. Less than 10 percent of the Arab press has a full-time editor specialized in issues concerning environment and sustainable development. A similar percentage of this press designates a weekly page or a regular corner for environmental issues.

2. Even publications which assign a page for environmental topics withdraw this under the pressure of political or economic events or increasing advertising bookings. Such a withdrawal might be permanent or limited

to months or even years, a measure never to be seen in political, economic, athletic, or social pages of the same publication.

3. Many environment pages in the Arab press receive financial support from government organizations, like ministries of environment, a practice depriving this press of its neutrality and rendering it practically incapable of criticizing these organizations. The environment page of *Al-Ahram*, the leading Egyptian daily, dedicated in its issue of 1 June 2008 four reports featuring the Minister of Environment, out of five.

4. With the exception of Al *Bi'a Wal Tanmiya*, published in Beirut since 1996, no other pan-Arab magazine which is specialized in the subject of the environment could achieve the status of a mainstream publication, distributed on a large scale throughout the Arab world, and which can be bought from newsstands that sell common interest publications.

5. Reliable sources of information on the environment are still weak or non-existent on the local level. This explains why some articles on the environment in the Arab press lack the strength of information, which is the basis of modern journalism.

6. The percentage of environmental issues in reports, interviews, and debates on Arab television channels is under 1 percent, while they reach 10 percent on channels in many European countries.

7. A boom has been witnessed during the last five years in the number of Arab environmental websites, although it is still incomparable with what exists in developed countries and even in most third world countries. The content of these sites is still trivial; and the information that they offer is mostly old, non-documented, and inappropriate for referential use even when these sites are run by governments. We have noticed that the content of most Arab websites on the environment is published as raw material, lacking scrutiny and editing. While some of these sites are serious and open to improvement, the major deficiency of all the Arab environmental sites is their lack of interaction with the public and the paucity of users reflected in the scantiness of comments, and failure to attract *'chatters'*.

8. Environmental titles that have gained primal concern in Arab media are related to general topics like nature, wildlife, solid wastes, environmental health, marine pollution, and disasters. Industrial pollution and desertification have acquired priority in Algerian media, whereas the subject of water has been brought to the fore in Oman and Jordan. What is highly remarkable is the quasi-absence of topics like air pollution (except in catastrophic cases), efficient use of energy and land, and town-planning.

9. The simultaneity between the fourth report of the Intergovernmental Panel on Climate Change (IPCC) and the occurrence of natural calamities and extreme weather conditions in several Arab regions raised the preoccupation of Arab media in 2007 with the issue of climate change. This concern was augmented after hurricane Gonu hit Oman by the middle of that year, followed by floods in Mauritania, and the hurricane in Yemen in 2008.

Blame cannot be put only on the media for failing to produce the sort of information which can effectively tackle the problems of environment and sustainable development. Three interrelated elements are at play here: (1) official development plans and environmental programmes; (2) a base of environmental scientific studies; and (3) a large public comprising millions of citizens who need to know about the environment and get involved in environmental and developmental action.[5]

Environmental information ties these elements together. Besides supplying news on them, it participates in supporting sound environmental measures. Furthermore, far from being an autonomous variety of information open to amateurship, environmental information is a professional brand sharing the precise characteristics of information in general.

Modern information takes its starting point from the public that it addresses. It depends for continuity on its success in drawing the attention of this public and obtaining its support. Failing to achieve this is equivalent to putting oneself at once outside the market. Arab information on the environment is still a newcomer to the scene. Undoubtedly, it has recognized the significance of the environmental element for development; and its interest in environmental issues has been clearly and increasingly reflected in the media. What is still lacking, however, is to transform the headlines into serious articles and convert the environmental press towards professionalism.

II. ENVIRONMENTAL MEDIA IN ARAB COUNTRIES

In this section we are going to survey the state of environmental information in the Arab printed media, with a special reference to programmes dedicated to the environment at the national level on radio and television stations. We intend to describe the situation objectively in 15 Arab countries where we were able to observe how the media approach environmental issues in daily newspapers with widespread distribution, in periodicals with lesser readership, as well as in the audio-visual media.

In the United Arab Emirates, the environment is an almost daily preoccupation in the media, although most of the treated subjects are related to occasions and activities held by various environmental groups. Undoubtedly, the concern about environment and nature in the UAE media bears the indelible mark of the late head of state, Sheikh Zayed Bin Sultan Al Nayhan, who admired nature and possessed a sophisticated outlook on the relation between environment and development. Thanks to his personal interest, the environment occupied, in many cases, the cover pages of the country's media. The leading dailies of the Emirates publish environmental news in their local sections. Among them, Alkhalij is the only one that dedicates a weekly page for the environment. Despite the daily presence of environmental topics in the UAE media, the material is generally presented in the form of news and announcements concerning activities and plans, remaining poor in analytic commentaries, especially about the environmental impact that some huge construction projects generate. There are six magazines and periodicals with environmental titles, issued by various bodies, mostly newsletters with limited circulation.[6]

In the Saudi media, there are two remarkable sections on the environment run in two dailies, one of them appearing weekly in *Aliqtisadiyya*, and the other appearing daily in *Okaz*. In addition, there are two quarterly reviews dealing with issues concerning environment and nature and published by government organizations. Radio and television channels lack special environmental programmes, except for the ordinary coverage of world environmental news, besides official Saudi activities and press releases, taken generally from the Saudi News Agency. The scope of coverage becomes wider during conferences and meetings on issues concerning environment and development.[7]

In Kuwait, the environment has occupied a prominent place in the media since the mid-

nineties, with the emerging interest in the persistent environmental effects brought about by the Iraqi military invasion and the ensuing war. First, the media concentrated on air pollution as a result of well fires, and marine contamination by oil leakages. The problem of radiation pollution with depleted uranium had been unnoticed by the Kuwaiti media even after the year 2000, when talk about radiation dangers in the Balkans, especially in the vicinity of destroyed armoured machinery, became widespread. Almost all the news of environmental character in the country's media revolves around wastes and marine, coastal, and industrial pollution. *Alqabas* daily newspaper publishes a weekly supplement entitled "Our Environment Is Our Life," whereas the daily Alanba' runs an intermittent environmental page. With the exception of these two publications, the environment is virtually absent in the printed media. The audio-visual media, on the other hand, have no regular programmes on the environment. However, Kuwait News Agency (KUNA) runs a section under the title "Health and Environment," with regularly updated news. Almost six magazines and publications with environmental titles are issued by official organizations and other Kuwaiti institutions, but with a limited circulation. The monthly series "World of Knowledge," run by the government, publishes, inter alia, some important books on the environment, especially translations of UN reports on environment and development.[8]

In Bahrain, only one of the six daily newspapers devotes a weekly section to the environment. However, the papers of Bahrain constantly publish environmental articles and news, borrowed mainly from the regional office of UNEP in the capital Manama. A Master's thesis, presented by the researcher Maha Mahmud Sabbagh to the Environment Management Programme at the Arab Gulf University in 2005 under the title "Priorities of Local Environmental Issues in Bahraini media," is probably the first documented study to deal, in detail and with scientific analysis, with environmental trends in the Arab printed media. In 2004, the six dailies of Bahrain published 2014 articles related to the local environment.[9] The emphasis, however, remains more on news – especially receptions, official visits and celebrations – than on in-depth reports, comments, editorials, and analytical essays. Radio Bahrain broadcasts two weekly episodes on the environment under the titles "Environment and Society" and "Native Life in Bahrain."

Coming to Oman, we find that the environment occupies a prominent place in the media. This reflects a truthful concern on the part of the government and the citizens. While one of the six daily newspapers in the country allocates a weekly page for the environment, environmental issues, both local and international, are strongly present in the contents of the remaining dailies and periodicals. *Oman*, the first official newspaper to appear in the sultanate, publishes, with the collaboration of the Ministry of Regional Municipalities, Environment, and Water Resources, a weekly page on environmental issues. The Omani television presents a weekly programme entitled "Together for Protecting the Environment," jointly with the same ministry. Oman radio broadcasts a weekly programme called "Environment and Life."[10]

In Qatar, with the exception of the weekly programme "You and the Environment" on the national radio station, the media are almost devoid of pages or sections dealing with environmental topics. This radio programme is prepared by the Higher Council for the Environment and Natural Reserves. It revolves around the news and activities of the Council, besides interviews, reports on key environmental issues, and covering of related occasions. In 1996, *Alsharq daily* started a page on the environment which was short-lived. But the paper continued to publish environmental topics and reports within the framework of exchange that it has with *Albi'a Wal Tanmia* magazine. Between 1999 and 2005, the daily *Alraya* of Qatar ran a weekly page on the environment.

In Lebanon, *Alnahar* is probably the first Arab daily to have devoted, since 1997, a daily page for the environment, though it is simultaneously concerned with heritage issues. Historical and archaeological subjects often outweigh environmental subjects on this page. *Alnahar* would have done better to merge environment with development. In any case, this page is suspended during political upheavals to devote its space to topics which are considered more timely and urgent. *Almustaqbal* newspaper has assigned a weekly page for the environment since it was first issued in 1999. *Alsafir* has a weekly environmental page

characterized by continuity, and following the method of analysis alongside news. The official Lebanese channel Télé Liban presented – during 1997-1999 a weekly programme prepared by *Al-Bia wal-Tanmia* under the title "The Environment Club," in the form of a televised magazine consisting of various sections. This channel has ever since aired the programme time and again.[11] At the beginning of 2008, the new channel Future News started a weekly environmental programme entitled "Blue, Green." One of the outstanding radio programmes specialized in environmental education is "The Environment Is Your Home" presented weekly, since 1997, by Alnour station. Another private radio station, Voice of Lebanon (VDL), has been broadcasting, since 2004, a weekly live programme receiving citizens' complaints on the air and seeking immediate answers from specialists, then referring them to officials to find solutions. The programme is prepared by "Environment Online," the hotline service of *Al-Bia wal-Tanmia*. While this magazine addresses a pan-Arab audience, being issued in Beirut where its main offices are located has contributed towards inducing a broad environmental awakening in Lebanese schools. The magazine is distributed to all school libraries in Lebanon, and students participate in the contests that *Al-Bia wal-Tanmia* organizes. In many official examinations, texts on the environment have been chosen from this review for tests in civics and Arabic literature for the high school certificate.

In Syria, interest in environmental information has been witnessing a big evolution since 2004, especially in the domains of printed and electronic media. A short period of only two years witnessed the issuing of three licensed environmental magazines belonging to the private sector, followed in 2007 by a quarterly of the Ministry of Local Administration and Environment. The distribution of these publications is still limited, and they lack professionalism. Electronic media in Syria has appeared, at its best, in a web site called "Environment News," a private initiative which later disintegrated. The Syrian *Althawra* is probably the only daily in the Arab world to have published, during a certain interval, a series of environmental editorials on its first page, written by Najib Saab. All Syrian dailies actually run a weekly or bimonthly environmental page supervised by a specialized editor. The Syrian news agency (SANA) is characterized by earmarking a special entry about the environment on its web site, although its content is not renewed regularly. The Syrian television broadcasts a weekly programme entitled "Environment and Man."[12]

In Jordan, information on the environment in daily newspapers appears usually in the various traditional sections, with no dedicated page. During the past five years, *Aldoustour and Alarab Alyawm* have devoted pages for the environment before closing them for one reason or another, among which are the conviction of the publishers that such topics do not attract enough advertisers. The Jordanian television presented, until the end of 2003, a weekly programme on the environment, after which environmental issues made their comeback in diverse reports within local programmes and interviews with officials. The radio station broadcasts a weekly environmental programme with local content. Among the specialized environmental periodicals in Jordan, *Alrim* quarterly, issued by the Royal Society for the Protection of Nature, centres on nature and biological diversity.[13]

Coming to Iraq, we remark that interest in the environment during the past two decades has been more conspicuous in the opposition media outside Iraq than in the local media domestically. The environmental preoccupations of "emigrant" Iraqi press were not restricted to disasters like drainage of the lagoons or pollution by chemical weapons, the blame of which it put on the bygone regime, but surpassed these to raise issues like contamination by depleted uranium during the 1991 war. Iraq has experienced, since 2003, a boom in the media, both printed and audio-visual, exhibited nowadays in more than 1,000 newspapers and magazines, besides several radio and television satellite stations. *Alsiyada*, *Almashreq*, and *Alsabah* dailies all run weekly sections on the environment. Prominent among their concerns are subjects like water and air pollution, the degradation of health conditions related to the environment, wastes, and radiation contamination. In 2006, the Iraqi Ministry of Environment launched a monthly review called *Albi'a Wal Hayat* (Environment and Life), with worthwhile and varied content. Its main subjects are, besides the news and activities of the ministry, international projects and programmes. The review is distributed to civil servants throughout the country.[14]

In Yemen, environmental concern makes its special appearance in the printed media. The daily *Althawra* published a weekly environmental page between 1994 and 2000, after which it was renamed "Water and the Environment." Another daily, *14 October*, runs a weekly page on the environment. *Adam and Hawwa* magazine has a monthly environmental section. At the official level, the Yemen Environment Protection Council issues a quarterly under the name Albi'a (Environment). It has a general content, varying between news, statements, reports, interviews, and studies.[15]

In Egypt, the media coverage of environmental topics is linked almost completely to the State Ministry of Environmental Affairs which provides the media with financial support and information. This explains why most of the published material on the environment revolves around the news and activities of the ministry and around the conferences that it organizes or takes part in. Partly, this is a positive indicator since it has contributed towards circulating environment dialogue in popular media. However, this is not sufficient since genuine information surpasses the communicating of mere news, and must include offering comments, analyses, and investigations. While all the Egyptian widespread dailies carry environmental news and articles, the environment page in *Alahram* remains the most regular. Pages on the environment appear periodically in *Aljumhuriyya*, *Alakhbar*, and *Almasa*'. In their turn, weekly magazines publish environmental reports, often descriptive, on diverse subjects. What catches the eye is that the opposition media in Egypt may be the only ones to run on their front pages articles of environmental content or interest. Usually, this occurs within the framework of unveiling what the opposition dubs as "official scandals." Foremost among these media is *Alwafd* newspaper, published by the party bearing the same name.

The Egyptian television presents some general environmental programmes based mainly on interviews. One of them, "A Clean Environment," is transmitted by Channel 2; another, "The Environmental Review," is transmitted by Channel 3. Many Egyptian radio stations broadcast environmental programmes with awareness content. Outstanding among these audio-visual programmes is "It Is One World," which has been presented weekly by Dr. Umayma Kamel on Channel 2, in the period 1992-2007. It offered surveys and analyses of environmental issues, both at the local and inter-

national levels, while evading the type of public relations information. Foremost among the radio programmes, to the extent that it does not stop at transmitting news but treats fundamental environmental issues, is "For Life on Earth" presented by Ms May Al Shafi'i on the General Egyptian Broadcasting Corporation.[16]

Tunisian media have witnessed a considerable growth in the last years, especially as Tunisia became the first Arab country to incorporate the name "development" with the ministry of environment, to become "The Ministry of Environment and Sustainable Development." The press coverage of environmental subjects reflects in general the activities and plans of the ministry. Materials appear in the form of news, reports, and diversified topics. *Alsahafa* is the only daily newspaper to single out a page for the environment, periodical but intermittent. Almost all the radio stations devote fixed weekly programmes for the environment. The Tunisian Channel 7 presents a weekly scientific programme entitled "Secrets of Nature," while Channel 21 broadcasts once per week a general environmental programme with the name "Always Green," "green" being the most popular epithet of the country. With the collaboration of the ministry, the Tunisian audio-visual media regularly broadcast short passages aiming at educating the public on particular environmental issues.[17]

In Algeria, the only daily paper with a weekly page on the environment is *Alsabah*, newly established and narrowly spread. Its environmental topics, which turn on local and international themes, are treated in a general way. This page concentrates on bits and pieces of information, aiming at environmental awakening. *Alshouruq* daily ran, for three years, a weekly environmental page that has been terminated despite its treatment of important issues starting with domestic wastes, contaminated water, and assaults on green areas, and ending with uncovering some major environmental violations. At the audio level, two weekly programmes are broadcast in Algeria.[18]

What is remarkable in Morocco is that most of the publications which devote weekly sections for the environment prepared by specialized editors are published in French. These are two daily newspapers: *L'Opinion* and *Le Matin du Sahara*, and two weekly magazines: *Tel Quel* and *Le Journal*. The subjects of these specialized sections vary between local, regional, and international themes, related to natural disasters, wastes, and pollution of air, water, and coasts. One distinctive feature of the Moroccan television is its 'clip'-type brief programme "A Drop of Water," presented each evening since 2005. The Moroccan radio runs a weekly programme called "Environmental Issues."[19]

III. ARAB ENVIRONMENT IN REGIONAL MEDIA

Among the Arab media that address a regional pan-Arab audience, as well as Arab-speaking residents in other countries, are three publications with outstanding experience in environmental information: (1) *Al-Bia wal-Tanmia* monthly magazine, (2) *Al Hayat* daily newspaper, and (3) *Monte Carlo Doualiya* Radio.

Al-Bia wal-Tanmia, published in Beirut since 1996 with Arab and international content, is distributed in all Arab countries by major distribution companies, and to Arabic-speaking subscribers around the world. This is an independent media enterprise, financed by its publisher, advertisers, and readers. It has a network of correspondents throughout the Arab world; it is affiliated to its own research centre which provides it with scientific content; and it is produced by a group of professional journalists. Thanks to its genuine independence far from governmental and other organizations, it has been able to maintain a wide scope of freedom and pose key issues with courage, objectivity, and professionalism. Being the only Arab publication specialized in the environment and edited, produced, and distributed in accordance with the most rigorous professional media standards, it has occupied a leading place among the major political, economic, and social publications. Its motto, "A specialized title for all readers," expresses its editorial policy based on simplifying environmental topics in such a way as to address the general reader, without compromising scientific integrity.

Al Hayat daily, published in London and distributed in the Arab countries and worldwide, runs, in collaboration with *Al-Bia wal-Tanmia*, a

monthly environmental page, besides periodical reports on the environment. This page is characterized by a diversity of content, comprising news analyses, reports, interviews, and documented news. An outstanding campaign launched jointly by both publications about depleted uranium stirred up many reactions and led to a series of practical measures. This campaign was a major factor that induced the Iraqi environment ministry to attend seriously to the problem by measuring the radiation and publishing the results, then calling for corrective action. The campaign had a big influence on awakening large sectors in the Arab world, especially in the Gulf countries, to the problem of depleted uranium.

The Arabic section of Radio Monte Carlo, broadcasting in Arabic from Paris to the whole Arab world, presents a weekly environmental programme entitled "The World Our Home," which is prepared by Hassan Al Talili and presented regularly since 2003. The programme is produced in the form of an audible magazine with news, interviews, reports, and comments. One of its distinctive characteristics is that, in many cases, it broadcasts from the very site of the environmental event.

While Arab satellite television channels do not allocate programmes to the environment, some of them present serious environmental topics, albeit sporadically. Aljazeera station is leading in this dimension. On its screen Mr Ahmad Mansur has devoted, during the last three years, a few episodes of his renowned programme "Without Limits" to environmental subjects, most of which were prepared in collaboration with *Al-Bia wal-Tanmia*. Mansur was among the first to raise the question of depleted uranium on an Arab screen. Towards the end of 2006, Aljazeera launched an environmental programme, live and brief, presented by Ms Rawan Al Damen.

Alarabiya television has presented varied reports on the environment, the most outstanding of which were those prepared by Ms Maysun Azzam on depleted uranium. These reports stand among the most comprehensive and accurate about the subject.[20]

In November 2006, a satellite channel, *Beeaty* (My Environment), commenced experimental broadcasting from Cairo under the supervision of its sponsor, the Environment Authority in Saudi Arabia. During its brief life, this channel lacked programming, while most of its sections consisted of pictorial scenes of nature and wildlife, usually of amateurish character and transmitted with no comment or voice-over. Unsurprisingly, the channel was off the air before it could celebrate its first birthday.

IV. ARAB ENVIRONMENT ON THE INTERNET

Some Arab countries exert big efforts to join the era of information technology. Yet the modes of internet exploitation in the Arab world are more driven by consumer habits rather than the desire to generate, accumulate, and propagate knowledge. Reports on the state of Arab human development prepared by UNDP reveal a lot of alarming and disquieting truths. Besides pointing to the fact that the rate of internet users in the Arab countries is still among the lowest in the world, UN reports indicate that Arab policies which attempt to fill the information gap concentrate on the infrastructure at the expense of the content. Most of the content available on the internet is written in English, proficiency in which is restricted to a minority of the population, while the Arabic content is so scanty that it falls short of satisfying the needs of the majority for useful information.

A survey carried out by the Study Centre of Quantitative Economics (Madar) has shown the number of internet users in the Arab world at the end of 2005 to be about 26 million, comprising 8.5 percent of the Arab population compared to 14 percent worldwide. The survey also showed that while the rate of internet users in the Gulf countries, especially UAE, witnessed an increase, it is still lower than 6 percent in 12 Arab states.[21] Undoubtedly, these rates reflect a big stride compared to less than one percent, the rate recorded by the Human Development report for 2002.

The fact remains that the size of useful environmental information is meagre. Most websites belonging to Arab official, private, and civil society bodies are in English. For the most part, their promotional and advertising content outweighs their scientific information content. It may be safely said that most Arab websites concerned

with the environment are promotional sites aiming at attracting foreign granting institutions. Even at this level, they are weak as public relations sites, besides their deficiency in information.[22]

In general, it is possible to get some information on the Arab environment from the internet. But this requires a big effort, with the necessity to be familiar with the international websites containing the required information, taking into consideration that most of these sites are in English. The persisting problem is the scarcity of novel and credible statistical reports, which are either originally non-existent, or there is no organization which assumes the responsibility, before presenting them on the internet, of compiling them in a way relevant to evaluate and compare. Arabic websites have to move away from a mentality of laudation and promotion towards a mentality of amassing reliable information, critical analysis, and founding platforms for interaction and dialogue.

V. CONCLUSION

Arab environmental information seems to be an expression of Arab environmental action as it stands in need to define its concepts, frameworks, and goals. As an integral part of a general environmental policy rather than a means to proclaim a ready-made policy, environmental information aims at developing environmental awareness inside the various social sectors, thus enabling them to participate effectively in developing, supervising, and revising environmental policies and preparing the public to engage positively in supporting the achievement of such policies and measures. Among the major preoccupations of environmental information is to effect a behavioural change in people's attitudes towards the environment, and to act upon the natural resources as if they were objects which have value and price tags rather than as gratuitous gifts.

While information is a main instrument for achieving environmental policy, it cannot be effective if it is not viewed as complementary with other measures like laws, rules, and financial measures, be they incentives or deterrents. Being conscious of a certain problem does not always dispose the knower to participate in solving it, taking into consideration all the restraints that such a solution might entail. Information is liable to facilitate the endeavour to convince people through laws and regulations. In their turn, laws may incite people to accept the calling of the environment. Financial incentives and deterrents contribute towards a better acceptance and observance of the laws. Environmental information aims primarily at motivating the public to engage effectively in attending to the environment by means of encouraging them to embark upon personal action and to involve themselves in dialogue and convey their opinions forcibly to officials in such a way that information becomes an element in decision making. This requires opening channels of dialogue through which the opinions of citizens can directly influence the officials, while the officials pass to the citizens clarifications about the steps taken by government and official bodies for the protection of the environment.

Environmental information urges the public to engage in the process of planning and decision making. The participation of the public in environmental dialogue leads to the propagation of public awareness for safeguarding natural resources. It also provides the officials with a clear description of public concerns.

National policies concerning environmental information approach the subject from the following perspectives:

1. Information is a means to pass to the public credible facts about the environment, and a channel through which the public can transmit their opinions to the officials and have a dialogue with them. Information here is an open means for dialogue and partnership in decision.

2. Information is a means to communicate to the public official policies and explain environmental plans and measures as an expression of granting the citizens their natural right to a free access to information and to secure the transparency of official action.

3. Information is a means to produce a change in people's behaviour and establish affinity with the environment, either within the framework of personal, voluntary conduct or

within the framework of securing support for official environmental policies and laws.

4. Information is a means for public relations, as official environmental policies cannot succeed in the absence of a system of relations between the persons in charge of these policies on the one hand (usually ministries of environment) and the civil society, industrialists, merchants, professionals, educators, consumers, and the rest of official and public bodies on the other.[23]

Almost all Arab media stand in need of specialized editors, except for the traditional sections like local news, world news, culture, economics, sports, and reports. In most cases, the same editor is asked to work for more than one section. Reports on local environmental issues usually concentrate on subjects which attract the sight, like wastes in the streets, or on disasters like oil leakages or oil-well fires, while they overlook other issues of magnitude, like the impact of industry on the environment, the depletion of natural resources, the pollution of water, the destruction of coastal lines, and the uncontrolled urban expansion. The Arab media often attend to such momentous environmental issues only when they receive ready-made materials on them from international organizations or news agencies.

While a journalist is not expected to be a scientist with expertise on the environment, it is indispensable that he should be sufficiently acquainted with his subject in such a way that he is able to locate the credible sources of information; then, having collected the basic information, to present and analyse it. This shows the importance of cooperation between the media on the one hand and environmental experts and organizations at the Arab, regional, and international levels on the other. Another matter of priority is to establish channels of communication between environmental writers and news providers, whether they are individual experts, official bodies, or organizations. One main obstacle remains scarcity of data, and restrictions on access to what might be available.

While governments, besides regional and international organizations, have a major role to assume in supporting Arab environmental media, the biggest responsibility falls upon the media, whether they are individual journalists or institutions. But the persisting question is whether environmental information is to be practised as an end in itself or as part of an environmental preoccupation encompassing all sectors of society-scientific, economic, political, and NGOs. Are the media to forge an environmental state of affairs, or to deal with one which is already in existence? Media can indeed be part of environmental change, through spreading awareness and instigating action, but only as an integral part of a wider environmental drive mobilizing various sectors of the society.

Ultimately, quality environmental information requires professional approach to both environment and media. Unfortunately, environment in Arab media is overwhelmingly controlled by media and environment amateurs.

NOTES

All the literature referred to in the following notes, whether in book form, articles, or reports, is in Arabic.

1 "Arab Information and the Environment," a paper presented by Najib Saab in 1987 to a conference held in Tunisia and organized by the Arab League education, Culture, and Science Organization (ALECSO) under the auspices of UNEP. See the full version in Najib Saab, *Environmental Issues*, Beirut: Technical Publications, 1997.
2 Najib Saab, "The Public and the Sources of Information," in *Environmental Issues*, pp. 23-24.
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4 The surveys were carried out by the correspondents of Al-Bia wal-Tanmia in 15 Arab countries, and based on reviewing the content of local media between November 2005 and September 2006. Data have been collected exclusively for this study by the following correspondents: Imad Saad (UAE), Ali Al Anzi (KSA), Ghada Farhat (Kuwait), Zakaria Khanji (Bahrain), Mahad Bin Ahmad Ma'sheni (Oman), Ahmad Hussain Abdul Rahman (Qatar), Nisrin Ajab (Lebanon), Abdul Hadi Alnajjar (Syria), Bater Wardam (Jordan), Kazem Maqdadi and Fadel Badrani (Iraq), Sadeq Al Assimi (Yemen), Wajdi Riyad and Khaled Ghanem (Egypt), Fathi Alhamrouni (Tunisia), Fatiha Alshar' and Younes Fassih (Algeria), Muhammad Altefrawi (Morocco).
5 Jamal Muhammad Ghitas, "Arab Scientific Information and the Problems of Development," a paper presented at a conference organized by *Al Arabi* review on scientific information, Kuwait, December 2005.
6 Interview with Shaikh Zayed Bin Sultan Al Nahyan, given to Najib Saab exclusively for Al-Bia wal-Tanmia, number 9, November 1997, pp. 14-19.
7 From a report on "Saudi Environmental Information," prepared by Ali Al Anzi (Riyadh 2006) exclusively for this study.
8 From a report on "Kuwaiti Environmental Information," prepared by Ghada Farhat (Kuwait, 2006), exclusively for this study.
9 See note 3 above.
10 Mehad Bin Ahmad Al Mesheni, "History of Omani Press and the Current State of Environmental Information," an unpublished report prepared exclusively for this study, Muscat (Oman), 2006.
11 "The Little Environmentalists," supplement of Al-Bia wal-Tanmia, number 15, November 1998. Complete episodes of this programme are available on video cassettes published by Al-Bia wal-Tanmia, 1999-2000.
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14 Dr Fadel Albadrani, "Environmental Preoccupations of the Iraqi Press in Exile," an unpublished report prepared exclusively for this study, 2006.
15 Sadeq Yahya Assimi, *Environmental Information: Concept and Significance*, Sanaa (Yemen): Abadi Centre for Studies and Publications, 2004.
16 Dr Khaled Ghanem, "Environmental Information in Egypt," an unpublished report prepared exclusively for this study, 2006.
17 From an unpublished report on "Environmental Information in Tunisia" prepared by Fathi Alhamrouni exclusively for this study, 2006.
18 Fatiha Alshar', "Environmental Information in Algeria," an unpublished report prepared exclusively for this study, 2006.
19 Muhammad Altefrawi, "Environmental Information in Morocco," an unpublished report prepared exclusively for this study, 2006.
20 Kazem Almaqdadi, "Death by Exhausted Uranium," Al-Bia wal-Tanmia, number 103, October 2006, pp. 52-54.
21 *Arab Human Development 2002*, UNDP report, 2002; and Muhammad Maghrebi, *Alhayat*, "Science and Technology" section, 24 September 2006.
22 Bater Wardam, "Arab Environmental Web Sites," Al-Bia wal-Tanmia, number 66, September 2003, pp. 20-26.
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Environmental Education

Riyad Y. Hamzah

I. INTRODUCTION

Arab countries have begun individual processes for educational reform. Environmental education is naturally a part of the larger educational reform process that is taking place in many parts of the Arab world. This has coincided with international awareness, treaties, actions, and initiatives towards the environment and, in particular, towards environmental education and research on environmental issues.

Since the Tbilisi Declaration of 1977, the countries of the Arab world have reacted positively towards the increasing concern over environmental issues. This chapter will review some of the endeavours undertaken by different countries of the Arab world to introduce environmental concepts and education into their basic educational systems, higher education, and research institutes, in addition to pan Arab cooperation for environmental education and research.

It discusses the international initiatives to promote environmental education through the declarations and directives of international organizations, and Arab endeavours to participate in and benefit from these initiatives in dealing with their national and regional environmental concerns.

This chapter also includes initiatives in the Arab world that promote national and regional environmental education and learning such as teacher training programmes for the environment and scientific publications on environmental issues.

Because the study of environmental education has yet to be institutionalized in the Arab world, numerous factors contribute to the lack of accessibility to data and current information on the environment. In many areas of the region, consistent environmental monitoring and data collection is absent and there has been little attempt to standardize data formats and reporting. The reports that are made are kept in numerous different government or private sector locations, which often results in duplication of information or gaps in data. These factors make a comprehensive study more difficult and impede the development of a formal environmental policy and its implementation.

The interest in environmental education has been witnessed at both the basic level and the level of higher education, where an increasing number of universities have introduced Environmental Studies as a major at the Bachelor's, Master's, and Ph.D. levels. Data and statistics are not easily available, as environmental education has yet to be institutionalized throughout the Arab world. In regard to higher education, the access to information is essential to its accountability and continual development, as information is the primary fuel for improving accuracy and availability.

Basic education has not yet developed specific courses for environmental studies, although issues of environmental concern have been incorporated into other required courses, such as numerous science classes. There are, however, several universities in which specialized programmes and degrees in various fields of environmental education have been developed. There are also a number research centres that have tackled environmental issues of concern to the Arab world.

In the Arab world, education information systems tend to still be largely inaccessible. There are many gaps in basic educational data available to the public and the information is often outdated and overly broad. Without standard information on education inputs and outputs, there are no avenues of verification, analysis, and correction. Additionally, if accurate, credible, regularly updated, and detailed information systems do not exist, it will remain challenging to effectively use incentives to improve educational outcomes or to ensure public accountability.

II. ENVIRONMENT IN EDUCATION THROUGH THE DECLARATIONS AND DIRECTIVES OF INTERNATIONAL ORGANIZATIONS

In December of 2002, in UNGA Resolution 57/254, the UN General Assembly declared the years 2005-2014 to be the "Decade of Education for Sustainable Development" (UNDESD). In the declaration, the role of education was recognized as being essential for achieving sustainable development, in accordance with international recommendations from sources such as the Earth Summit of 1992 in Rio de Janeiro and the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 (Hopkins and McKeown,

2002; Johannesburg Declaration). The aim of the declaration of the UNDESD was to encourage the worldwide incorporation of the values, principles, and practices of sustainable development into all levels of basic and higher education.

At the 59th session of the UN General Assembly in October 2004, and again at the 171st and 172nd sessions of the UNESCO Executive Board in April and September 2005, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) presented a framework for its worldwide International Implementation Scheme (ILS), developed through consultations with various UN agencies, national governments, nongovernmental organizations, and specialists in various fields (UNESCO 2002, 2006). The ILS discussed the key role of partnerships and how these partnerships could contribute to the achievement of the objectives of the UNDESD on the local, national, regional, and international levels.

With the launch of the UNDESD in March 2005, the United Nations Environmental Programme (UNEP) assumed a leading role in the development of programmes and various projects designed to achieve the UNDESD objectives. It relied upon collaboration with UNESCO and the development of an Environmental Education and Training (EET) strategy for the decade to promote environmentally ethical behaviour through values that enable people to become informed citizens actively participating in sustainable environmental development.

The First International Conference on Environmental Education (ICEE) organized by UNEP was held in Tbilisi, Georgia in 1977. The Fourth ICEE was held in Ahmedabad, India in 2007 with the objective of understanding the changes and developments that have taken place in Environmental Education (EE) since the 1977 conference and the role of Environmental Education in Education for Sustainable Development (ESD).

Given that ESD should be a lifelong strategy in which education takes place in both formal and informal settings, the conference provided a number of recommendations to be adopted in order to achieve education for sustainable development. These recommendations called for changes in formal educational approaches and for

further informal education through the workplace, local civic societies and other community-based organizations.

In order to promote and implement ESD during the Decade of Education for Sustainable Development, seven interlinking strategies were proposed incorporating advocacy and vision building, consultation and ownership, partnership and networks, capacity building and training, research and innovation, information and communication technologies, and monitoring and evaluation.

III. ENVIRONMENTAL ISSUES IN EDUCATION IN THE ARAB WORLD

In view of the general crisis of education in the Arab world, it is not surprising that its level of environmental education and awareness is fairly low in comparison to international levels in other areas of the world. However, efforts are continuing to be made to combat this problem.

Environmental Issues in Basic Education

The objectives of environmental education at this level are to establish a relationship between the individual and his or her natural and social environment, aiming for children and youth to gain skills, direction, and values that are related to the environmental problems and responsibilities that face the individual, and to align behaviour in a positive and interactive way towards his environment. No one discipline can or should claim ownership of ESD. In fact, ESD poses such

TABLE 1 DEGREES OFFERED IN ENVIRONMENTAL STUDIES IN DIFFERENT ARAB UNIVERSITIES

Country	University	Field	Degree	Website
Bahrain	Bahrain University	Environment and Sustainable Development	Master's	http://www.uob.edu.bh/scientific-research/unesco/ENV/project.html
Egypt	Alexandria University	General Degree in Biochemistry & Environmental Science	Bachelor's	http://www.alex.edu.eg/
		Special Degree in Environmental Sciences	Bachelor's	http://www.alex.edu.eg/
		General Degree in Environmental Sciences & Chemistry	Bachelor's	http://www.alex.edu.eg/
		General Degree in Environmental Sciences & Biochemistry	Bachelor's	http://www.alex.edu.eg/
		Environmental Sciences	Master's	http://www.alex.edu.eg/
		Environmental Sciences	PhD	http://www.alex.edu.eg/
	American University in Cairo	Environmental Science Minor	Bachelor's	http://catalog.aucegypt.edu/preview_program.php?catoid=4&poid=323
		Environmental Engineering (M.S.)	Master's	http://catalog.aucegypt.edu/previewprogram.php?\catoid=4&poid=369
		Environmental Systems Design (M.Eng.)	Master's	http://catalog.aucegypt.edu/previewprogram.php?catoid=4&poid=370
	Mansoura University	Environmental Management, Engineering and Technology	Master's	http://mudb.mans.edu.eg/envmed/intro.swf
	Mansoura University (Damietta Faculty of Science)	Environmental Sciences	Bachelor's	http://www.mans.edu.eg/facscid/english/Envir/Environmanetal.htm
Jordan	Al al-Bayt University	Applied Geology and Environmental Sciences	Bachelor's	http://www.aabu.edu.jo/earth/bs.htm
		Water Resources and Environment	Master's	http://www.aabu.edu.jo/earth/ms.htm
	Al-Hussein Bin Talal University	Environmental Engineering	Bachelor's	http://www.ahu.edu.jo/index.php?mod=department&id=26
	Hashemite University	Land Management and Environment	Bachelor's	http://www.hu.edu.jo/fac/dept/undergraduate_Programs.aspx
		Water Management and Environment	Bachelor's	http://www.hu.edu.jo/fac/dept/undergraduate_Programs.aspx
		Geology and Environmental Sciences	Bachelor's	http://www.hu.edu.jo/fac/dept/undergraduate_Programs.aspx
	Yarmouk University	Environmental Sciences	Master's	http://portal.yu.edu.jo/Default.aspx?tabid=231

broad and encompassing challenges that it requires contributions from many disciplines. For example, consider these inter-disciplinary contributions to ESD (UNESCO 2006):

- Mathematics helps students understand extremely small numbers (e.g., parts per hundred, thousand, or million), which allows them to interpret pollution data.
- Language Arts, especially media literacy, creates knowledgeable consumers who can analyze the messages of corporate advertisers and see beyond "green wash."

TABLE 1 CONTINUED

Country	University	Field	Degree	Website
Kuwait	Kuwait University	Environmental Geology	Bachelor's	http://www.science.kuniv.edu.kw/Courses.xphp? Language=En&UnitID=U046000
Lebanon	American University	Environmental Health	Bachelor's	http://fhs-lb.aub.edu.lb/degree_programs/undergraduate_studies.html#eh
		Environmental Sciences	Master's	http://fhs-lb.aub.edu.lb/degree_programs/master_science.html
		Aquatic and Environmental Sciences	Diploma	http://wwwlb.aub.edu.lb/~webbiol/programs.htm
		Environmental and Water Resource Engineering	Master's	http://webfea-lb.fea.aub.edu.lb/fea/cee/programs/ewre_general.aspx
		Environmental and Water Resource Engineering	PhD	http://webfea-lb.fea.aub.edu.lb/fea/cee/programs/phd_general.aspx
		Environmental Technology	Master's	http://webfea-lb.fea.aub.edu.lb/fea/cee/programs/et_general.aspx
	Beirut Arab University	Biological and Environmental Science	Bachelor's	http://www.bau.edu.lb/science.htm
	Beirut University Online	Environmental Studies	Master's	http://www.buonline.edu.lb/bu/envstudies.htm#offer
	University of Balamand	Environmental Science	Bachelor's	http://www.balamand.edu.lb/english/Sciences.asp?id=1437&fid=164
	Notre Dame University	Environmental Science	Bachelor's	http://www.science.nd.edu/science_undergrad/bios/bios_ES_major.htm
Libya	Academy of Graduate Studies	Environmental Science and Engineering	Bachelor's	http://www.alacademia.org/english/Eng1.htm#
Mauritania	University of Nouakchott	-	-	http://www.univ-nkc.mr/
Morocco	Al Akhawayn University	-	-	http://www.aui.ma/
	International Institute for Higher Education in Morocco	-	-	http://www.iihem.ac.ma/fr/src/home.php
	Université Hassan Ier - Settat	-	-	http://www.uh1.ac.ma/uh1/
Oman	Nizwa University	Environmental Engineering	Diploma, Bachelor's	http://www.unizwa.edu.om/e-index.php

- History teaches the concept of global change, while helping students to recognize that change has occurred for centuries.
- Reading develops the ability to distinguish between fact and opinion and helps students become critical readers of political campaign literature.
- Social Studies helps students to understand ethnocentrism, racism, and gender inequity as well as to recognize how these are expressed in the surrounding community and nations worldwide.

TABLE 1 CONTINUED

Country	University	Field	Degree	Website
Palestine	Al-Quds University (The Arab University in Jerusalem)	Applied Earth and Environmental Sciences	Bachelor's	http://www.alquds.edu/faculties/science/index.php?page=aees
		Environmental Studies	Master's	http://www.alquds.edu/faculties/science/index.php?page=aees_msc
	Birzeit University	Water and Environmental Engineering	Master's	http://www.birzeit.edu/institutes/water_std/
		Water and Environmental Sciences	Master's	http://www.birzeit.edu/institutes/water_std/
Qatar	Qatar University	Biological Sciences	Bachelor's	http://www.qu.edu.qa/qu/colleges/arts_sciences/cas_bio_intro.html
		Agricultural Sciences	Bachelor's	http://www.qu.edu.qa/qu/colleges/arts_sciences/cas_bio_intro.html
	College of the North Atlantic, Qatar	Environmental Health Technology	Diploma	http://www.cna-qatar.com/cnaqatar/futurestudents/Programdetailsnew.asp?eht
Saudi Arabia	King Saud University	Environmental Sciences	Master's	http://www.ksu.edu.sa/sites/Colleges/CollegeofScinces/MSCPES/Pages/default.aspx
	King Fahd University of Petroleum and minerals	Environmental Sciences	Master's	http://www.kfupm.edu.sa/cs/
Sudan	University of Khartoum	Public and Environmental Health	Master's	http://www.uofk.edu/index.php?id=279
		Environmental Studies	Diploma	http://www.uofk.edu/index.php?id=164
		Environmental Studies	Master's	http://www.uofk.edu/index.php?id=164
		Environmental Studies	PhD	http://www.uofk.edu/index.php?id=164
	Sudan University of Science and Technology	Water and Environmental Engineering	Bachelor's	http://www.sustech.edu/
UAE	UAE University	Environmental Science	Master's	http://www.fsc.uaeu.ac.ae/Postgraduate_Prog.htm
	University of Sharjah	Environmental Health Technology	Bachelor's	https://www.sharjah.ac.ae/English/Academics/Colleges/Health Sciences/DepartmentsPrograms/EnvironmentalHealth/Pages/default.aspx
	American University of Sharjah	Environmental Sciences	Bachelor's	http://www.aus.edu/cas/env/index.php
	Higher Colleges of Technology	Environmental Health Program	Diploma	http://www.hct.ac.ae/catalogue07_08/aspx/cms_program_offerings.aspx
	The British University in Dubai	Sustainable Design of the Built Environment	Master's	http://www.buid.ac.ae/buid/html/article.asp?cid=273
Yemen	Hadhramout University of Science and Technology	Environmental Sciences	Master's	http://www.hust.edu.ye/prochure.pdf

The Arab world has witnessed remarkable and laudable efforts in creating awareness, spreading information, teaching concepts, developing habits and skills, and encouraging values with regards to environmental issues, all of which have been embedded in its curricular and extracurricular activities.

The following summarizes the methodologies by which environmental initiatives have been implemented:

- The development of extracurricular activities for environmental education and awareness. These activities are usually designed according to the age range of the students. However, the objectives of all are towards the concepts of protecting the environment, preserving our natural resources, and tying them into the environmental issues that concern the world. These activities are usually conducted in an interactive, problem-solving manner and with the use of materials and resources that are of low cost and can be easily obtained by the students. Such activities include recycling of glass, paper, plastics and aluminium, beach clean-ups and trash disposal, active participation in water and electricity conservation, reforestation and the planting of new trees, etc. A comprehensive manual for extracurricular environmental activities in schools, The Environmental Activities Guide, has been produced by *Al Bi'a Wal Tanmiya* (Environment & Development) magazine in 1999, and is being used in thousands of schools across the region, with special editions developed for Lebanon, the UAE and Syria (*Al Bi'a Wal Tanmiya*, 1999). Training courses for teachers were carried out in various countries based on the manual, and consequently hundreds of school environment clubs were established.

- Trying to introduce environmental concepts, information, and issues within the different courses whenever appropriate. Such information is often introduced within the scope of the individual courses, such as the study of climate change within courses on geography and chemistry, biodiversity within courses on biology, alternative energy within the study of physics, etc. Reading selections concerning environmental information are also introduced in language courses involving reading comprehension in Arabic and English. One main source for environmental contents in textbooks in many countries has been *Al Bi'a Wal Tanmiya* magazine, and the magazine itself has been widely used in schools as extra reading material. It is interesting to note that 5 times between 2001-2007, texts taken from Najib Saab's editorials in this magazine were the subject of high school official final exams in Lebanon, 4 times in civics and one time in Arabic literature (*Al Bi'a Wal Tanmiya*, 2007). The magazine has been organizing annual competitions on environmental themes among Arab students since 1997, attracting over one hundred thousand entries.

- School libraries are being strengthened and enriched with the addition of environmental reference materials, books, and magazines.

- Schools organize activities in celebration of the internationally proclaimed environmental awareness days established by UNEP, such as Earth Day.

Jordan and Egypt have witnessed various remarkable educational reforms that have led to the introduction of environmental concepts in their national education systems, as well as in extracurricular activities within the schools. These activities are carried out usually via different international programmes working with local institutes. The Global Green Communication and Education Programme (GreenCom), consisting of various educational packages, was produced and adopted by Ministries of Education in the Arab world. The Arab media were also encouraged to highlight environmental issues. Pages or corners dedicated to environmental awareness appeared in the national press and regular television programmes addressed environmental issues.

IV. ENVIRONMENTAL ISSUES IN HIGHER EDUCATION

The earliest programme of study of environmental issues in higher education in the Arab world was launched at Alexandria University in Egypt in 1983. The first such programme in the Arabian Gulf region was launched at the United Arab Emirates University in 1991.

As early as the 1980s, the Arabian Gulf University, a regional university situated in

Bahrain and serving the Gulf region, launched an Integrated Water Management Programme as well as a Desert and Arid Land Programme. In 1987, the university established a Biotechnology Programme wherein an Environmental Biotechnology track was introduced. Research by staff and students covers such areas as bioremediation of toxic pollutants and biodesulfurization of crude oil and its derivatives. The Arabian Gulf University also launched the first academic postgraduate programme awarding a graduate degree in Environmental Management in 2004. This programme is delivered through the modular system to suit the work commitments of the enrolled practicing managers, and uses the case study method.

Table 1 demonstrates that most of the degrees pertaining to environmental studies offered by universities in the Arab world are at the Bachelor's level, with fewer at the Master's level and even fewer offering a PhD. These statistics reflect the current deficiencies found in providing higher education in environmental issues. However, this finding is to be expected as research for higher level degrees requires additional funding which is already scarce at all levels and for all educational fields.

Examining the titles of the degrees offered, one can note the need for additional specializations in environmental education such as environmental legislation, environmental management, and environmental risk management. Current degree programmes should be expanded to cover all the necessary aspects of environmental education.

Enhancement of these programmes in terms of qualification and accreditation is also required. These programmes should satisfy quality assurance requirements and accreditation. Attempts should also be made to establish stronger links to other stakeholders, such as government agencies and industries in the private sector having a stake in future developments in fields relevant to their industry.

Quality education is a prerequisite for education for sustainable development. Quality education, first and foremost, views each individual as a learner capable of having an impact upon the development of society. The role of quality education is to provide the individual with the tools necessary to transform society into a more sustainable society, taking into consideration the social, economic, cultural, and environmental elements of the place, as well as its history and traditions. Quality education takes these various factors into account and develops a programme or curriculum that reflects the local conditions, is relevant to the present, and prepares the individual for the future.

Education for sustainable development has four major thrusts: promoting and improving basic education; reorienting existing education programmes at all levels to address sustainable development; developing public awareness and understanding of sustainability; and providing training.

A trend in current educational systems has been to incorporate environmental concepts into the teaching of other subjects, allowing environmental awareness and education to infiltrate the educational process even when specific courses are not offered. It may, in fact, complement other courses or stress the concepts to be communicated. In addition, numerous universities that do not offer specific degrees in environmental sciences often offer individual environmental courses within other specialties. Many of the universities, increasingly in recent years, and sometimes in association with international bodies such as UNEP, provide training courses which cannot be overlooked or neglected, as they help the capability-building of specialists and professionals in these fields.

Since the late 1980s, there has also been an increase in the number of regional research centres in the Arab world dedicated to environmental issues such as marine sciences, energy and water resources. Table 2 lists some of these regional research centres. These centres are primarily funded nationally by each individual country, often with additional international partnerships and alliances for some of their programmes. However, the funding does not by far meet the minimal requirements of funding availability, levels of funding that are available to most international research centres outside the Arab world.

Contributions for research from the private sector from such sources as oil companies and other industries in the Arab world are still relatively

minor. However, there are indications that this is beginning to change, such as the laudable example of ARAMCO funding research in oil pollution and bioremediation in collaboration with King Fahd University for Petroleum and Minerals in Saudi Arabia.

Universities and research centres are continuing to collaborate with regional and international environmental organizations to carry out research seminars and workshops, which provide an outlet for staff members and researchers to interact, attending conferences and meetings, encouraging participants to remain up-to-date and aware of current trends and new developments.

V. REGIONAL INITIATIVES FOR ENVIRONMENTAL EDUCATION IN THE ARAB WORLD

The Arab Network for Environmental Education and Learning (ANEEL)

Environmentalists, scientists, and educators of the Arab region initiated the Arab Network for Environmental Education and Learning (ANEEL). This network will work in conjunction with the Commission on Education and Communication (CEC) and will be linked to the International Union for Conservation of Nature (IUCN). Established in 2007, ANEEL is a non-governmental organization dedicated to providing leadership in areas of environmental education and learning in the Arab world.

The mission of this network is to use education as a form of promoting a deeper knowledge and understanding of environmental issues and concerns, aiming to ultimately reach a sustainable means of living with the conservation of the planet. By means of sharing, exchanging and disseminating innovative educational events, programmes and curriculum development, the network intends to raise awareness, support problem-solving of current environmental issues, and to build the capacity of professionals to meet conservation and sustainable development goals in the Arab world.

ANEEL will distribute information on relevant events (conferences, workshops, forums, etc.) and educational programmes available in the region, initiate change through academic dialogue regarding environmental issues, and create opportunities to exchange visits, promote scholarships and grants, provide links with other networks, and share success stories.

IWRM E-Learning Graduate Programme at the Arabian Gulf University

A regional centre for the Arab region was established in 2007 at the Arabian Gulf University (AGU) offering a distance-based post graduate diploma in Integrated Water Resources Management (IWRM) under the United Nations Water Virtual Learning Centre (UN-WVLC) Project in collaboration with the United Nations University (UNU) International Network on Water, Environment and Health (INWEH) in Canada (AGU – IWRM).

TABLE 2 **NATIONAL AND REGIONAL RESEARCH CENTRES IN THE ARAB WORLD FOR DIFFERENT ASPECTS OF ENVIRONMENTAL STUDIES AND RESEARCH**

Country	National Research Centers	Division
Bahrain	Environmental Research Center (Bahrain University)	
Egypt	Soil, Water and Environment Research Institute	
	Institute of Environmental Studies and Research, Minufia University, Sadat branch	
	Institute of Environmental Studies and Research, Ain Shams University	
	Agricultural Research Center (ARC)	
	Egyptian Environmental Affairs Agency (EEAA)	
	Mubarak City for Science and Technology	Agriculture Research and Development Institute (ARADI)
	National Water Research Center (NWRC)	
	Desert Research Center (DRC)	
	Desert Development Center (DDC)	
Jordan	Environmental Research Center	
	Water and Environment Research and Study Center	
	Al Urdun Al Jadid Research Center (UJRC)	Jordan Environmental Watch
	Badia Research and Development Center	
Kuwait	Kuwait Institute for Scientific Research (KISR)	Environment and Urban Development
	Marine Science Center (Kuwait University)	
	Environment Public Authority (EPA)	
Lebanon	Water Energy and Environment Research Center	
Libya	Marine Biology Research Centre (MBRC)	
Oman	Center for Environmental Studies and Research (Sultan Qaboos University)	

Academic Chairs for Environmental Issues

Academic chairs devoted to environmental concerns have been established at some universities to further environmental research. One such example is the academic chair carrying the name of the late President of the United Arab Emirates, Shaikh Zayed bin Sultan Al-Nahayan, in Environmental Studies established at the Arabian Gulf University in 1994. Another example is the academic chair at Bahrain University sponsored by the UNESCO – Cousteau Ecotechnie Programmeme, an international initiative designed to promote interdisciplinary education, research and policy-making in the field of the environment and development (UNESCO – UCEP).

Participation of Some Arab Countries in International Initiatives for Environmental Education

There are many international programmes of which some Arab countries are taking advantage to assist in environmental education and training professionals throughout the Arab world.

UNEP has a vast depository of knowledge products emanating from its work in environmental assessment, policy development and implementation, support to environmental conventions, and technology industry and economics. The Environmental Education and Training Unit at UNEP has taken the lead in producing learning support and resource mate-

TABLE 2 CONTINUED

Country	National Research Centers	Division
Palestine	Palestine Energy and Environment Research Center	
	The Water and Soil Environmental Research Unit (WSERU) (Bethlehem University)	
	Palestinian Environmental Authority (PEnA)	
	House of Water and Environment	
Saudi Arabia	Prince Sultan Research Center for Environment, Water and Desert	
	King Abdullah University for Science and Technology (KAUST)	Resources, Energy and Environment
	King Abdul Aziz City for Science and Technology	Natural Resources and Environment Institute
Sudan	Sudanese Environment Conservation Society (SECS)	
	Institute of Environmental Studies, University of Khartoum	
Syria	Marine Research Center	
	International Center for Agricultural Research in the Dry Areas (ICARDA)	
UAE	Terrestrial Environment Research Center (TERC)	
	The Environment Agency , Abu Dhabi (EAD)	
	Marine Environment Research Center (MERC)	
	Federal Environmental Agency (FEA)	
	Gulf Research Center (GRC) (Dubai)	
Yemen	Water and Environment Center (Sana'a University)	

rials for environmental education that include: training manuals, resource kits, starter packs, theme packs, posters, curriculum manuals, training modules, and newsletters.

The following are examples of such projects in which numerous countries in the Arab world are participating:

Global Environment Outlook (GEO)

The Global Environment Outlook (GEO) project is the implementation of UNEP's mandate to keep the global environment under review. Initiated at the request of the UNEP Governing Council in 1995, GEO is both a process and a series of reports, analyzing environmental change, causes, impacts, and policy responses (GEO; UNEP, 1997). It provides information for decision making, supports early warning and builds capacity at the global and sub-global levels. GEO is also a communication process that aims at raising awareness on environmental issues and providing options for action. Several Arab universities are contributors to this project.

Global Learning and Observations to Benefit the Environment (GLOBE)

The Global Learning and Observations to Benefit the Environment (GLOBE) is "a worldwide hands-on primary and secondary school-based science and education programme. GLOBE's vision

promotes and supports students, teachers and scientists to collaborate on inquiry-based investigations of the environment and the earth system, working in close partnership with NASA and NSF Earth System Science Projects (ESSPs) in study and research about the dynamics of Earth's environment" (GLOBE website).

Its mission is to promote the study of science and scientific discovery with scientists and citizens, teachers and students, all working together at local, regional, and international levels to achieve a better understanding of the environment. Assistance from parents as well as other members of the community is encouraged in collecting data and learning more about the Earth and how to sustain its environments and habitats.

Having been announced in 1994, GLOBE celebrated Earth Day 1995 with the launch of its operations. Bilateral agreements between the government of the United States and governments of other nations enable the GLOBE programmes to be implemented internationally.

More than a decade after its launch, the GLOBE network boasts 110 countries participating, including eleven countries from the Arab world. Table 3 indicates the Arab countries that have signed the GLOBE agreements, the year each signed, and the number of schools participating in each country.

Egypt Environmental Education and Outreach Programme

The Egypt Environmental Education and Outreach Programme (E3OP) is a programme designed to promote environmental education in primary and preparatory schools in Egypt, working in conjunction with local schools and communities as well as the government and the private sector to increase awareness and skills pertaining to environmental education in four Egyptian governorates (E3OP website). The two-year initiative, awarded under the Assistance to Basic Education/Basic Education (ABE/BE) Indefinite Quantity Contract, in support of the United States Agency for International Development, is being implemented by the Education Development Center, Inc. in collaboration with the Academy for Educational Development, RTI International, and Wadi Environmental Science Centre.

The E3OP trains teachers to lead their students in various environmental projects and to work with the government, media, and private sector to encourage their communities to participate in such activities. The programme also aids in the assessment of existing environmental education materials, develops new materials as needed, and distributes these materials directly to schools and communities or through an outreach resource centre.

VI. PUBLICATIONS AND THE NEED FOR ENVIRONMENTAL RESEARCH JOURNALS AND PUBLISHED ENVIRONMENTAL LITERATURE

Several publications have tackled the question of the recent scientific contributions of the Arab world in comparison with those of other nations and regions. Scientific and environmental contributions of the Arab world to global knowledge were found to be very low in comparison with other nations and regions. This is hardly surprising due to the desperate need of universities and research centres for further funding and the need to develop more international alliances and partnerships.

Currently, there are no specialized refereed scientific journals published in the Arab world that are specifically dedicated to issues relating to the environment, whether environmental education, management, or sciences, while there exists a strong need for such journals. Currently, publications dedicated to these issues are sprinkled among various other scientific journals. As there is this need for a number of prestigious, internationally recognized journals in the Arab region, each individually dedicated to a separate field such as environmental sciences, environmental management, environmental management legislation, and environmental education and learning, collaborative efforts are needed to bring about the birth of such journals of high standard, with a regional and international scope in terms of both prestige and quality.

However, the Arab world has relatively recently witnessed the emergence of several non-academic magazines and newsletters that are dedicated to environmental issues and concepts. These magazines and newsletters, in addition to their role as tools for raising the public awareness in environment, serve as resource material for educational purposes at the basic educational level. It is fair to say that the only professional environmental Arab periodical which could achieve wide circulation all over the region and affect tangible change is *Al Bi'a Wal Tanmiya* (www.mectat.com.lb)

There is also a great need for the publication of textbooks dealing with environmental issues in the Arab world. Numerous conferences and their proceedings have been produced but have yet to be published in book form, rendering them not easily accessible to other researchers. Attempts should be made to produce and disseminate this information in the more easily accessible book form, and budgets should be set aside within the context of the conference for producing such a text. Such texts would then make the information more readily available, forming a foundation for accumulative knowledge and decreasing the duplication of research and data gathering.

VII. CONCLUSION

The nations of the Arab world have reacted positively towards the increasing concern over environmental issues since the 1977 Tbilisi Declaration. The educational reforms being witnessed in the Arab world have included a review of the need to further include and promote environmental education. Incorporating environmental education in basic and higher education should benefit from the international directions, initiatives, and treaties set forth by the international community in this regard. Although there is an increase in the number of institutes of higher education in the Arab world that provide different academic degrees and training for graduates to participate in the environmental sector for sustainable development of the Arab countries, this survey of such higher educational institutes demonstrates the need for an increase of such degrees and programmes covering a greater number of disciplines within the sphere of environmental education.

TABLE 3 **ARAB COUNTRIES THAT HAVE SIGNED THE GLOBE AGREEMENTS**

Arab Country	Year of Joining	Number of Schools
Bahrain	2001	31
Egypt	1995	13
Jordan	1996	30
Kuwait	1999	5
Lebanon	1998	15
Mauritania	2004	1
Morocco	1996	2
Qatar	2000	26
Saudi Arabia	2002	44
Tunisia	1995	4
United Arab Emirates	1999	1
Total		**172**

Source: www.globe.gov (Retrieved 29 Feb. 2008)

Because the study of environmental education has yet to be institutionalized in the Arab world, numerous factors contribute to the lack of accessibility of data and current information on the environment. In many areas of the region, consistent environmental monitoring and data collection is absent and there has been little attempt to standardize data formats and reporting. The reports that are made are kept in various different government or private sector locations, which often results in duplication of information or gaps in data. These factors make a comprehensive study more difficult and impede the development of a formal environmental education policy and its implementation.

The positive initiatives witnessed in the Arab world and earlier discussed for basic education need to be maintained, promoted and strengthened. Funding of research for environmental issues and challenges should be addressed by different institutions on the national level and on a pan-Arab level. Integration of data for environmental research and assessment should be expanded in order to allow users and researchers to profit from data collection at all levels.

It is hoped that future reports will contain further outstanding examples that reflect the ongoing and continuous commitment, efforts and initiatives made by the Arab countries to the world environment and their own national sustainable development.

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Environmental Scientific Research

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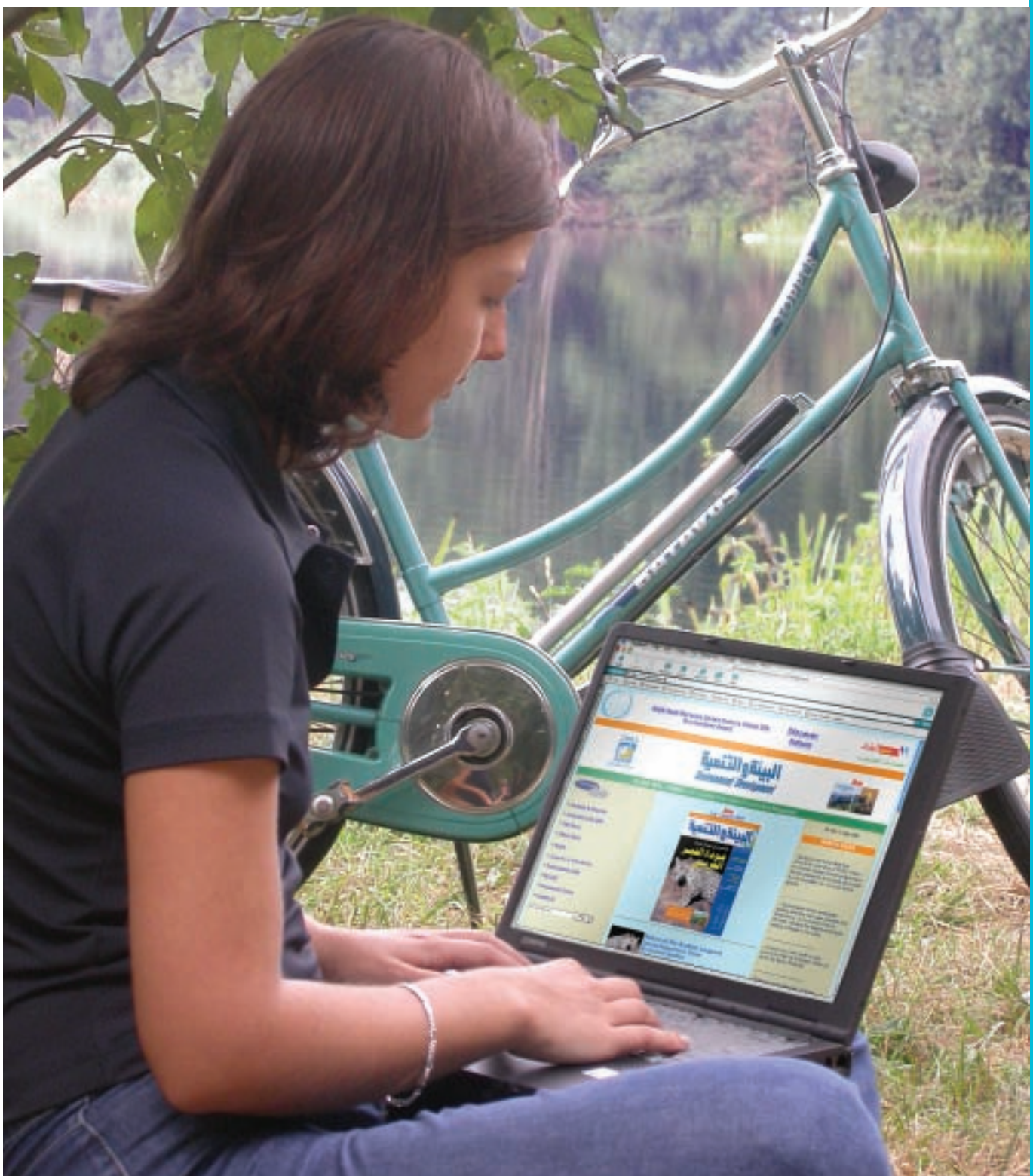


I. INTRODUCTION

This chapter is intended to study the current state of affairs of scientific research in the environmental field in the Arab region. The issue is important for a number of reasons:

- Arab countries are facing extreme challenges regarding the conservation of natural resources and protecting the environment from pollution.
- Addressing those challenges necessitates recourse of all scientific research tools to identify ideal solutions to each problem.
- Documented world experience has proven that the application of scientific research approaches and tools has achieved satisfactory success in solving complex environmental problems extending across spatial and temporal dimensions.

In this chapter, we try to assess the current situation of scientific research in the Arab region in the field of the environment, based on the first reading of available output of research institutions and researchers concerned with environmental anxiety in Arab world.

II. FRAMEWORK AND APPROACH

Environmental research has certain distinguishing features that set it apart from other types of research. The most important of these features are:

- Environmental research is carried out in most of the scientific faculties of universities and research centres. These faculties do not necessarily carry a name that refers to a dedicated focus on environmental questions and problems. As such, while environmental research appears at first glance to be a secondary concern at the scientific level, it is the main concern for a number of specialized researchers in these faculties.
- Most environmental research takes a practical approach, aimed at solving real life problems. For this reason we can refer to such research as "applied research" in most cases. In general, scientific research tools are used that were most likely developed to solve problems not directly related to environmental problems.
- Researchers concerned with environmental issues deal with their research subjects from their particular scientific background and hence use their own tools and linguistic vocabulary. As examples, soil pollution with heavy metals is a research subject that draws researchers from the fields of botany, soil, agriculture, irrigation, public health, economy, and law; and the scarcity of water resources is a subject that attracts researchers from the fields of climate, modelling, water resources, agriculture, economy, and law.

If some of these researchers were to be brought together around a specific environmental issue, their cumulative research could be transformed into a type of compound research subjected to multidisciplinary perspectives.

This chapter attempts to observe the current status of scientific research in the several environmental areas in Arab world. It is important to affirm, from the beginning, that the major determinant in this "observation" process is the availability of information. With the same importance, we confess that the available information is certainly not enough to achieve a definitive judgement, apart from recognizing their insufficiency to achieve any of the scientific assessment levels that adhere to the sober-minded assessment approaches of published scientific research.

From another point of view, scientific research in the environment field cannot be considered a discrete field whose situation can be studied in isolation from the condition of scientific research in Arab countries in general. This in turn consists of looking at the sum of several fields, ranging from engineering and fundamental sciences to those in the economic and social arenas. Therefore, this chapter tries to demonstrate the state of scientific research in Arab countries in general, out of published studies, in order to present the reader with a general overview of scientific research in Arab countries compared to other world areas. Subsequently, this chapter will try to recognize – through the "survey" method – the state of scientific research in the environment field in particular. For its data about environmental scientific research, this chapter relied mainly on information available on the internet, and on a sample of the Arab countries including Egypt, Saudi Arabia, Syria, and Tunisia.

Definition and Classification of Environmental Research

Scientific research on the environment is, as mentioned earlier, a multifaceted activity in which researchers from different backgrounds collectively participate. That is why environmental research and studies are difficult to be defined and classified. In this chapter, the European approach, prepared by European Office for Statistics (EUROSTAT) on environmental pressure indicators (Figure 1), was followed. It classifies the environmental problems into the ten groups (policy fields) shown in the figure, each of which is considered an independent environmental challenge of different dimensions. The European approach tries to present obvious definitions and frameworks for each group to facilitate the classification process. This is the reason why the European approach is more concentrated than approaches followed in other countries. In case of research that may be classified in more than one group, classification was made according to the primary trend of the research and neglecting secondary trends, which is an estimation process in the first place.

The second reason for selecting this approach to classify environmental research is the easiness of linking environmental problems of higher priority to priorities of scientific research. This makes evaluation of the research activity – according to its response to most hazardous environmental challenges – more clear. Using this approach, and the different pressure indicators, in the future, may help to put an integrated system for measuring the state of the environment, identifying scientific research priorities, and achieving an optimal distribution of human and physical resources in each of the countries; such that resource management can become more effective and its goals better realized.

It is worth highlighting that in the European example mentioned above, the main objective of classifying and setting indicators for environmental pressures is to link the state of the environment to European sustainable development indicators in order to enable decision-makers and beneficiaries to more clearly see and appreciate their environmental and development options.

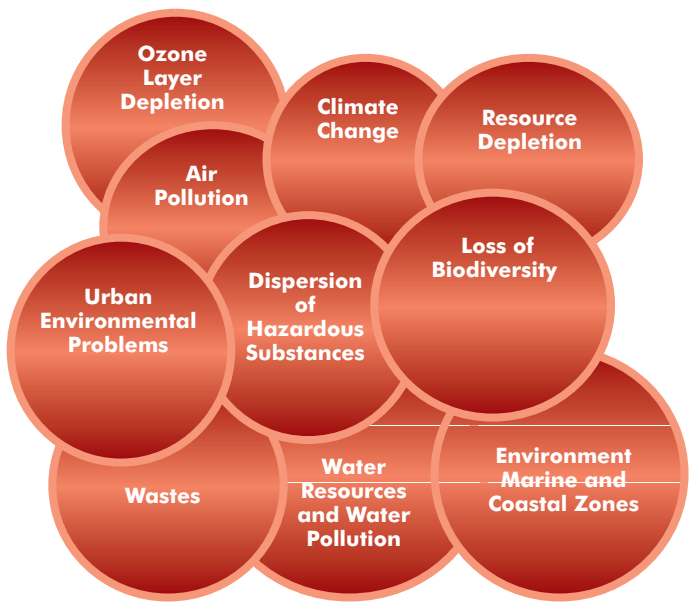
Research Samples and Data Accuracy Margins

In its observation of the general state of scientific research in the Arab world, this chapter chooses to present the results obtained by some researchers who studied the sources of production (IDRC, 2003) and national research systems in the Arab world (Gaillard et al, 2008) in a detailed manner.

As for the environmental research fields, this research considered the sample of Arab countries chosen as being representative of the general Arab region. In fact, there was no other choice due to a lack of information released to the internet and an absolute absence of information in certain cases. This raises questions about the extent to which Arab research institutes move towards "numeralization" of their databases to facilitate their availability, accessibility, and, consequently, their usage.

Care was taken in selecting the samples to represent (as much as possible) the economic, social, and geographical diversity of the Arab world while taking into consideration problems of information availability and political circumstances. Iraq, for instance, is a good example of

FIGURE 1 **ENVIRONMENTAL PROBLEMS IN EUROPEAN CLASSIFICATION AND THEIR OVERLAPS AND LINKAGES**



an Arab country that owns oil resources in addition to having an advanced industrial and research infrastructure; however, the occupation conditions and unavailability of online information excluded it from being included in the research sample.

The four selected Arab countries are Saudi Arabia, that represents the economic development model which depends on a high endowment of oil and mining resources in a desert environment suffering from water shortage; Egypt, with the largest population, which is concentrated in the Nile wadi and Delta (creating more acute pressures on the environment); Syria, as an Arab example of a controlled economy built on agriculture and industry; and, finally, Tunisia, as an example of an Arab Maghreb sub-region that has a diverse economy which depends on a combination of agriculture (one third of the population), tourism, and mining resources. The four countries, with their combined population of 132 million represent about 44% of the Arab world's total population, and contain a large part of its different resources. The primary remark at the regional Arab level is the multiplicity of principal research languages (multilingualism): French is used in Tunisia, English in Egypt, and Arabic in Syria. From one point of view, such a degree of external openness facilitates knowledge transfer, but on the other hand, multilingualism makes pan-Arab collaboration in environmental research a more difficult task.

Research Questions

This chapter attempts to answer the following questions:

- What is the current situation of scientific research in general in the Arab world? What are the major deficiencies, and how could these be corrected?
- What are the environmental fields focused on by scientific research in the Arab world? Which fields get less concern?
- Are researchers of specific scientific backgrounds interested in some fields more than others?
- What is the extent of inter-disciplinary cooperation? Does it satisfy scientific research needs?
- What are the items of consideration in developing the scientific research system in its existing configuration, and what are the possibilities of this system to play an effective role in achieving sustainable development and environment conservation?
- Has any research network been established at the local or regional level in any field of environmental research?

III. THE GENERAL STATE OF SCIENTIFIC RESEARCH IN THE ARAB WORLD

In this section, the general state of scientific research in the Arab world will be presented. The production process of scientific research is basically a transformative process that has inputs (human and financial resources) which are transformed (through managerial and financing systems and educational and research institutes) into outputs (research, studies and patents). Similar to any other transformation process, the productivity of scientific research can be measured by measuring the efficiency of transforming inputs into outputs.

Inputs of Scientific Research

In general, the two basic indicators of scientific research inputs are the number of researchers (absolutely, or as a percentage of population) and rate of expenditure (as an absolute rate, or a percentage of domestic national product). Regarding the first, the number of researchers in the Arab world approximated the number in the rest of the world's regions in 1998; however, as a percentage of population, it is relatively lower, although the difference is small (UNESCO, 1998). According to the same study, the number of researchers in Arab world increased at an annual rate of 6-7% from 1994 to 1998, which is double the population growth rate.

As for the rate of expenditure on scientific research as a percentage of domestic national product (Gross Expenditure on R&D, GERD), the performance of Arab world is almost shameful, standing at 0.2% compared to the world average of 1.4%. This regional rate is the least in the whole world, even when compared to the southern desert areas in Africa (UNESCO, 1998). The comparison is especially striking when comparing the expenditure on scientific

research in the Arab world, with its 300 million habitants, to those in Israel, with a population of six million.

Looking at these figures holistically, we can deduct that scientists in Arab world are many and their number is increasing, but they suffer a shortage of resources. This, in fact, is a problem faced by nearly all Arab scientists.

It is worth mentioning here two major phenomena. The first is an Arab scientific diversity that calls for integration. For example, Egypt brings together the biggest research base, and Saudi Arabia has the largest domestic national product with a much smaller research base. What is meant here is that Arab integration has established bases in the field of scientific research, and Arab scientific cooperation will yield positive returns for all participants, if only the existing potential were to be utilized. As such, it is not only an emotional invitation out of place in today's world, as some critics counter.

The second phenomenon is the "brain drain." It deserves precise research and serious discussion. Although we cannot devote much attention to this issue, we shall only mention that in the year 2000, the number of Egyptian researchers working in the United States alone reached 12,500 (half of them were specialized in basic and engineering sciences). The number of Lebanese researchers was 11,500. Most other Arab countries suffer a similar situation (Gaillard et al, 2008). Of course this phenomenon cannot be isolated from the financing crisis mentioned before, as well as many other factors.

Outputs and Productivity of Scientific Research

There are two basic world indicators for scientific research outputs: the number of studies and the number of patents. While the Arab world's share of the former is low, its contribution in the latter is entirely negligible, which may refer to a complete absence of any relationship between scientific research and the actual production of an economy. This in turn may be interpreted as indicating that the main motivation of scientific research is job promotion, and as such it is an individual effort that is not institutionalized (IDRC, 2003; Gaillard et al, 2008).

As for productivity indicators, one of the few surprises is that the Arab world beats even North America in the ratio of the amount of published research to the rate of expenditure on scientific research. However, with respect to the ratio of the amount of published research to the number of researchers, the productivity of the Arab world is the least of all regions, even when compared to the southern desert area in Africa (UNESCO, 1998).

IV. SCIENTIFIC RESEARCH IN ENVIRONMENTAL FIELDS

This section presents results of the modest survey research made by us as an attempt to explore and assess the state of scientific research in environment fields. A presentation of the results in those Arab countries selected within the research is shown in this section.

Saudi Arabia

Information was collected mainly from Saudi Research Database (Qabas) of King Abdel Aziz City for Science and Technology. Most research and studies were prepared by the universities of King Saud, King Abdel Aziz, and King Fahd for Petroleum and Minerals. Lesser contributions were made by King Faysal University, Girls Faculty of Education, King Abdel Aziz City for Science and Technology, and King Khaled University.

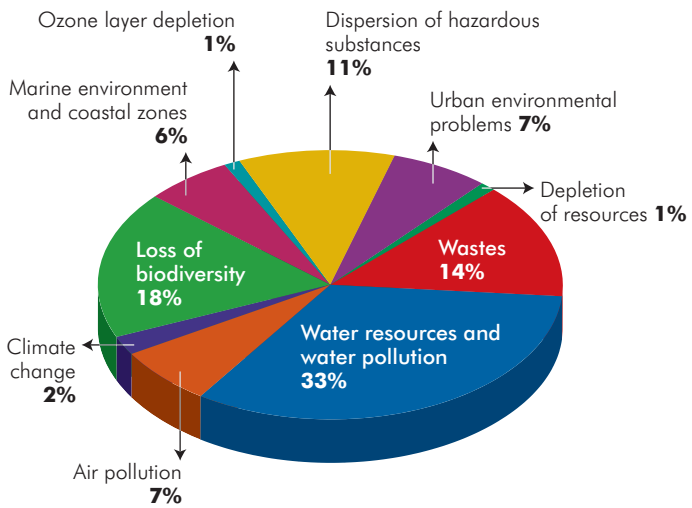
The number of research studies observed since 2000 to date reached 87. It was noticed that

there is no definite link between most of the different research either in one field or in different fields, except in the case of repeated studies. There is no common research between different departments, which points to few inter-disciplinary studies.

Saudi research classification (Figure 2) points to a small share of worldwide problems (i.e. that do not affect one specific geographic area alone) out of the scientific research: 2% only were on climate change, 1% each on ozone layer depletion and resource depletion, while 18% of the scientific studies were devoted to studying the loss of biodiversity. Research on water resources and water pollution, and wastes represented 50% from the total published research.

Viewed from the perspective of the contribution of different disciplines towards environmental research, it seems that researchers concerned with botany and civil engineering have the most interest in environmental research (Figure 3); especially in the two fields of biodiversity, for the first, and water resources and water pollution, for the second. They are followed by research in chemical engineering (Wastes), environmental design (Urban environmental problems), chemistry (Wastes and dispersion of hazardous substances), meteorology (Water resources and water pollution), and geology.

FIGURE 2 **SAUDI ENVIRONMENTAL RESEARCH IN THE PERIOD FROM 1998 TO 2007 CLASSIFIED ACCORDING TO FIELDS**



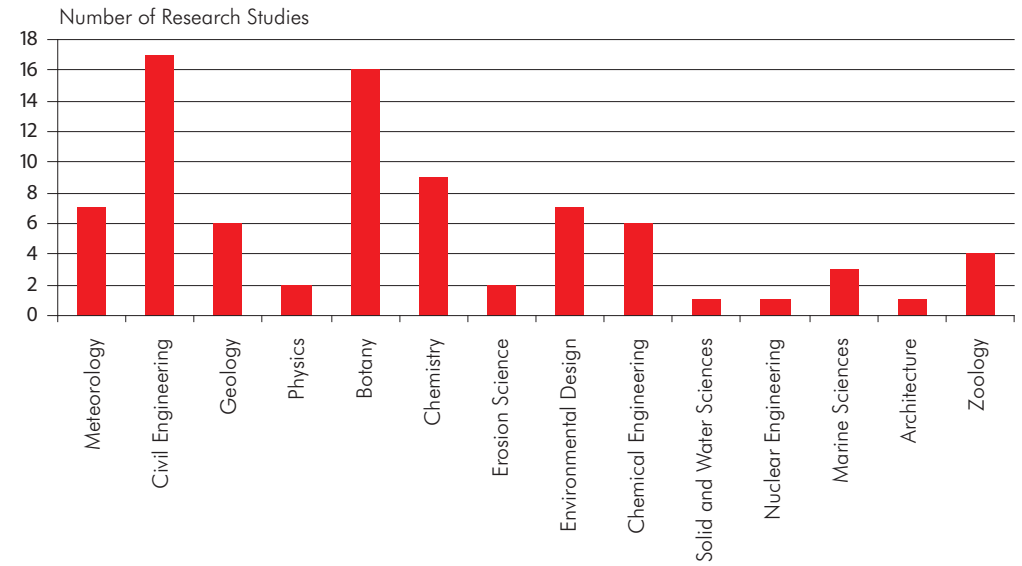
Source: Saudi Research Database "Qabas" of King Abdel Aziz City for Science and Technology in 2007

Saudi Arabia has recently established a group of research centres of excellence (in 2007), some of which have a tight and direct relationship with the environment such as the Renewable Energy Research Center of Excellence of King Fahd University for Petroleum and Minerals and the Environmental Studies Center of Excellence of King Abdel Aziz University. The latter has an ambitious plan that focuses on certain research areas in participation with experts of different disciplines. It also plays a coordination role between various agencies that participate in its activities. Although due to the juvenility of the centre, it is difficult to assess its actual role so far, its vision and plan are promising.

In order to give the reader a closer idea about Saudi research subjects, here are some research titles in the different areas:

- *Air Pollution* – Studies of air polluters and their effects on the environment and public health in Yanbu industrial city.
- *Climate Change* – Clean production of hydrogen via laser-induced methane conversion.
- *Loss of Biodiversity* – The application of molecular genetics to the conservation of Arabian gazelles.
- *Marine Environment and Coastal Zones* – Study of environmental pollution in Tarout Gulf area using remote sensing technology and geographic information systems (GIS).
- *Ozone Layer Depletion* – Thermodynamic study of the formation, decomposition, and oxidation of methane in the soil atmosphere.
- *Depletion of Resources* – Use of dates in the production of degradable biopolymers.
- *Dispersion of Hazardous Substances* – Bioremediation of some heavy metals from contaminated regions by Actinomycetes.
- *Urban Environment Problems* – Drawing urban growth boundaries and their implications on the Saudi cities.
- *Wastes* – Treatment of liquid industrial wastes using green algae.
- *Water Resources and Water Pollution* – Assessing groundwater capabilities in Asfan valley with respect to quantity and saltiness under draught and rain conditions.

FIGURE 3 **CONTRIBUTION OF DIFFERENT DISCIPLINES IN SAUDI ENVIRONMENTAL RESEARCH IN THE PERIOD FROM 1998 TO 2007**



Source: Saudi Research Database "Qabas" of King Abdel Aziz City for Science and Technology in 2007

Syria

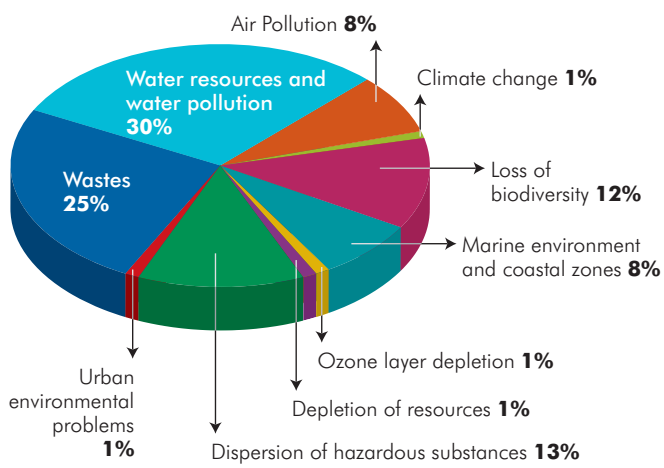
In the case of Syria, information was collected from scientific periodicals dealing with engineering and science subjects and published by the main Syrian universities. The biggest share was for the Damascus, El-Baath, and Tishreen universities; and a small ratio for Halab University. The number of observed research studies from the year 2000 until now reached 75. As above, the remark about the absence of links between different research undertakings, and the scarcity of inter-disciplinary researches, is repeated.

Few differences exist vis-à-vis the Saudi example, and almost the same remarks are repeated (Figure 4): activities of more world-wide character which are not related to one geographic site have only 1% share; these areas are climate change, depletion of resources, and ozone layer depletion. It increases to 12% in the area of biodiversity loss. And through the same sequence the ratios of wastes, and water resources and water pollution areas reach 55% of the total amount of research. The largest difference between Syrian and Saudi environmental research lies in that of urban environmental research: in Syria these are fewer than in Saudi Arabia; the difference, however, is little.

The following are some titles of Syrian research studies in different environmental fields:

- *Air pollution* – Study of distribution and dispersion of gaseous pollutants in Damascus.
- *Climate Change* – Study of emissions produced from gas burning in vehicles.

FIGURE 4 **SYRIAN ENVIRONMENTAL RESEARCH STUDIES IN THE PERIOD FROM 1998 TO 2007 AND CLASSIFIED ACCORDING TO FIELDS**



Source: Scientific Periodicals of Damascus, El-Baath, Tishreen, and Halab Universities

- *Loss of Biodiversity* – Contribution in studying biodiversity of Ascomycetes and Basidiomycetes in Barada basin.
- *Marine Environment and Coastal Zones* – Contribution in the study about distribution of perfume hydrocarbons (PAHs) in sedimentaries and water of Banias city shores.
- *Ozone Layer Depletion* – Study into destroying gases that are environmentally harmful to catalysts (Hexafluoride Ethane and Tetrafluoride Methane).
- *Depletion of Resources* – Selecting building and plastering materials through their environmental specifications.
- *Dispersion of Hazardous Substances* – Study of soil pollution with Cadmium in Qatena area, and treating the soil.
- *Urban Environmental Problems* – Environmental management in small and medium enterprises: case study in the old city in Halab.
- *Wastes* – Absorption of pollutants in the dispersed phase (experimental and mathematical questionnaire).
- *Water Resources and Water Pollution* – Using bacterial flora as an indicator for water pollution in the South Kabeer river.

Egypt

Survey research in Egypt is confined to the Faculty of Engineering at Cairo University which is considered the largest and oldest engineering college in the Arab world for many reasons. The first is the multiplicity (in addition to the diversity) of Egyptian environmental research authorities; unfortunately, this makes the collection (or even survey) of their research a more difficult task. The second reason is the important role of engineering research in the environmental field (which is of more applied nature). Therefore, the data drawn upon was taken from the Periodical of the Faculty of Engineering at Cairo University.

Before presenting the research results of the Faculty of Engineering at Cairo University, it is worth attempting to present in brief some other Egyptian research authorities and their role in conducting environmental research, in order to provide a more comprehensive overview of the environmental scientific research system in Egypt. We try to select authorities of administrative nature and diverse research specializations to clarify the extent of multiplicity of Egyptian research authorities working in environment field.

The National Research Centre

The National Research Centre is one of the biggest and oldest research centres in the Arab world. It comprises about 4,000 researchers, 1,000 of them holding doctorate degrees and working in 52 laboratories within 13 sections, including one section specialized in environmental sciences research. This centre consequently possesses the infrastructure and human resources necessary to produce inter-disciplinary environmental research. However, a proper evaluation of its functioning requires more independent research.

Water Research Centre

This centre consists of 12 specialized research institutes working in numerous fields and aiming to achieve the focal objective of the centre which is realizing the optimal use of water through maximizing water supply and minimizing water losses. Although all Water Research Centre branches take into consideration the environment and its conservation in producing their studies and research, some of these institutes are more directly concerned with environmental research in particular, such as: the Environment and Climate Research Institute which concerns itself with climate change at the local and regional levels and its impacts on water resources; the River Nile Research Institute; the Water Management Research Institute; the Drainage Research Institute which focuses on water recycling and re-use in irrigation; the Coastal Research Institute; and the Groundwater Research Institute which works towards the management of groundwater reservoirs and making use of them.

Desert Research Centre

This centre aims to provide adequate information to decision makers regarding desert land reclamation plans (as deserts represent more than 95% of Egyptian lands) and making use of desert resources. The administrative structure of the centre consists of four main sections: water resources and desert soil, cultivating dry lands, breeding of cattle and poultry, and economic and social studies.

Institute of Environmental Research and Studies, Ain Shams University

This institute is considered a school for graduate studies in environmental fields, hence it focuses on the preparation of scientific cadres in the environmental field. This institute adopts a comprehensive approach based on systemic thinking for

environmental research. The centre's seven sections comprise different and numerous aspects of environmental fields: environmental human sciences, educational sciences and environmental information; environmental economic, legal, and administrative sciences; and environmental fundamental, medical, engineering, and agricultural sciences. The institute accepts graduates of different scientific backgrounds, thus providing a rare chance for researchers to familiarize themselves with numerous and different perspectives on their research topics.

Agricultural Research Centre

Although the activities of this centre are not explicitly concerned with environmental scientific research, due to the nature of agricultural activities, environmental concerns are an integral part of its research. The centre clearly recognizes this fact; therefore it established a soil, water, and environment research institute to be one of the 16 institutes affiliated to this centre. The activities of this institute comprise many fields such as: environmental impact assessment of agricultural projects, production of fertilizers and environmentally safe bio-disinfectants, and assessment and monitoring of the impact of urban expansion on agricultural lands.

Faculty of Engineering, Cairo University

As previously mentioned, the Faculty of Engineering at Cairo University is considered the main scientific research centre in Egypt. The number of research studies undertaken reached 127 since 2000 until the present. Our earlier remarks about an absence of links between independent research studies and an absence of inter-disciplinary research are repeated here. Figure 5 presents the environmental research studies conducted by the Faculty of Engineering at Cairo University classified according to environmental field within the period from 2000 to 2004. Analyzing the data shown in Figure 5 reveals that the shares of most environmental fields are similar to those we outlined earlier, except some differences that may be attributed to the applied nature of the Faculty of Engineering; such as the following:

- Scarcity of research on the loss of biodiversity (1%).
- Increased amount of research concerned with urban environmental problems (20%).
- Decreased amount of research on the depletion of resources (6%).

As for the contribution of different specializations (sections) to environmental research studies, the following sections occupy the leading positions:

- Public Works Section (mainly for water resources and water pollution).
- Architectural engineering (urban environmental problems, and marine environment and coastal zones).
- Chemical engineering (distributed over different fields).

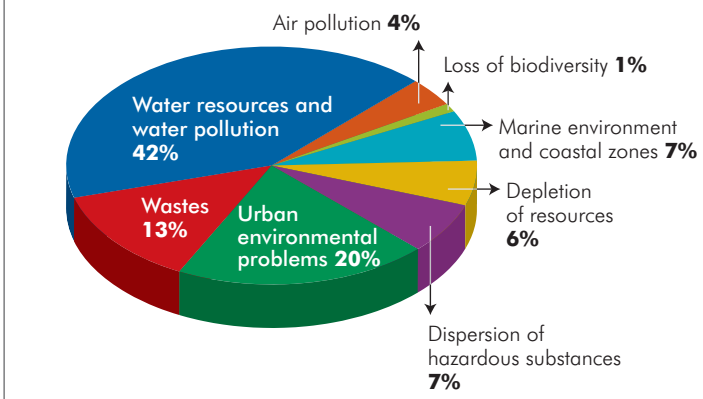
The lowest sections in producing environmental research studies are: mechanical engineering (power, production, and other mechanical specializations), while the computer and communication sections have no contributions to environmental research at all.

Figure 6 presents the sectoral contribution of the Faculty of Engineering at Cairo University to environmental research within the period from 2000 to 2004.

Below are some titles of research studies conducted by the Faculty of Engineering at Cairo University in different environmental fields:

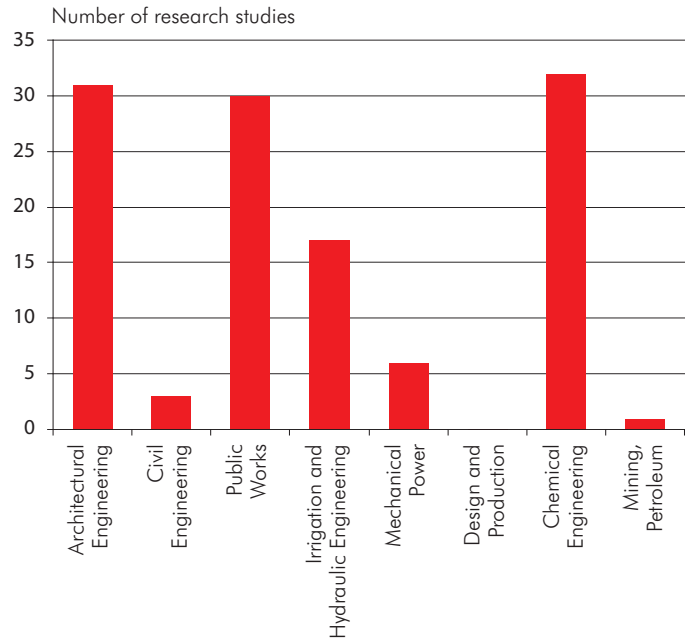
- *Air pollution* – A study of air pollution inside road tunnels.
- *Marine Environment and Coastal Zones* – Integrated coastal zone management – An approach to the protection and development of the coastal environment in Egypt.

FIGURE 5 **ENVIRONMENTAL RESEARCH CONDUCTED BY FACULTY OF ENGINEERING IN THE PERIOD FROM 2000 TO 2004 CLASSIFIED ACCORDING TO FIELD**



Source: Cairo Engineering College Scientific Magazine

FIGURE 6 **CONTRIBUTION OF FACULTY OF ENGINEERING, CAIRO UNIVERSITY SECTIONS TO ENVIRONMENTAL RESEARCH IN THE PERIOD FROM 2000 TO 2004**



Source: Faculty of Engineering, Cairo University Scientific Magazine

- *Resources Depletion* – Assessment of rapeseed oil as an alternative fuel for diesel engines.
- *Dispersion of Hazardous Substances* – Degradation of pesticides wastewater using new surfactants.
- *Urban Environmental Problems* – Industrial zoning and urbanization contribution to Egypt's urban planning.
- *Wastes* – Modelling and simulation of a fixed bed absorber for the removal of phenol from industrial effluents.
- *Water Resources and Water Pollution* – Water resources development in the Blue Nile basin in Ethiopia and its impacts on Egypt.

Tunisia

The number of research studies observed in Tunisia reached 58 since 2000 until the present (IRSIT, Université de 7 Novembre; Sécheresse). The two fields of ozone layer depletion and resources depletion were given more importance compared to other countries; while the two fields of water resources and water pollution, and wastes were given the same share (combined these occupy 48% of the total amount of research). The share of the climate change field was slightly higher at the expense of urban environmental problems. Positively, 25% of environmental research conducted in Tunisia was interdisciplinary; this indicates the existence of a higher degree of coordination between researchers of diverse scientific backgrounds.

Figure 7 presents Tunisian researches conducted within the period 2000-2007 classified according to environmental field.

Below are some titles of Tunisian research studies in different environmental fields:

- *Air Pollution* – De-pollution of atmospheric emissions of wood pyrolysis furnaces.
- *Climate Change* – Variabilité climatique rapide lors du dernier Interglaciaire enregistrée dans les sédiments littoraux du Sud-Est Tunisien.
- *Loss of Biodiversity* – Biodiversité et évolution des plathelminthes parasites des Elasmobranches.
- *Marine Environment and Coastal Zones* – Contribution à l'étude des poissons pélagiques des eaux Tunisiennes.
- *Ozone Layer Depletion* – Variability of aerosol optical thickness and atmospheric turbidity in Tunisia.
- *Depletion of Resources* – Analysis by simulation of a solar still integrated in a greenhouse roof.
- *Dispersion of Hazardous Substances* – Degradation photocatalytique de colorants dans l'eau.
- *Urban Environmental Problems* – Loisir et Espaces vertes.
- *Wastes* – A study on treatment and reuse of textile wastewater.
- *Water Resources and Water Pollution* – The role of membrane technologies in supplying drinking and industrial water in Tunisia.

V. RECOMMENDATIONS

The remainder of this chapter attempts to put forth some recommendations and suggestions which may contribute to finding the remedy of those aspects found to be deficient and to achieving an optimal utilization of available capabilities. These recommendations represent a group of ideas brought up for discussion and can be used as a basis for setting a plan for improving

environmental scientific research conditions in Arab countries according to the individual conditions faced by each country.

Setting a Strategy for Environmental Scientific Research

Despite the existence of strategies for scientific research in most Arab countries, no strategies are available for environmental scientific research. The importance of setting such strategies refers to the nature of environmental concerns and worries, as there is a big diversity of theoretical and applied sciences related to environmental field, and consequently the required resources (human or physical) are scattered among different and diverse institutions and faculties. The current sum total of the research undertaken by these institutions is not adequate to achieve the objectives of effective environmental action; if these resources are managed in a more planned and integrated manner, their synergy will achieve a level of production larger in quantity and better in quality. Besides, setting clear strategies for environmental scientific research shall contribute to determining clear priorities for research and rectifying any defaults or shortcomings in some research fields, especially those related to international long-range sustainability such as climate change, ozone layer depletion, and natural resources depletion which were previously mentioned.

A key question now remains to be answered: who is responsible for setting these strategies? The answer to this question is *all*, because environmental concerns are the responsibility of the whole community: citizens and governments, scientists and religious figures, state authorities, civil community, and the private sector. As all of these have the right to participate in setting objectives and priorities, they should also participate in sharing the costs of achieving these objectives.

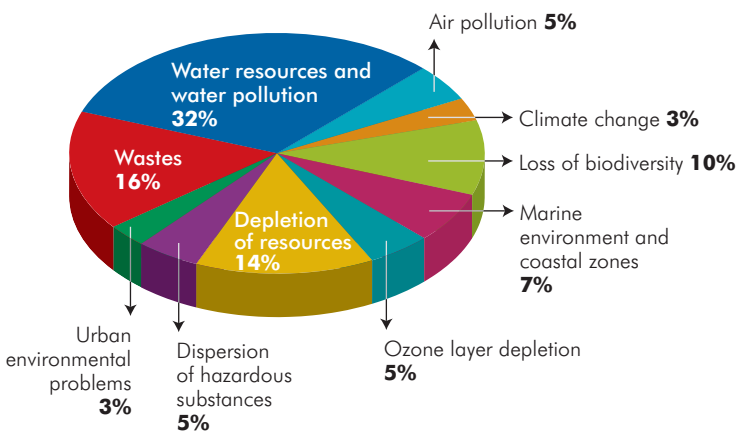
The first step for setting the strategy – once priorities and objectives have been identified – is to ascertain the available resources to enable their optimal management and utilization. For example, research authorities and entities should be surveyed. The same applies for their capabilities such as: the number, specialization, and level of researchers; laboratories and devices and their condition; and financial resources allocated for research (for example, in Egypt the largest portion of the allocated budget goes to salaries and the small remaining portion is spent on actual research).

We recommend planning applicable research through a centralized mechanism to ensure that the research is more related to the reality and priorities of plans for environmental action; in some cases, researchers devote themselves to solving problems which are not given priority as regards plans for environmental action at all, or such plans do not even exist. This planning certainly does not mean the suppression of the innovative spirit of researchers. Consequently the strategies should be dynamic and open for discussion in order to be able to adapt themselves to any scientific or economic changes while leaving a reasonable margin of freedom in determining research points. From the administrative point of view, it is recommended to set a management system linking research finance with clear set of standards that make the assessment of proposed research points a straightforward process that is not overly consuming of either time or effort, in order not to add further bureaucratic burdens to the scientific research authorities.

Centres of Excellence

The idea of centres of excellence is essentially one of a pooling of available resources regarding a top priority field or crucial problem into one centre,

FIGURE 7 **TUNISIAN ENVIRONMENTAL RESEARCH CONDUCTED IN THE PERIOD 2000-2007 CLASSIFIED ACCORDING TO FIELD**



Source: Scientific Institute for Scientific Research and Technology, Tunisia

which is thus responsible for coordinating efforts and managing the resources to achieve a set of specific and ambitious objectives. As a clear example, many authorities participate in the research of alternative energy sources. These authorities possess several resources which, if combined together in a single centre of excellence, would be able to directly cooperate without the need for a mediator.

Research Networks

Research networks are also one of the ways for achieving strategic objectives via gathering researchers of different scientific backgrounds in one research network which focuses on a specific topic or issue. Thus inter-disciplinary research studies are able to inclusively cover different aspects of the researched issue in a holistic manner. In this manner research will yield bigger returns and possess more capabilities for developing solutions and satisfying knowledge gaps.

An example of such a research network in the environmental field is the Collaborative Mercury Research Network (COMERN) in Canada which aims at monitoring and understanding the exchange and sedimentation of mercury in environmental systems to enable interpretation of increased mercury levels in Canadian lagoons. Researchers from all scientific fields related to this topic participate in this research network. These researchers represent 14 universities, 3 research centres, 3 governmental authorities, 12 civil community organizations, and 7 industrial partners (companies). The network sets, within its plan, specific research proposals and suggestions which are considered a "way map" to achieve the network's objectives. The network plan includes all details related to the research: starting from administrative frameworks and communication systems, until organizing intellectual property (copyright) and publication methods.

Regarding the Arab countries covered by our research, there currently exists no model for research networks (according to the available information), despite the existence of several environmental concerns and fields that need to be addressed in a comprehensive and inter-disciplinary manner. A famous example of such environmental worries or fields is the black cloud in Cairo with its diverse scientific, social, and economic dimensions.

Financing Problems and the Industrial Sector

Although the research delivered in this chapter does not include clear information on the deficiency of scientific research finance in Arab countries, there is no doubt that the Arab countries need to develop their financial resources in order to be able to conduct and produce high level research. Most scientific research finance in Arab countries currently comes from the government and international donations.

As for governments, there is a wide consensus on the necessity of increasing the general budget share for scientific research if there is any desire

to embark upon a path of sustainable development. Many experts have written on this topic, but it is one in which concrete action depends on the prevailing notions of political interest. As for international donations, although they currently play an important role, they cannot be considered a sustainable and reliable resource to depend on, given their relevancy in political matters and their role in political negotiations.

At the same time, the industrial sector in Arab countries has largely been shunning and disclaiming its responsibility towards scientific research, even as regards corporate social responsibility which is currently limited to supporting football clubs and congratulating chiefs on national feasts. Although this disregard is disapproved in the case of scientific research in general, it is considered a crime in the case of environmental research when taking into account the role of the industrial sector in environment pollution.

The question now is how to motivate the industrial sector to assume its role in financing environmental research. The simple answer is providing obvious economic incentives. If environmental pollution penalties become more costly than providing scientific research finance (while assuming the ability of research corporations to provide economic alternatives for pollution sources), and if taxes imposed on corporations participating in scientific research finance were reduced, we would surely observe a great change in investors' priorities and choices.

Some concerned stakeholders may see that increasing the value of penalties imposed on pollutants shall negatively affect Arab competitiveness in attracting foreign investment. The only reply to this idea is that the mission of maintaining natural resources and the environment easily prevails when compared to unsustainable levels of national economic growth. The principle "who pollutes pays" is almost irrefutable, especially as it captures the often-ignored environmental externalities of economic activities.

Although the industrial sector largely neglects financing environmental scientific research, it should not be considered to be solely responsible for this neglect. Environmental scientific research institutions do not currently seek to adequately market the results of their research and their relevance and usefulness for the industrial sector (with the exception of the Egyptian and Saudi petroleum sectors which have relations with some scientific research centres). Environmental scientific research institutions also do not undertake adequate communication with the industrial sector in order to ascertain the environmental problems it faces and provide tailored solutions matching its needs.

In some cases, it may be appropriate to establish companies that transform the results of research or patents into income-generating economic projects. Researchers and their corporations would participate in these projects. These companies would increase the revenues of research corporations, in addition to providing additional incentives to researchers who live off meagre incomes in most Arab countries. The idea of establishing companies for researchers and research corporations is not an unprecedented innovative idea, as it has already been widely applied all over the world.

Databases and Electronic Resources

The benefits of databases for environmental research at the regional and Arab level are obvious and diverse. Databases reduce the possibility of the wasteful repetition of the same research through different authorities. It also facilitates searching for experts or professionals in any field in other research institutions or even in other Arab countries, to benefit from their experiences. Finally, for environmental policy and strategy makers, it facilitates effective decision making on sound knowledge bases.

Despite the existence of Arab research databases such as the Saudi Data Base (Qabas) and the Egyptian Bibliographic Database for Sciences and Technology (STEB) which is under construction, the available information at these databases is classified according to colleges rather than according to research fields.

As regards electronic sites for research corporations, a considerable number of these does not reach the required level, thus giving off a bad impression to any site visitor who may be a potential research or industry partner. Therefore the development of these electronic sites should be given top priority.

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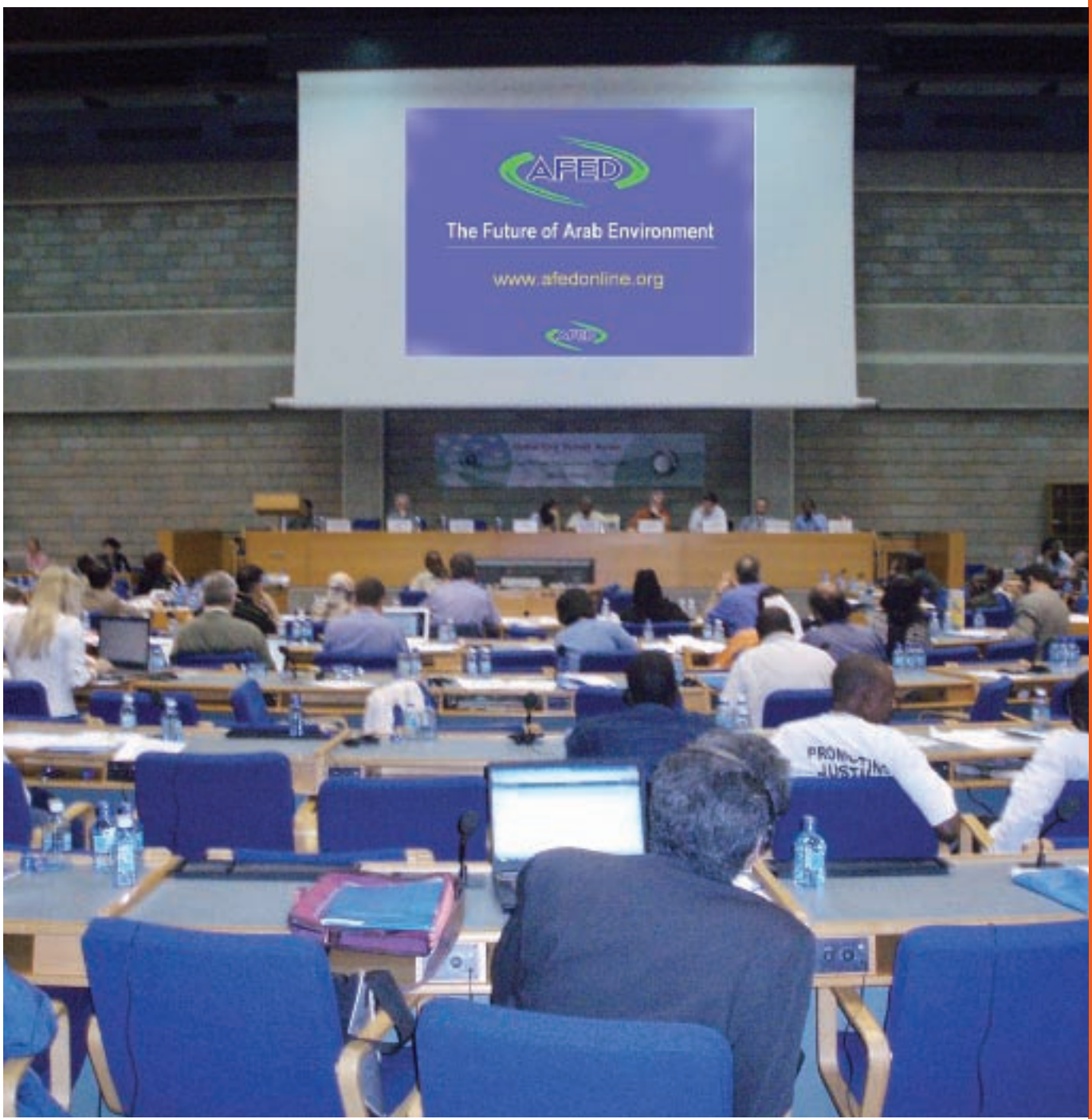
Financing of Environment Programmes: Private-Public Partnership

Hussein Abaza



I. INTRODUCTION

More than three-and-a-half decades have elapsed since the Stockholm Conference on the Human Environment and the establishment of the United Nations Environment Programme, and since then a series of multilateral environmental agreements have been adopted by governments in the Arab region. Nevertheless, the environment continues to deteriorate and regional countries are not yet on a sustainable development path. These trends continue in spite of the evidence that suggests that the unsustainable management of ecosystems was the main cause of the demise of old civilizations. There is therefore a compelling need for a serious shift in mindsets that translates into concrete policies a view of the environment not as a luxury or a constraint on economic growth, but as an opportunity and necessary requirement for sustainable development and human welfare.

II. THE REGIONAL CONTEXT

Several of the ancient civilisations originated from the Middle East and evolved along the prosperous Nile and the Euphrates rivers, and today, many of the modern Arab countries continue to take advantage of the region's rich natural resources. Most of the current environmental problems facing Arab countries can be attributed to a lack of awareness on the importance of the environment and the services it provides for economic growth and human welfare. This is reflected in the lack of measures and approaches that integrate environmental considerations into national development plans and policies. This has resulted in the unsustainable management and use of natural and financial resources devoted to environmental projects and programmes. These factors, combined with changes in climatic conditions and high population growth rates in the region, have compounded the complex environmental management challenges facing the Arab world. Among the environmental problems facing the region are diminishing water resources, land degradation and desertification, limited treatment of municipal and industrial waste, coastal degradation, and uncontrolled waste and CO_2 emissions from industry. Recent reports show that CO_2 emissions in the Arab region soared to 1.2 trillion metric tons in 2003, an 81 percent increase since 1990.[1]

Financing of Environment Programmes: National Responses

The economic cost of the unsustainable use of natural resources and environmental degradation is substantially affecting the Arab region and is negatively influencing efforts for socio-economic development and poverty reduction. World Bank estimates show that the annual cost of environmental degradation ranges from 4 to 9 percent of GDP for certain countries (Algeria, 9.6 percent; Morocco, 8 percent; Syria, 7 percent; and Lebanon, 6 percent).[2] Air pollution alone costs Egypt an estimated 2.1 percent of its GDP, which was equivalent to US$ 1.7 billion in 2003. The overall cost of environmental degradation for Egypt was estimated to be 5.4 percent of its GDP.[3] These ratios are higher than those for Eastern Europe (5 percent) and substantially higher than those for OECD countries (2-3 percent).

Though the cost of environmental degradation in the region continues to rise, priority and financial resources allocated to address environmental concerns do not match the gravity of the problem. Not a single country in the region has allocated even close to 1 percent of its national budget for environmental purposes. The environment continues to be given a low priority by sectoral ministries, causing the environment and the goods and services it provides to continue to deteriorate. Moreover, the low budgets of ministries and departments concerned with the environment, which do exist in most Arab countries, accompanied by weak mandates, prevent these entities from having a real impact on the ground. Table 1 shows the budgetary allocations on the environment from a sample of countries and Figure 1 shows environmental expenditures as a percentage of total budgets in these countries.

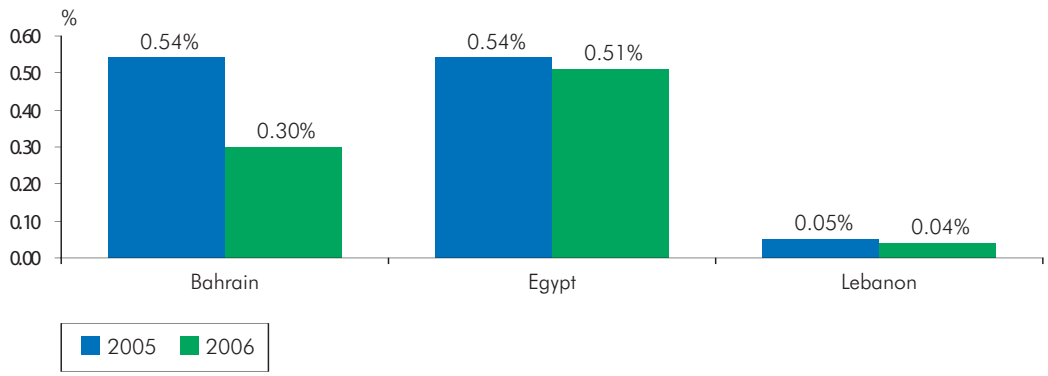
Another reason for the failure to halt environmental degradation is the general tendency to make the ministry of environment the main body responsible for addressing environmental issues. Considering the financial allocations provided for environmental authorities, their institutional capacities, and the complexity of their mandates, it is likely that Arab countries will continue to fail to achieve their environmental targets until the mandates and roles of environmental authorities are redefined and a greater role is given to sectoral

TABLE 1 **NATIONAL BUDGET ALLOCATIONS FOR THE ENVIRONMENT**

Country	Budget Allocation[4]		
	2004	2005	2006
Bahrain (thousands Bahrain Dinars)	-	7884.00	4745.0
Lebanon (billions Lebanese Lira)	4.88	3.91	-
Egypt (millions Egypt Pounds)	-	877.10*	962.5**

*Figure for 2004-05,
**Figure for 2005-2006
Source: Compiled on the basis of official government budget documents

FIGURE 1 **ENVIRONMENTAL EXPENDITURES AS A PERCENTAGE OF TOTAL BUDGETS IN BAHRAIN, EGYPT AND LEBANON**



Source: Compiled on the basis of official government budget documents

ministries to deal with environmental issues. Environmental degradation is a cause as well as a result of a variety of factors, many of which fall under the mandate of other ministries, such as agriculture, industry, urban planning, and municipal services.

The mandate of environmental authorities should focus on environmental advocacy (making a case for the environment for ministries of agriculture, industry, trade, social development, housing, urban planning and development, energy, water, etc.) and the provision of technical assistance and guidance to these ministries. This entails that sectoral and line ministries should take the lead in ensuring the integration of environmental considerations in their activities, with environmental authorities providing advisory and technical services and guidance to ministries as well as setting aside money for pilot experiments in environmental management and incentives to achieve the targets required by national legislation. Another major responsibility of the environmental authorities should be the development or amendment of environmental legislation and monitoring their implementation.

The complex environment-development-poverty linkages can only be addressed through inter-ministerial and cross-sectoral coordination. Confining the concept of environment to pollution issues without acknowledging the link between the environment and the services it provides, and development and human welfare, will continue to present a major obstacle to the serious consideration of the environment and its integration in the planning and decision making processes in countries.

Financing the environment through funds and awards

To boost the meagre level of funding allocated to national environmental programmes and activities, many Arab countries have established financial mechanisms for national, regional and international development assistance through funds and awards.

The Abu Dhabi Fund, Kuwait Fund, and Saudi Fund are three such mechanisms. Definitive figures are not available on the specific allocations for environmental projects for these three funds. However, using the water and sanitation sector as a proxy for the environment, the Kuwait Fund has allocated 9.1 percent of its grants to Arab countries (702.7 million Kuwaiti Dinars, approximately US$ 2.5 billion) for this sector from its inception up until 2005.[5] Between 1975 and 2006, the Saudi Fund allocated 6.74 percent (1,794 million Saudi Riyals, approximately US$ 480 million) of its total funds to the sector, though it is unclear what portion of these funds specifically went to projects in the Arab region.[6]

The Zayed Prize, established by Sheikh Mohammad Bin Rashid Al Maktoum, Ruler of Dubai, offers the world's highest environmental award, worth US$ 1 million every two years. During the first three rounds, four of the fourteen winners were from the Arab region.

To promote environmental awareness and encourage best practices, the city of Dubai launched the Dubai International Award for Best Practices to Improve the Living Environment (DIABP) in 1996. Unfortunately, only three of the 46 winners of the US$ 400,000 award have been from the Arab region.

To encourage and finance research on water issues, the Prince Sultan Bin Abdulaziz International Prize for Water was launched in 2002. The prize is an international award offered every two years to recognize distinguished scientists throughout the world. Three million Saudi Riyals are awarded to the recipient of this prize.

The Gulf Cooperation Council (GCC) has set up a GCC Environmental Award to encourage competitiveness, promote environmental awareness, sense of responsibility, and moral obligation towards environmental preservation and resource conservation and protection in the region. The GCC award is divided into five categories: environmental awareness, environment personality, the best educational and research institution for the environment, the best industrial establishment in each member state that complies with environmental standards and specifications, and finally, the best research in the field of environment.

The Arab Gulf Programme for United Nations Development Organizations (AGFUND) was launched in 1980 as a regional development initiative. It has contributed more than US$ 235 million to over 1,045 regional development projects since its establishment and awards three US$ 300,000 prizes each year through the AGFUND international prize for pioneering development

projects. Over the past seven years, three environmental projects on rationalizing water utilization and its role in environment protection, the management of water resources, and environmental protection through community-based activities received the award amounting to US$ 900,000.[7]

In addition to allocations through these national and regional funds, the Arab region has supported international environmental programmes through contributions to the Environment Fund of the United Nations Environment Programme (UNEP). Kuwait was at one point one of the top 20 donors to UNEP, and though it has since slipped to a lower position, it is still the largest Arab contributor, providing US$ 200,000 annually to the fund.[8] The UAE provided a substantial US$ 7.6 million donation to the fund in 2004, but ceased its contributions in 2006. Oman, Qatar, Saudi Arabia and Yemen have also made recent contributions to the fund.[9]

Financing the environment through the private sector

Over the last few years, the Arab region has experienced a rapid increase in the number of private initiatives that contribute to environmental protection. An increasing number of companies have joined the Global Compact Initiative (GCI), though many have been categorised as inactive companies due to non-compliance with reporting requirements.

Nevertheless, there are several environmentally responsible private sector entities that provide encouraging examples for development and environmental protection. One example is the SEKEM Holding in Egypt, which has based its operational strategy on caring for the environment through investments in organic agriculture and community development. Other examples include a Jordanian-Russian joint venture in the field of renewable energy that was launched in June 2007 with the aim of reducing energy consumption from traditional sources. The venture has already established ten patents in the fields of solar, wind, geothermal and biogas energy, and is currently developing a number of partnerships with Jordanian universities for research and development. On the consumer product scale, Vodafone in Egypt is financing an initiative to encourage the use of solar powered phone chargers.

In the United Arab Emirates, the Al Maha Resort is a world-class retreat where ecology has been put to work for tourism. The British Gas (BG Group) in Egypt is developing a Biodiversity Action Plan, which it plans to implement in close collaboration with government agencies responsible for implementing the National Biodiversity Strategy and Action Plan. Egypt's Mansour Manufacturing and Distribution Group, after joining the Global Compact, has invested in water and energy efficiency and is converting its fleet of over 900 vehicles to natural gas.

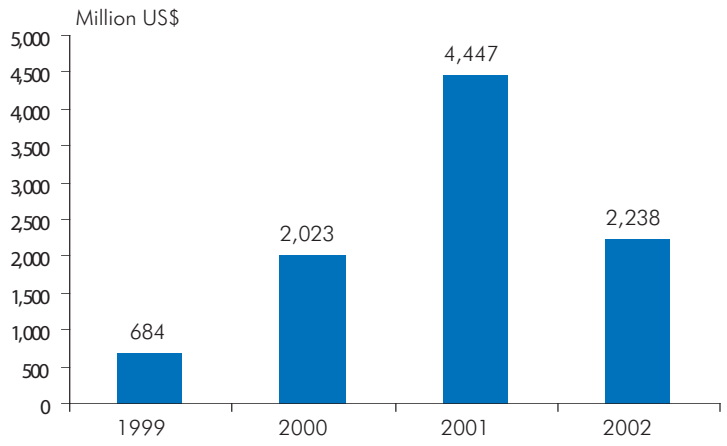
There has been a mixed response from the banking sector. Out of the top 50 Arab banks, only 11 have shown some form of commitment to social responsibility principles. An analysis of the banks' corporate social responsibility (CSR) frameworks show that only the National Bank of Dubai, Abu Dhabi Commercial Bank, Gulf Bank, Banque Morocaine du Commerce Extérieur (BMCE), First Gulf Bank, National Bank of Kuwait, Bank Muscat, and National Bank of Bahrain have taken environmental concerns into account.

And lastly, the recent 4th Corporate Social Responsibility Summit in Dubai brought top executives from 18 countries together to discuss issues, challenges and trends in CSR. However, no financial commitments were made by Arab companies attending the summit.

Financing the environment through non-governmental organizations (NGOs)

The Arab region lacks a network of vibrant, effective and organised civil society groupings that can successfully raise the awareness and financial resources necessary to address key environmental challenges. A recent survey of the NGO sector found that "NGOs in the Arab region, in general, are particularly lacking the skills of launching campaigns on particular topics of special importance to the region, developing programmes and preparing project proposals for funding by bilateral and multilateral agencies."[10] The Arab NGOs Network for Development (ANND), which was established in June 1996, has a membership of only 45 NGOs from 12 Arab countries. Out of these 45, very few have an environmental agenda or mandate. Additionally, only a

FIGURE 2 **TOTAL PROJECT DISBURSEMENT BY PERSGA FROM 1999 TILL 2002**



Source: PERSGA, SAP Annual Report 2002 (2002), p. 36, http://www.persga.org/Publications/Technical/pdf/2%20SAP%20Annual%20Reports%2099-02/SAP%20Annual%20Report%202002%20(English).pdf

TABLE 2 **INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS FINANCING**

	2001	2002
Total Disbursement	22,038,000	24,229,000
(Figures in US$)		

Source: ICARDA, Annual Report 2002 (2002), Appendix 7, http://www.icarda.org/publications/annualreport/2002/Financial.htm

very limited number of Arab NGOs are known outside the Arab region. For example, Duke University's database of environmental NGOs includes only four from the Arab region.

However, there are a few well-established NGOs that have been successful in bringing external resources to the region. The Arab Forum for Environment & Development (AFED) is one such example. AFED is playing a key role in bringing the public, private and NGO sectors together using funding resources from membership fees, contributions to AFED's Trust Fund, sponsorship of programmes by corporate partners and organizations, and income from the Forum's activities and services. In partnership with the Environment Agency of Abu Dhabi, and in cooperation with UNEP and the World Business Council for Sustainable Development, it organised a successful Arab Corporate Environmental Responsibility Summit in November 2007 in Abu Dhabi attended by CEOs of a large number of Arab companies. They committed themselves to reducing water and energy uses in their companies by 20% in the year 2020 from the base year 2000.

The Jordanian Network for Environmentally Friendly Industries (JNEFI) and the Emirates Environmental Group (EEG) are other such initiatives, which have been able to redirect external finances for environmental purposes in the region.

Financing the environment through regional cooperation

As a result of the growing concern over the environment, different institutions and financial mechanisms have been established at national and regional levels to address environmental problems. Lately, there has been an increase in aid from rich Arab countries to least developed Arab countries. Saudi Arabia has been by far the largest Arab donor to the region, followed by Kuwait and the United Arab Emirates (UAE). Between the years 2000-2003, GCC countries provided US$ 13.7 billion in development aid to the region, with Saudi Arabia contributing 58 percent of that total.[11] Development projects financed from these resources have been taking environmental considerations more seriously than before.

A number of institutions have been set up to address environmental issues; these included the Council of the Arab Ministers Responsible for the Environment (CAMRE), its technical Secretariat in the League of Arab States (LAS), as well as the Sustainable Development Initiative in the Arab Region and the Regional Capacity Building Programme on Trade and Environment for the Arab Region.

Other regional initiatives that provide funding for environmental projects in the Arab region are: the Regional Organisation for the Protection of the Marine Environment (ROPME), the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), The Mediterranean Action Plan (for the five North African Arab countries as well as Syria and Lebanon), the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), the International Center for Agricultural Research in the Dry Areas (ICAR-

DA), and the Center for Environment and Development for the Arab Region and Europe (CEDARE). (For more on ROPME, PERSGA, and the MAP, see chapter 6.)

As shown in Figure 2, PERSGA disbursed US$ 9.3 million in project funds from 1999-2002, and ICARDA disbursed US$ 46 million from 2001-2002 (Table 2). In both cases, the amounts that were provided to each Arab country projects were not specified.

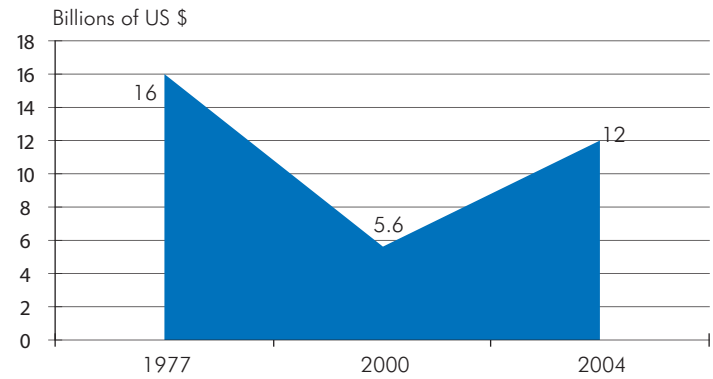
In March 2006, the Arab Summit endorsed the creation of an Arab Environment Facility (AEF), as a regional body structured along the lines of the Global Environment Facility (GEF). The Economic and Social Council of the League of Arab States (LAS) has approved the bylaws of the AEF in March 2008, with its transitory secretariat hosted by the Lebanese Ministry of Environment. The work plan is expected to be submitted to the Council of Arab Ministers Responsible for the Environment (CAMRE) by the end of 2008 for endorsement and referral to other LAS bodies. The plan envisages membership of the AEF Managing Board to include Arab Governments and development funds. While an initial budget of $30,000,000 is targeted, contributions will be on voluntary basis. AEF's mandate covers financing Arab projects in various environmental fields and facilitating private sector investment in environment protection projects.

III. INTERNATIONAL COOPERATION: BILATERAL AND GLOBAL LEVELS

International development assistance to the Arab region fluctuates depending on the geopolitical conditions of the region. Egypt received approximately 30 percent of the overall international aid to the region in 1999, but received 10 percent in 2003; whereas Iraq received less than 2 percent in 1999, but obtained more than 27 percent of the overall aid to the region in 2003.[12]

The European Union (EU) and United States of America (USA) have been the major donors to the region. Financial support by the EU has been fairly consistent during the last three decades, whereas US support has been influenced by political and security considerations. Overall aid has varied widely over the past 30 years (Figure 3).

FIGURE 3 OVERALL AID TO THE ARAB REGION



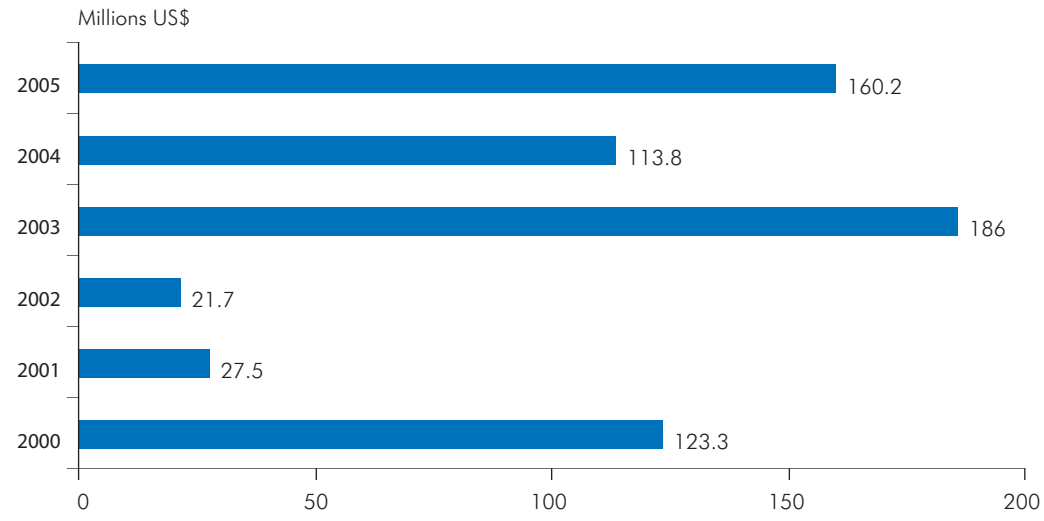
Source: ESCWA: 2007, Economic Trends and Impacts: Foreign Aid and Development in the Arab Region, Issue No 4. New York.

In 2005, aid to the least developed Arab countries (the Comoros Islands, Djibouti, Mauritania, Somalia, Sudan, and Yemen), which have the greatest need for funding to address their environmental and poverty problems, was around US$ 2.5 billion (less than what it was in 1990), whereas overall aid to the Mashreq region (Egypt, Iraq, Jordan, Lebanon, Palestine and Syria) was around US$28 billion (close to double what it was in 1990 and almost five times that of 2000).

A not so bright picture emerges when we look at the international aid targeted for environment programmes and projects. USAID provided US$ 48.5 million in funding for the environment in 2002.[13] However, according to the 2004 USAID Egypt Strategic Plan Update, the funding allocated to the environmental component of the budget was discontinued and reallocated to other components. In Jordan, the USAID funding for water resource management was reduced from US$ 58 million in 2006 to US$ 45 million in 2007. In Lebanon, USAID completely eliminated funding for its programme on improved environmental policies and practices in 2007; in 2004, it had provided US$ 12.4 million to the programme.[14] The USAID Programmes for Yemen and Iraq (2002-2005) do not include any explicit allocations for the environment.

The European Union committed more than € 3.4 billion under MEDA I (the Euro-Mediterranean Partnership financial instrument) for the period 1995-1999, and € 5.35 billion between 2000-2006 for MEDA II. However, only € 12 million per year was allocated by the

FIGURE 4 WORLD BANK FUNDING FOR THE MENA REGION



Environmental and Natural Resource Management

Source: The World Bank, Annual Report 2005, World Bank Lending in Middle East and North Africa (2005)

MEDA II budget for the promotion of the full integration of environmental concerns in the development process.[15] To provide additional funding, the European Investment Bank (EIB) disbursed € 7.4 billion in loans for the Euro-Mediterranean area.[16] The Facility for Euro Mediterranean investment and Partnership (FEMIP), an EIB initiative that covers many of the Arab region countries, has supported environmental protection projects with more than € 2.5 billion in loans from 1995-2004, accounting for 22 percent of its lending over that period.[17]

The World Bank (WB) funding for environment in the MENA region was cut by almost 75 percent between 2000 and 2001, but returned to its previous levels by 2003, as seen in Figure 4.[18] In addition to this funding, the WB was the leading institution in developing and updating the Middle East and North Africa Region Environment Strategy. During the first five years of the strategy's implementation (1995-2000), investments in environment-related projects totalled US$ 3.4 billion, including US$ 2.3 billion allocated to water-related projects.

The World Bank Institute (WBI) approved eight environmental projects in the Arab region for funding in 2006, representing a total commitment of US$ 111.8 million.[19] WBI has also provided training workshops to the region. In 2006, 5 percent of the participants at the WBI workshops came from the Middle East and North Africa region, and 17 percent of the training days focused on the environment and sustainable development.[20]

The United Nations Development Programme (UNDP) spent US$ 430 million on its programmes in the Arab region in 2006.[21] Over 13 Arab countries have so far received UNDP Global Environment Facility (GEF) support in focal areas related to biodiversity, climate change, international waters, and national capacity self-assessment, including Algeria, Djibouti, Egypt, Jordan, Lebanon, Morocco, Oman, Palestinian Authority, Somalia, Sudan, Syria, Tunisia and Yemen.[22]

UNEP is providing financial and technical support to Arab countries for environment-related activities. Areas being covered include early warning and assessment, post-conflict assessment, management of drylands and natural resources, water resource management, compliance with the Montreal Protocol, and the interface between trade and environment. In partnership with the United Nations Economic and Social Commission for Western Asia (ESCWA) and CAMRE, UNEP has developed a five-year regional trade and environment capacity building programme for Arab countries, aimed at identifying priorities for capacity building activities and devel-

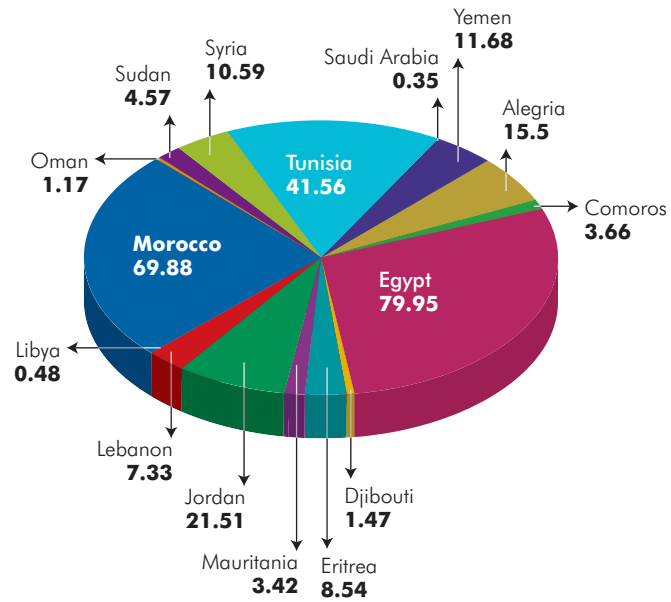
oping a long-term programme for the region. This programme sets the stage for collaboration between ministries of environment, planning and trade in order to integrate environmental and sustainable development considerations in trade policies as well as bilateral and multilateral trade negotiations. UNEP has supported two national projects in Lebanon that analysed the effects of trade liberalization on the agriculture sector. One project focused on the reduction of methyl bromide, and one examined the impact of the EU-Lebanon Association Agreement on the olive oil sector.[23]

ESCWA is also providing assistance, mainly to the Mashreq and Gulf regions, through its programmes on sustainable development and productivity; globalization and regional integration; and emerging and conflict related issues. The sustainable development and productivity programme includes a special focus on energy, water resources, sustainable environmental management and private sector and institutional development. In 2002 ESCWA allocated US$ 74,000 from its trust fund for capacity building in support of sustainable environmental economic policy, and US$ 47,721 for preparations for the World Summit on Sustainable Development.[24]

The Global Environment Facility (GEF) has also provided targeted financial and capacity building support to the region to address challenges related to climate change. Lately, countries from the Arab Region have reported to the GEF needs related to the lack of capacity for the preparation of GHG (greenhouse gases) inventories, assessments of impacts and vulnerability to climate change, facilitation of adaptation to the adverse effects of climate change, and the identification and implementation of measures for addressing climate change.[25] The region received a total of US$ 282 million from the GEF between 1991-2005, which is less than 5 percent of total GEF allocations. As shown in Figure 5, Egypt received the largest percentage of total funding, with 28 percent of the regional total, followed by Morocco, with 25 percent, and Tunisia, with 15 percent. Iraq, Kuwait and Qatar did not receive any funding from GEF during this period (Table 3).

The strong interest and political commitment in the region to multilateral environmental agreements (MEAs) is reflected in the ratifications and accessions to over 64 international and regional

FIGURE 5 **DISTRIBUTION OF THE GEF FUNDING TO ARAB COUNTRIES (MILLIONS US$) (1991-2005)**



Source: GEF Annual Report 2005

environmental conventions and agreements.[26] However, national policy and institutional failure coupled with a lack of financial resources have resulted in only partial success in terms of the achievement of their objectives at the national level. As shown in Table 4, most countries in the Arab region have signed major international environmental agreements, but policy and institutional failures have hindered progress on their implementation. Moreover, a recent report on the Millennium Development Goals (MDGs) shows that the Arab region has not made significant progress on any of the indicators to measure progress towards achieving MDG 7 (Ensuring Environmental Sustainability).

IV. RECOMMENDATIONS

A more holistic approach to policy development is essential for effective environmental protection policies. Mainstreaming environment into national development policies, plans and budgets should be a key priority. Arab countries should adopt an integrated approach for policy development and implementation, with a full understanding and consideration of the relationship and feedback loops between the three pillars of

TABLE 3 **GEF FUNDING TO ARAB COUNTRIES (1991-2005)**

Country	Mil US $	Country	Mil US $
Algeria	15.50	**Mauritania**	3.42
Bahrain	0.34	**Morocco**	69.88
Comoros	3.66	**Oman**	1.17
Djibouti	1.47	**Saudi Arabia**	0.35
Egypt	79.95	**Sudan**	4.57
Eritrea	8.54	**Syria**	10.59
Jordan	21.51	**Tunisia**	41.56
Lebanon	7.33	**Yemen**	11.68
Libya	0.48		

Source: Calculated on the basis of Global Environment Facility Annual Reports

sustainable development: environmental, social, and economic. Sectoral line ministries should be encouraged to integrate environmental and social considerations into their policies and programmes. This will entail the promotion of inter-ministerial coordination and the involvement of relevant stakeholders in the design and implementation of policies, plans, and programmes.

Environment should cease to be considered in isolation from macroeconomic policies. It should be regarded as a necessary prerequisite for sustainable development and as an opportunity rather than as a constraint for development. Policies should be designed to utilize the environment, its ecosystem and the services it provides as an opportunity to access markets and promote trade, create jobs and advance development and human welfare. Viewed in this way, sectoral ministries should be encouraged to take environmental considerations into account. To support this approach, capacities of environmental authorities should be strengthened to provide technical assistance on environmental issues to line and sectoral ministries, and to increase their ability to address environmental priorities. In addition to increased effectiveness in achieving environmental and sustainable development objectives, adopting such an integrated approach will also reduce the financial burden on ministries of environment.

Since aid flow is dependent on geopolitical circumstances, countries in the region need to consider developing a permanent mechanism to finance environmentally sustainable projects. A strategy for gradually reducing dependence on external funding should be developed. There are a number of existing funding mechanisms established by Arab countries; however, environment is not a priority for many of them. These mechanisms should be encouraged to include environmental sustainability as a priority.

While the long-term strategy should be based on reducing reliance on external funding, regular roundtables on environment and economic growth between development assistance institutions and national entities should in the meantime be organised at the national and regional levels in order to ensure that the special needs of countries in the region, particularly least developed countries, are taken into account. In addition, Arab countries should adopt a proactive approach to enable themselves to effectively utilize funding opportunities provided through existing funding mechanisms such as the Aid for Trade and the integrated framework facilities in order to promote sustainable trade, as well as environmental and development objectives. Another funding resource largely under-utilized by Arab countries is the GEF. Capacities should be built to enable Arab countries to develop funding proposals that could be financed through this mechanism.

Regional cooperation is essential in order to address specific issues unique to the region. Improved regional cooperation will not only improve environmental indicators but will also create a greater prospect for trade between countries of the region, exchange experience and knowledge and address priority environmental problems of common concern to the region.

Currently, resource allocations for research and development in the Arab region are meagre. Sufficient budgetary allocations need to be made to finance research and development, including technology development, data collection, institutional and technical capacity building of the public and private sector. Government capacities need to be enhanced to address environmental and sustainable development challenges, including the adoption of the right policies and the appropriate technologies to address these challenges. Sufficient and reliable data is essential to understand the linkages between policies and environmental degradation and in the development of appropriate measures and approaches to achieve environmental and sustainable development objectives.

TABLE 4 **RATIFICATION OF MEAS BY ARAB COUNTRIES**

Country	Montreal Protocol	Basel Convention/ Basel Ban	Convention on Biodiversity/ Cartagena Protocol	Climate Change Convention/ Kyoto Protocol	Stockholm Convention	CITES
Bahrain	X	X / -	X / -	X / -	-	-
Egypt	X	X / X	X / X	X / -	X	X
Jordan	X	X / X	X / X	X / X	X	X
Kuwait	X	X / -	X / -	X / -	-	X
Lebanon	X	X / -	X / -	X / -	X	-
Mauritania	X	X / -	X / -	X / -	-	X
Oman	X	X / X	X / X	X / -	X	-
Qatar	X	X / X	X / -	X / -	X	X
Saudi Arabia	X	X / -	- / -	X / -	-	X
Sudan	X	- / -	X / -	X / X	-	X
Syria	X	X / X	X / X	X / -	-	X
UAE	X	X / -	X / -	X / -	X	X
Yemen	X	X / -	X / -	X / X	X	X

Source: Southern Agenda on Trade and Environment Phase II, Arab Region, Resource Paper (2005)

The current system of national accounts does not provide a true indicator for sustainable development, as it does not reflect the depletion and degradation of environmental resources. On the contrary, it provides a flawed and distorted indicator for sustainable development; for example, it categorizes the sale of natural assets and capital as an income and not as a cost. In other words, it does not treat natural capital the same way it treats human-made capital. A system of integrated environmental and economic accounting needs to be introduced to provide a true indicator for sustainable development.

Market incentives should also be promoted as a tool to internalize environmental and social costs and to alter production and consumption patterns towards more sustainable patterns. Internalizing costs will promote efficiency, reduce waste, and encourage innovation, in addition to generating revenues for environmental projects. The use of economic instruments to internalize environmental costs will also help generate income for governments to help finance environmental and sustainable development activities.

Trade is a driving force for growth and development and provides an opportunity for business that must be fostered. However, it is essential that the impacts of trade and trade liberalization are fully assessed so that their consequences are known and addressed in order to avoid or mitigate potential negative implications. Such an assessment will help reduce potential environmental damage, lessen the associated remedial costs involved and enhance the net development gains from trade. Moreover, a comprehensive integrated assessment of trade and trade liberalization policies will enable countries to fully understand the consequences of trade on sectors such as agriculture, industry, tourism, and the impact of sector contraction or expansion on the environment (natural resource depletion and degradation), the economy (GDP growth, per capita incomes), and society (employment, health, equity).

In order to capitalize on the opportunities trade provides, Arab countries and their business sectors need to adopt a more proactive approach, which includes their involvement in standards setting, including environmental standards. In addition, Arab countries must acquire a clear understanding of local capacities in order to effectively manage the extent to which their public and private sectors can respond and cope with environmental standards and hence enhance their market access opportunities.

The full potential of the private sector in the Arab region to contribute to environmental and sustainable development objectives has not yet been utilized. The private sector can provide the

necessary human and financial resources and entrepreneurial skills to promote the environment as a market and business opportunity. Conducting business through sustainable practices can result in a more efficient use of resources, reduce waste, and encourage innovation. Businesses should be encouraged to adopt the principles of responsible investment, and invest in activities that contribute to achieving sustainable development. Creating opportunities and encouraging investors to invest in green stocks, a rapidly growing market, could also generate funds for environmental projects. It is therefore essential to provide incentives for the private sector to engage in environmental and sustainable development activities at the national and regional level.

The financial sector should be encouraged to complement government efforts in implementing environmental and sustainable development projects. This can take the form of providing micro-finance to small farmers and small- and medium-size enterprises, low interest rates and preferential repayment of loans for projects aimed at dealing with environmental issues, such as conserving water, reducing energy consumption, or promoting sustainable agriculture.

Building capacity of the civil society can also be instrumental in resource mobilization and in supporting environmental and sustainable development projects in countries in the region. Arab countries should therefore promote and encourage the creation of a vibrant and environmentally conscious civil society that can effectively support government efforts in financing and implementing sustainable development projects.

There is a need to promote public-private partnership in the region. There are already several successful examples of public-private partnerships for financing environmental conservation in the Arab region. These models need to be encouraged and replicated. Examples include the promotion of organic agriculture (SEKEM model in Egypt), development of eco-tourism parks (Al Maha Resort model in UAE), development of sector specific strategies for priority environmental issues (BG Group's Biodiversity Action Plan for Egypt), green building designs (Toyota model), environmentally friendly hotels, and carbon neutral cities. Promoting eco-tourism could also help reduce coastal degradation and generate additional revenues.

V. CONCLUSION

Though Arab countries in general have a great deal in common such as historical background, geographical proximity and cultural and social background, they can be grouped along three main groupings: Northern Africa,[27] the Gulf States,[28] and the conflict-stricken states.[29] Each of these groups is characterized by unique geopolitical, economic, and social circumstances and constraints. Environmental and developmental problems facing these groups of countries are to a large extent attributed to the different geopolitical, economic and social circumstances these groups of countries experience. Policies and plans to address the environmental and development challenges in the region should therefore be designed taking into account the specific circumstances of countries, including existing human, institutional and financial resources and capacities.

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Response to International and Regional Agreements

Ibrahim Abdel Gelil

I. INTRODUCTION: ARAB COUNTRIES' RESPONSES TO MULTILATERAL ENVIRONMENTAL AGREEMENTS (MEAS)

The ratification of MEAs by any country, including the Arab countries, has a multitude of benefits. The clearest benefits of any particular MEA usually relate to the specific goals of that MEA. For example, the Basel Convention seeks to protect human health and the environment from illegal transport and disposal of hazardous waste, thus protecting human health and the environment specifically in developing countries where capacity to deal with such hazardous wastes is weak. In addition to these MEA-specific benefits, there are some general benefits of ratifying, implementing, complying with, and enforcing MEAs. Some of these benefits are:

Improving Natural Resources Governance

Many MEAs improve the governance and management of natural resources. For example, MEAs often seek to avoid or limit resource-driven conflicts by promoting equitable arrangements, for instance regarding access to fresh water within an international watercourse basin.

International Political Commitment and Respect

Most MEAs address global environmental challenges that are shared by many nations. It is therefore necessary for the international community to unite to find a solution to those global challenges. Those countries that do not engage in a dialogue on the problem in good faith – or who engage, but do not undertake good faith efforts to ratify, implement, and enforce the MEA – risk international criticism. This criticism can undermine the country's credibility and erode the willingness of other countries to take action on other, unrelated matters such as trade, development, security, or social issues. That is, there are linkages between international cooperation on environmental issues and cooperation in other areas.

Financial Assistance

Often, a country considers becoming party to an MEA in order to access funding through the MEA, multilateral sources (such as the GEF), and certain bilateral sources. Except for the GCC countries which are ineligible for aid, in most of the cases of bilateral and multilateral funding of environmental initiatives in the Arab countries, ratification of some MEAs were a prerequisite for funding.

Technical Assistance and Networking

In addition to financial assistance, MEAs often facilitate technical assistance, for example through technology transfer. Additionally, MEA secretariats often help build capacity of governmental authorities to implement the MEA by fostering regional and global networks through which members share experiences. A good example of this case is the Basel Convention Regional Centre for Training and Technology Transfer for Arab States in Egypt.

Long-term Economic Benefits

Analyses by the OECD, the World Bank, and others indicates that in many instances it is economically more profitable to develop within the context of environmental management. Thus, while the priority of many countries may be on development, participation in MEAs can enhance the long-term sustainability of development initiatives. MEAs have been a driving force for many environmental initiatives in the Arab countries.

Trade

In certain instances, it is necessary to be a Party to an MEA (and to comply with and enforce that MEA) in order to be able to engage in trade and to avoid trade sanctions. The Montreal Protocol and CITES are two such examples.

Facilitating Changes in Domestic Environmental Law

While environmental problems may be evident, governments or parliaments may not place the necessary environmental laws and institutions in their lists of priorities in order to address those problems. Environmental concerns may be viewed as "secondary", or the country might not want to put domestic businesses at a competitive disadvantage. In this context, an MEA can elevate the international importance of a particular

environmental problem, providing additional political motivation domestically (as well as internationally) to address the problem. Moreover, the specific provisions of the MEA can provide a common, basic framework for the country to follow in developing measures to address the problem. For instance, legal banning of trade in hazardous wastes in Arab countries has been mostly driven by their ratification of the Basel Convention (UNEP, 2006).

Arab countries have developed a range of procedures for deciding whether and how to become a party to MEAs. Information available about those procedures is rare or even non-existent. To some extent, the various considerations set forth above can factor into such decision making processes, although it is often done on an informal basis.

One example is the case of Egypt where an organizational unit was created within the Egyptian Environmental Affairs Agency (EEAA) to coordinate such activity. When considering whether to ratify or accede to an international agreement, the unit identifies the major stakeholders and seeks their inputs. This is usually done through forming an ad hoc committee comprising representatives of those stakeholders from government, as well as non-governmental organizations. The committee then discusses the benefits and costs to the country of becoming a party to a specific convention, reviews the agreement's articles and finally develops a recommendation on whether Egypt should be a party to the treaty in question. The recommendation is then deliberated upon at a meeting of the Board of the EEAA before a final decision is taken. The board decision is then sent to the Ministry of Foreign Affairs which is responsible for Egypt's ratification of all international agreements. Different departments within the Ministry usually review the different aspects of the treaty before sending their final recommendations to the Cabinet. Once the Cabinet takes a decision to ratify the convention or agreement, it is sent to the Parliament to endorse it.

At the national level, institutional arrangements for environmental governance in the Arab region have evolved over the last two decades and have become increasingly structured in their ability to address a variety of issues within the sustainable development framework. However, while institutions have developed, political support, human capacity, institutional coordination and financial resources remain limited. National environmental laws have also facilitated the creation of institutions responsible for coordinating, supervising and monitoring environmental management in the Arab countries. New institutions have been created and, sometimes, old ones rehabilitated. However, many of these institutions are experiencing significant shortages of skilled personnel, inadequate funding and uneasy relations with other government institutions whose cooperation is essential in dealing with environmental issues. Some countries have environmental ministries (such as Lebanon, Jordan, Iraq, Qatar, Oman,

TABLE 1 RATIFICATIONS OF MEAS BY ARAB COUNTRIES

States	POPs	Biosafety	UNCCD	CBD	UNFCCC
Algeria	09/22/2006	08/05/2004	05/22/1996	08/14/1995	06/09/1993
Bahrain	01/31/2006		07/14/1997 (a)		12/28/1994
Comoros			03/03/1998	09/29/1994	10/31/1994
Djibouti	03/11/2004	04/08/2002 (a)	12/08/1997 (a)	09/01/1994	08/27/1995
Egypt	05/02/2003	12/23/2003	07/07/1995	06/02/1994	12/5/1994
Iraq					
Jordan	11/8/2004	11/11/2003	10/21/1996	11/12/1993	11/12/1993
Kuwait	06/12/2006		06/27/1997	08/02/2002	12/28/1994 (a)
Lebanon	01/3/2003		05/16/1996	12/15/1994	12/15/1994
Libya	06/14/2005 (a)	06/14/2005 (a)	07/22/1996	07/12/2001	06/14/1999
Mauritania		07/22/2005 (a)	08/07/1996	08/16/1996	01/20/1994
Morocco	06/15/2004		11/07/1996	08/21/1995	12/28/1995
Oman	01/19/2005	04/11/2003 (a)	07/23/1996 (a)	02/08/1995	02/08/1995
Palestine					
Qatar	12/10/2004(a)	12/06/2007 (a)	03/15/1999(a)	08/21/1996	04/18/1996(a)
Saudi Arabia		07/11/2007 (a)	06/25/1997 (a)	10/03/2001 (a)	12/28/1994(a)
Somalia			07/24/2002 (a)		
Sudan	08/29/2006	06/13/2005 (a)	11/24/1995	10/30/1995	11/19/1993
Syria	08/05/2005	04/01/2004 (a)	06/10/1997	01/4/1996	01/04/1996(a)
Tunisia	06/17/2004	01/22/2003	10/11/1995	07/15/1993	07/15/1993
UAE	07/11/2002		10/21/1998(a)	02/10/2000	12/29/1995(a)
Yemen	01/09/2004	12/01/2005 (a)	04/14/1997 (a)	02/21/1996	02/21/1996

Sources: WTO, ESCWA, UNEP and MEA secretariat homepages
(a) Accession
R: Ratified

Morocco, Tunisia and Syria), others have general directorates and/or environmental councils or agencies (such as in Bahrain, Kuwait, and Saudi Arabia,), and few have both (such as Egypt, United Arab Emirates and Yemen).

Continuous changes in institutional structures and responsibilities reflect the changing attitude of states to developments in environmental management (UNEP, 2000). In Arab states in particular, environmental institutions tend to be politically weak. UNEP attributes this weakness to a number of main reasons: (a) relatively recent establishment and restructuring; (b) power politics; (c) limited institutional mandates; (d) comparatively smaller roles as advisors or coordinators; (e) limited budgets; (f) limited capacity to generate income; and (g) overlapping institutional jurisdictions (UNEP, 2007).

Within this imperfect legislative and institutional framework, the Arab countries have to implement a large number of MEAs; this large number has in turn been a main obstacle to compliance with such MEAs. This is primarily because government institutions have become overloaded with the reporting requirements and meetings called for by the growing number of conventions and protocols.

In addition to the weak institutional capacities stated earlier, several other challenges exist, namely inadequate financing; low public awareness; limited negotiation capacity; and marginal involvement of civil society and the private sector. This has limited the ability of some Arab states to meet certain MEA commitments in the region.

Table 1 reveals that in many cases, Arab countries only joined the treaties after their entry into force (in 49% of the cases). This can be attributed mainly to two reasons: either they had not played an active role in negotiating the MEAs, or the ratification processes are slow in the respective countries. Further, it was found that the Vienna Convention, Kyoto Protocol, and Cartagena Protocol have the largest number of accessions by Arab states among the MEAs. The same table indicates that both Saudi Arabia and Qatar have the largest number of accessions to MEAs.

Kyoto	Basel	Kuwait	Jeddah	Vienna	Barcelona
16/02/2005 (a)	12/15/1998(a)			20/10/1992 (a)	16/02/1981(a)
31/01/2006 (a)	10/15/1992	07/01/1979		27/04/1990 (a)	
				31/10/1994 (a)	
12/03/2002 (a)	05/31/2002(a)			30/07/1999 (a)	
12/01/2005	01/08/1993(a)		05/21/1990(a)	09/05/1988 R	30/05/1990 (a)
		07/01/1979			
17/01/2003 (a)	06/22/1989		11/09/1988	31/05/1989 (a)	
11/03/2003 (a)	10/11/1993	07/01/1979		23/11/1992 (a)	
13/11/2006 (a)	12/21/1994			30/03/1993 (a)	08/11/1977 (a)
24/08/2006 (a)	07/12/2001(a)			11/07/1990 (a)	31/01/1979
22/07/2005 (a)	08/16/1996(a)			26/05/1994 (a)	
25/01/2002 (a)	12/28/1995(a)			28/12/1995	15/01/1980
19/01/2005 (a)	02/08/1995(a)	07/01/1979		30/06/1999 (a)	
			03/31/1982		
11/01/2005 (a)	08/09/1995	07/01/1979		22/01/1996 (a)	
31/01/2005 (a)	03/07/1990	03/26/1982	03/22/1985	01/03/1993 (a)	
			03/01/1988	01/08/2001 (a)	
02/11/2004 (a)	01/09/2006(a)		06/01/1984	29/01/1993 (a)	
27/01/2006 (a)	01/22/1992			12/12/1989 (a)	26/12/1978 (a)
22/01/2003 (a)	10/11/1995(a)			25/09/1989 (a)	30/07/1977
26/01/2005 (a)	11/17/1992	03/01/1980		22/12/1989 (a)	
15/09/2004 (a)	02/21/1996(a)		08/29/1982	21/02/1996 (a)	

As mentioned above, then, the implementation of MEAs has been largely slow, due to the reasons mentioned. Other factors have also played a role in impeding the swift implementation of MEAs, including: international commitments, political pressures and the limited availability of financial mechanisms for implementation. Among the various MEAs, the Montreal Protocol has been most successfully implemented in the region, and this can be directly attributed to the financial and technical resources made available to countries of the region to achieve their commitments under the Protocol. Research needs to be undertaken to study the effects of bilateral and multilateral funding in meeting the commitments under different MEAs in the Arab countries.

The implementation of most MEAs in the region was focused on the setting of frameworks, priorities, development of strategies and action plans, in addition to mobilizing funds. The mode of compliance with MEAs thus relied on the development of legal and institutional frameworks for addressing issues related to MEAs. As such, it can be said that progress has been achieved since new environmental institutions have been created and many environmental laws promulgated, which are prerequisites to implementing provisions in many MEAs. The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have witnessed the most involvement by Arab countries during both their negotiation and implementation stages. This is because most, if not all of the Arab countries are vulnerable to the potential environmental and economic impacts of climate change. On the other hand, some conventions of primary interest to the region have not achieved significant progress because of a lack of resources. This is most evident in the case of the United Nations Convention to Combat Desertification (UNCCD), which remained outside the funding mandate of the Global Environment Facility (GEF) until very recently. Weak international interests and limited external funding, combined with inadequate national and regional resources, infrastructures and expertise, have prevented a number of MEAs from being adequately implemented (ESCWA, 2002).

It is important to note that the degree of importance attributed to MEAs by Arab countries varies both between countries and between the MEA in question. Among the most important MEAs are the UNCCD, the United Nations Convention on Biological Diversity (UNUNCBD), the UNFCCC, and the Kyoto protocol. Other global conventions of significant importance to the region are the Vienna Convention on the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Table 1 clearly shows that apart from Iraq, Palestine, Somalia, and in some cases Lebanon, which have special political situations, the rest of the Arab countries have already ratified these conventions. Exceptions are few and include Saudi Arabia that has not yet ratified the Stockholm Convention on Persistent Organic Pollutants (POPs). In addition, the Cartagena Protocol on biosafety has not yet been ratified by a large number of Arab countries, for reasons which will be discussed below. These countries include Bahrain, Kuwait, Lebanon, and UAE.

Additionally, for the last two decades, MEAs have catalyzed regional coordination on common environmental concerns through regional organizations. Sustainable development issues are now addressed through several Arab ministerial forums. The Council of Arab Ministers Responsible for the Environment (CAMRE) provides a forum for environmental ministers in the region. The Gulf Cooperation Council (GCC), Mediterranean Action Plan (MAP), Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) and the Regional Organization for the Protection of the Marine Environment (ROPME) councils provide sub-regional forums for addressing global and regional environment, development and trade agreements. CAMRE, in collaboration with UNEP/ROWA and UNESCWA has been trying to coordinate activities of the Arab countries related to some of the MEAs. Three standing committees were formed, one of which is responsible for the UNFCCC and the Kyoto Protocol, the second is responsible for chemical management, and the third one is responsible for protection of the ozone layer. The memberships of these committees include representatives of the Arab member countries, Arab League organizations, and some Arab experts. These committees meet regularly to discuss the agenda items of the respective MEAs with the aim of information and expertise exchange, and coordination of the Arab countries' positions. This does not mean that consensus on a specific issue within a certain MEA is reached in all cases.

In the following section, levels of implementation by the Arab countries of different MEAs will be discussed.

II. THE STATUS OF MEAS IN THE ARAB COUNTRIES

Vienna Convention and Montreal Protocol for the protection of the ozone layer

Under the auspices of the United Nations Environment Programme (UNEP), the governments of the world arrived at the Vienna Convention on the Protection of the Ozone Layer in 1985. Through this Convention, governments committed themselves to protect the ozone layer and to cooperate with each other in scientific research to improve understanding of atmospheric processes. Countries could not agree on specific control measures, making the Vienna Convention a framework treaty for controls development that also facilitated cooperation on research. It was on September 16, 1987, that the Montreal Protocol on Substances That Deplete the Ozone Layer was adopted and signed by 24 countries. The Montreal Protocol committed parties to implement actual controls on the production and consumption of ozone-depleting substances. This included reducing the consumption of CFCs, by the late 1990s, to 50% of 1986 levels. Also included was a 1992 freeze on the consumption of halons at 1986 levels. Developing countries were given a grace period of ten years. The Protocol is quite complex. However, it has the important feature of having a provision which allows for the control of all ozone-depleting substances (ODS), not just those originally identified in the agreement. Amendments can be made as advancements are made enhancing scientific and technological

understanding. Trade measures to build support for the Montreal Protocol were also unique.

Based on the report of the multilateral fund for the implementation of the Montreal Protocol (Multilateral Fund for Implementation of the Montreal Protocol, 2007), and the Report of the Implementation Committee under the Non-compliance Procedure for the Montreal Protocol on the work of its thirty-ninth meeting (UNEP, 2007), it was found that the following Arab countries have failed to meet their obligations regarding control measures to reduce consumption of ozone-depleting substances (ODS), as their consumption levels of some ODS were found to be above their baseline levels as per the Montreal Protocol. These countries include Comoros, Egypt, Libya, Morocco, Oman, Qatar, Saudi Arabia, and the UAE. Thus these countries are currently given the non-compliance status by the implementation committee. Furthermore, Djibouti failed to meet some of its reporting obligations under the Protocol and it is likewise seen as non-compliant by the implementation committee.

Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes

The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, which is the most comprehensive global environmental agreement on hazardous and other wastes, was drafted in 1989, and came into force in 1992. The Convention has 170 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, trans-boundary movements and disposal of hazardous and other wastes. The main principles of the Basel Convention are:

- Trans-boundary movements of hazardous wastes should be reduced to a minimum consistent with their environmentally sound management.
- Hazardous waste should be treated and disposed of as close as possible to their source of generation.
- Hazardous waste generation should be reduced and minimized at source.
- Export of hazardous waste from developed to developing countries is banned.

In order to achieve these principles, the Convention aims to:

- Control all trans-boundary movements of hazardous and other wastes.
- Provide assistance regarding the implementation of the Basel Convention.
- Provide assistance for the environmentally sound management of hazardous wastes.
- Monitor and prevent illegal traffic in hazardous wastes.
- Promote co-operation in this field between the Parties to the Convention.

Inadequate hazardous waste management in the Arabic countries generates considerable public health and environmental problems, including contamination of soil and water. It also prevents the countries of the region from meeting their obligations under the Basel Convention. A regional centre was established in Cairo to assist Arab countries in meeting their obligations under the Basel Convention. The centre was established in response to the needs indicated by Arab countries to the secretariat of the convention, which were also identified by a needs assessment study as part of the feasibility of establishing the regional centre. These needs can be summarized as follows:

- Guidance in setting up hazardous waste criteria;
- Advice on efficient means for drawing up hazardous waste generation inventories and inventories of existing hazardous wastes disposal options.
- Guidance in drafting legislation that transposes Basel Convention provisions into national law, in terms of both waste management and shipment requirements;
- Assistance in developing documentation systems for hazardous wastes generation, transport and disposal;
- Information exchange concerning best practice in managing various types of hazardous wastes; and
- Information exchange regarding waste minimization and cleaner production techniques.

The availability of data on hazardous waste and waste producing activities in the Arab region, although very important to develop proper policies and hazardous waste management plans, is

very scarce. This is reflected in the results of a recent survey done by the regional centre. A questionnaire was sent to the 22 Arab countries, but only five countries responded. Two countries (Bahrain and Morocco) out of the five respondents are considered to hold and maintain a hazardous waste inventory.

National legislation is one of the most powerful tools for controlling and limiting the impact of hazardous waste problems. Many of the countries of the region have included in their national legislation provisions to control hazardous waste management. The enforcement of these laws has brought to light several weaknesses of the legislation, and revision of the pieces of legislation is deemed necessary. The regional centre will assist the countries of the region to review their hazardous wastes national legislation towards more efficient and sound management of hazardous wastes and to comply with the provisions and fulfil national commitments under the Basel Convention (Basel Convention Regional Center for Training and Technology Transfer for Arab States in Egypt, 2006).

Pursuant to Article 13, Parties must transmit, before the end of each calendar year, a report on the previous calendar year containing information regarding trans-boundary movements of hazardous wastes or other wastes in which they have been involved. Table 2 indicates that only Morocco and Qatar have regularly submitted their annual national reports from 1999 until 2005, the latest reported year by the Secretariat of the Basel Convention. It is worth noting that Egypt used to report regularly until 2003, and stopped afterwards. Bahrain has submitted its annual reports since 2000 till 2005. Lebanon, Mauritania and Comoros have submitted their national reports only once. The following countries, despite being parties to the convention, have never met their reporting commitments: Djibouti, Libya, Saudi Arabia, Sudan, Syria, the UAE, and Yemen.

The Stockholm Convention on POPs

The Stockholm Convention was adopted at a Conference of Plenipotentiaries held on 22-23 May 2001 in Stockholm, Sweden. Over 150 countries signed the Convention and it entered into force on 17 May 2004, 90 days after its ratification by the fiftieth country. The Stockholm Convention focuses on eliminating or reducing releases of 12 Persistent Organic Pollutants (POPs), the so-called "Dirty Dozen." It set up a system for tackling additional chemicals identified as unacceptably hazardous. It recognizes that a special effort may sometimes be needed to phase out certain chemicals for certain uses and seeks to ensure that this effort is made. The Convention also channels resources into the cleaning up of the existing stockpiles and dumps of POPs that litter the world's landscape. The Global Environmental Facility (GEF) is the designated interim financial mechanism for the Stockholm Convention.

Pursuant to Article 7(b) of the Stockholm Convention, parties are required to submit National Implementation Plans. Arab countries which failed to do so include Bahrain, Kuwait, Libya, Mauritania, Oman, Qatar, Saudi Arabia, the UAE, and Yemen.

United Nations Convention on Climate Change (UNFCCC) and the Kyoto Protocol

The UNFCCC, adopted at the United Nations Conference on Environment and Development (UNCED) in 1992, has at its ultimate objective the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Being a framework treaty, the UNFCCC contained only a non-binding recommendation for industrialized countries to return to the 1990 emission levels of CO_2 and other greenhouse gases (not controlled by the Montreal Protocol) by the year 2000.

The Kyoto Protocol, adopted in 1997, contains, for the first time, greenhouse gas reduction targets for most industrialized countries. The targets, however, range from an obligation to reduce emissions by 8 percent (for the European Union and many Central European countries) to a permission to increase emissions by 10 percent (Iceland) and 8 percent (Australia). Overall, industrialized countries are required to reduce their aggregate emissions to at least 5 percent below the 1990 level in the period 2008-12. The Kyoto Protocol entered into force on 16

TABLE 2 NATIONAL REPORTING TO THE BASEL CONVENTION

	1999	2000	2001	2002	2003	2004	2005
Algeria		X	X	X		X	X
Bahrain		X	X	X	X	X	X
Comoros		X					
Djibouti							
Egypt	X	X	X	X	X		
Iraq							
Jordan		X	X	X			
Kuwait	X		X				
Lebanon					X		
Libya							
Mauritania		X					
Morocco	X	X	X	X	X	X	X
Oman	X	X	X				
Palestinian Authority							
Qatar	X	X	X	X	X	X	X
Saudi Arabia							
Sudan							
Somalia							
Syria							
Tunisia	X						X
United Arab Emirates							
Yemen							

Source: http://www.basel.int/natreporting/index.html

February 2005, and has to date been ratified by 182 parties. Because it will affect virtually all major sectors of the economy, the Kyoto Protocol is considered to be the most far-reaching agreement on environment and sustainable development ever adopted (UNFCC website).

Nineteen Arab countries have ratified or acceded to the UNFCCC, only Egypt has ratified the Kyoto protocol, and seventeen other Arab countries have acceded to it (Table 1). Amongst those countries that are parties to the UNFCCC, only Comoros has not acceded to the protocol.

Articles 4 and 12 of the UNFCC require all signatories to the Convention to communicate information to the Conference of the Countries (COP). Article 12 specifies that each Party not included in Annex I to the Convention (non-Annex I Party) shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance with Article 4, paragraph 3. Countries that are Least Developed Countries (LDCs) may make their initial communication at their discretion. Currently, only 14 Arab counties have submitted their first national communication. Countries that have not submitted their first national communications include Iraq, Libya, Oman, Qatar, Somalia, Syria, and the UAE. To date, none of the Arab countries have submitted a second national communication.

NAPAs (national adaptation programmes of action) provide a process for LDCs to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. The rationale behind NAPAs is built on a recognition of the limited ability of LDCs to adapt to the adverse effects of climate change. In the NAPA process, prominence is given to community-level input as an important source of information, recognizing that grass-roots communities are the main stakeholders (UNFCC website). NAPA is requested from the six Arab countries listed as least developed, namely Comoros, Djibouti, Mauritania, Somalia, Sudan and Yemen. Both Somalia and Yemen have not submitted their NAPA yet.

The Clean Development Mechanism (CDM) is one of three flexibility mechanisms of the Kyoto Protocol. Annex I countries that have ratified the Kyoto Protocol can invest in projects that both reduce GHGs and contribute to sustainable development in non-Annex I countries. A CDM project provides certified emissions reductions (CERs) to Annex I countries, which they can use to meet their GHG reduction commitments under the Kyoto Protocol. While many factors influence the size and stability of the global carbon market, facts indicate that this market would move billions of dollars a year, increasing foreign investment capital flow in developing countries. In this context, the CDM projects offer many opportunities for developing countries to promote sustainable development through investment, technology transfer, and capacity building. The Arab participation in this mechanism has been very low; only four Arab countries have participated in the CDM since its inception in 2005. They are namely Egypt, Morocco, Tunisia, and lately Qatar. The large CDM potential in the region has not been fully utilized yet.

At the regional level, the Conference of Arab Ministers Responsible for the Environment (CAMRE) has been hosting two regional committees on climate change aiming at following up on the climate change negotiations and coordinating Arab countries' positions in the Kyoto deliberations. The first committee comprises governments' representatives from the Arab Meteorological Institutions, and the second one represents oil experts from the Arab oil producing countries (OAPEC). At its last meeting from 24-26 November 2007, the first committee called on the Arab countries to develop their institutional capacities to make use of the opportunities offered by the Clean Development Mechanism (CDM). Recommendations of both committees have to be endorsed by CAMRE. CAMRE is currently developing an "Arab Action Plan on Climate Change" which is to be presented to the upcoming Arab Development Summit to be held in Kuwait at the end of 2008 (LAS, 2007).

From the perspective of international trade, the Kyoto Protocol is very important to the oil producing countries. Measures that parties of the Kyoto protocol may take to meet their commitments could have significant trade implications. Arab countries, together with the *G77* and China have stressed the need for technology transfer, financial assistance and capacity building to cope with the potential adverse effects of climate change. Most of the Arab countries, if not all, are vulnerable to the adverse impacts of climate change ranging from sea level rise, to water shortage, desertification and widening the food gap in the region, and so forth.

The GCC states, together with other oil producing countries such as the OPEC group have been playing an active role in the Kyoto deliberations. This is mainly because of the potential economic impacts resulting from the response measures by developed countries to meet the Kyoto commitments. One study has shown that the losses experienced by the GCC region, whether in GDP or welfare terms, are higher than when compared to an Annex B country like Japan, or even when compared to other energy exporting regions such as Venezuela or North Africa. Thus, with the assumption that the international price of oil will fall and that import prices of energy-intensive goods will rise in the GCC region, the terms of trade will deteriorate nearly 9% and 7%, respectively, in the GCC and North African regions (Babiker).

Convention on Biodiversity

One of the key agreements adopted at Rio in 1992 was the UN Convention on Biological Diversity (UNCDB). It sets out commitments for maintaining the world's ecological underpinnings as we pursue economic development. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (UNCBD website).

The UNCBD was opened for signature at the Earth Summit in Rio in 1992. It entered into force on 23 December, 1993. To date, the number of parties to the convention has reached 191.

Article 6 of the Convention states that each Contracting Party shall, in accordance with its particular conditions and capabilities:

- Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this pur-

pose existing strategies, plans or programmes which shall reflect, inter alia, the measures set out in this Convention relevant to the Contracting Party concerned; and

- Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

Arab countries which have not prepared National Biodiversity Strategies and Action Plans are Bahrain, Kuwait, Libya, Saudi Arabia, and the UAE.

In addition, Article 26 of the Convention states that the objective of national reporting is to provide information on measures taken for the implementation of the Convention and the effectiveness of these measures. Until now, three periodic national reports have been submitted by parties to the UNCBD. Only Kuwait and Libya have not submitted any national reports. Algeria, Bahrain and Yemen have submitted the first national reports. UAE has submitted only the third national report. Jordan has submitted the first and third national reports. The rest of the Arab countries have already submitted the three national reports.

The Cartagena Protocol on Biosafety

On 29 January 2000, the Conference of the Parties to the Convention on Biological Diversity adopted a supplementary agreement to the Convention known as the Cartagena Protocol on Biosafety. The Protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology. It establishes an advance informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. The Protocol contains reference to a precautionary approach and reaffirms the precaution language in Principle 15 of the Rio Declaration on Environment and Development. The Protocol also establishes a Biosafety Clearing-House to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of the Protocol (UNCBD website).

In general, there have been limited capacities to manage biosafety issues in the Arab region, in addition to the problems of weak political will and a low level of public awareness. As in many developing countries, the majority of Arab countries have not yet developed operational biosafety systems that regulate the release and trade in Genetically Modified Organisms (GMOs). Generally, information on the status of GMOs in the Arab countries remains uncertain due to the limited availability of reliable data. According to the FAO, there only exists official information about Egypt – on the cultivation of genetically engineered (GE) tomatoes and the testing of nine Genetically Engineered crops (cotton, corn, groundnut, potato, soybean, squash, sugar cane, sweet potato, and wheat) – and Saudi Arabia, where genetically modified mushrooms are cultivated (Makdisi and Choufani Cherfane, 2005). But with the increasing volume and trade of GMOs, and the corresponding urgent need to formulate clear policies regarding the handling and transfer of GMOs, many Arab signatories of the UNCBD have now ratified the Cartegena Protocol (Table 1). Accordingly, there have been several initiatives on the national level to build capacity and develop new legislations or amend existing ones in line with the Cartagena protocol.

It should be noted that the restrictions on trade in GMOs, as provided by the Cartegena Protocol, are in many ways at odds with the policies of the World Trade Organization (WTO), and perhaps for this reason many Arab countries have not ratified the Cartegena Protocol.

Each Party is required, in accordance with Article 33 of the Protocol, to monitor the implementation of its obligations under the Protocol and to report to the Conference of the Convention Parties serving as the meeting of the Parties to the Protocol (COP-MOP) on measures taken to implement the Protocol. National reports are to be submitted 12 months prior to COP-MOP meetings at which they will be considered, with a frequency of every four years. The deadline for submission of the first regular national reports was 11 September 2007. Only three Arab parties have submitted their first national report, namely Qatar, Sudan, and Syria.

Further, in its Decision BS-I/9, the COP-MOP approved a format for the interim national report

on implementation of the Protocol which is set out in its Annex. The deadline for submission of the interim national reports was 11 September 2005. Only two Arab countries have met this obligation, namely Algeria and Egypt.

United Nations Convention to Combat Desertification (UNCCD)

The question of how to tackle desertification was a major concern for the United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro in 1992. The conference called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee (INC) to prepare, by June 1994, a Convention to Combat Desertification, particularly in Africa. The Convention was adopted in Paris on 17 June 1994 and opened for signature there on 14-15 October 1994. It entered into force on 26 December 1996, 90 days after the fiftieth ratification was received (UNCCD website).

Article 10 of the convention states that the purpose of national action programmes is to identify the factors contributing to desertification and practical measures necessary to combat desertification and mitigate the effects of drought. National Action Programmes (NAP) are among the key instruments in the implementation of the Convention. They spell out the practical steps and measures to be taken to combat desertification in specific ecosystems. In spite of the vital importance of combating desertification in the Arab region, only twelve Arab countries have submitted their NAPs. They are: Algeria, Djibouti, Egypt, Morocco, Sudan, Tunisia, Lebanon, Oman, Saudi Arabia, Syria, UAE, and Yemen. (For more on desertification, see chapter 7.)

Pursuant to Article 26 of the convention, each Party shall communicate to the Conference of the Parties for consideration reports on the measures which it has taken for the implementation of the Convention. Twelve Arab countries have submitted three periodic reports each, Qatar and Kuwait have submitted two reports, and Bahrain has submitted only the first report in 2002.

III. REGIONAL ENVIRONMENTAL AGREEMENTS

Regional conventions and agreements have generally achieved a greater level of compliance by countries of the region since they deal with issues

that directly interest certain Arab states. As such, it is easier for them to secure national political support. Key agreements include the regional seas conventions, namely the Mediterranean Action Plan (MAP; Barcelona, 1976), Regional Organization for the Protection of the Marine Environment (ROPME; Kuwait, 1978), Protection of the Environment in the Red Sea and Gulf of Aden (PERSGA; Jeddah, 1982). These conventions have proven to be useful instruments for the protection and sustainable use of regional marine and coastal resources (ESCWA 2002). Ratifications of those regional agreements have reached 100% by the respective Arab countries (table 1).

MAP Barcelona convention

In 1975, 16 Mediterranean countries and the European Economic Community adopted the Mediterranean Action Plan (MAP), the first-ever Regional Seas Programme under UNEP's umbrella. In 1976 these Parties adopted the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention). Six Protocols addressing specific aspects of Mediterranean environmental conservation complete the MAP legal framework:

1. Dumping Protocol (from ships and aircraft);
2. Prevention and Emergency Protocol (pollution from ships and emergency situations);
3. Land-based Sources and Activities Protocol;
4. Specially Protected Areas and Biological Diversity Protocol;
5. Offshore Protocol (pollution from exploration and exploitation);
6. Hazardous Wastes Protocol.

The Contracting Parties also adopted an amended version of the Barcelona Convention of 1976, renamed Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (UNEP MAP website). Parties to the Barcelona convention are those Arab countries east and south of the Mediterranean, namely Morocco, Algeria, Tunisia, Libya, Egypt, Lebanon, and Syria.

Table 3 indicates that all Arab Mediterranean countries have ratified the Barcelona conventions and its six protocols except for the Protocol for the Protection of the Mediterranean Sea Against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Sea-bed and its Subsoil adopted in Madrid in 1994. Only Tunisia has signed this protocol in 1994.

ROPME (Kuwait convention)

In 1978 Kuwait recognized the importance of the regional approaches in protection of the marine environment by inviting the eight countries surrounding the Gulf for a conference which was convened under the auspices of UNEP within its Regional Seas Programme. That conference adopted the following documents:

- Kuwait Action Plan for the Protection and Development of the Marine Environment and the Coastal Areas.
- Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution.
- Protocol concerning Regional Cooperation in Combating Pollution by oil and other Harmful Substances in Cases of Emergency.

An outcome of Kuwait Regional Convention for Co-Operation on the Protection of the Marine Environment From Pollution was the establishment of the Regional Organization for the Protection of the Marine Environment (ROPME) hosted in Kuwait. Since then, ROPME has been playing an essential role to harmonize the exerted efforts of the Member States towards protection of the marine environment and to follow up the activities of each Member States. In conformity with the provisions of the Protocol concerning Regional Cooperation in Combating Pollution by oil and other Harmful Substances in Cases of Emergency, the Marine Emergency Mutual Aid Centre (MEMAC) was established in Bahrain and started functioning in 1983. With a view of strengthening governance in the Region, ROPME has developed protocols addressing the critical areas of environmental management. These protocols included – in addition to the above Protocol:

- Protocol concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf (1989)

TABLE 3 RATIFICATION OF BARCELONA CONVENTION AND ITS PROTOCOLS

	Algeria	Egypt
Convention for the Protection of the Mediterranean Sea against pollution	16.2.1981 (AC)	24.8.1978 (AP)
Protocol for the prevention of pollution of the Mediterranean Sea by Dumping from Ships and Aircraft	16.3.1981 (AC)	24.8.1978 (AP)
Protocol concerning cooperation in combating pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency	16.3.1981 (AC)	24.8.1978 (AP)
Protocol for the Protection of the Mediterranean Sea against pollution from Land-Based Sources	2.5.1983 (AC)	18.5.1983 (AC)
Protocol concerning Mediterranean Specially Protected Areas	16.5.1985 (AC)	8.7.1983 (R)
Protocol for the Protection of the Mediterranean Sea against pollution resulting from Exploration and Exploitation of the Continental Shelf and the Sea-bed and its Sub-soil		

AC: Acception AP: Aproval R: Ratified S: Signed
Sources: WTO, ESCWA, UNEP and MEA secretariat homepages

- Protocol for the Protection of the Marine Environment against Pollution from Land-Based Sources (1990)
- Protocol on the Control of Marine Transboundary Movements and Disposal of Hazardous Wastes and Other Wastes (1998)
- Protocol concerning the conservation of biological diversity and the establishment of protected areas.

PERSGA (Jeddah convention)

PERSGA is a regional organization based in Jeddah, Saudi Arabia, responsible for the development and implementation of regional programmes for the protection and conservation of the marine environment of the Red Sea and Gulf of Aden, and was formally established in September 1996. A major function of PERSGA includes the implementation of the Jeddah Convention. It has also been given responsibility for preparation and implementation of the Strategic Action Plan (SAP) and related activities. PERSGA has played an active role in promoting regional cooperation and has recently supported regional workshops concerning environmental assessment (EA), Marine Protected Areas, navigation risks and living marine resources. In addition, a series of national workshops have been sponsored by PERSGA to facilitate the development and review of Country Reports prepared as part of the SAP process. A Regional Marine Emergency Mutual Aid Centre (MEMAC) is being established in Hurghada, Egypt to coordinate activities in the event of oil spills. PERSGA Council of Ministers approved a "Draft Action Plan for the Development of National Systems and Regional Mechanism for Preparedness and Response to Major Marine Oil Spills in the Red Sea and Gulf of Aden" in 2003. PERSGA continues to work with its member countries to harmonize oil spill contingency plans and uses the MEMAC centre as a focus for those efforts (UNEP 2007). Parties of the Jeddah Convention are: Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan and Yemen.

In accordance with Article III of the Jeddah Convention, PERSGA formulated three additional protocols: The Protocol Concerning the Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1982); the Protocol Concerning the Conservation of Biological Diversity and the Establishment of Network of Protected Areas in the Red Sea and Gulf of Aden (2005); and the Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden (2005). The present Consolidated Jeddah Convention comprises the Convention, its associated Protocols and legal documents produced during 1982–2006 (PERSGA, 2006).

For more information on MAP, PERSGA and ROPME, see chapter 6 of this report.

Lebanon	Libya	Morocco	Syria	Tunisia
8.11.1977 (AC)	31.1.1979 (R)	15.1.1980 (R)	26.12.1978 (AC)	30.7.1977 (R)
8.11.1977 (AC)	31.1.1979 (R)	15.1.1980 (R)	26.12.1978 (AC)	30.7.1977 (R)
8.11.1977 (AC)	31.1.1979 (R)	15.1.1980 (R)	26.12.1978 (AC)	30.7.1977 (R)
27.12.1994 (AC)	6.6.1989 (AP)	9.2.1987 (R)	1.12.1993 (AC)	29.10.1981 (R)
27.12.1994 (AC)	6.6.1989 (AP)	22.6.1990 (R)	11.9.1992 (AC)	26.5.1983 (R)
				14.10.1994 (S)

IV. TRADE AND ENVIRONMENT IN THE ARAB REGION

The level of awareness in the Arab region for the issues of trade and environment has been very low. Few trade and environment working groups or committees have been formed in some countries such as Egypt and Tunisia. However, there has been no evidence that these committees are effective. Recently, CAMRE recommended that Arab countries establish national committees on trade and environment to facilitate inter-ministerial coordination and discussion with civil society on this topic. During the last few years, the issues of trade and environment have become clearer to most of Arab officials, especially after the WTO meetings such as in Seattle and Doha, and the World Summit on Sustainable Development (WSSD) in Johannesburg. It is noticeable that the Arab Declaration To The World Summit On Sustainable Development failed to recognize the relationships between environment, trade, and sustainable development; rather, it stipulated that: "Negotiations at the WTO should work towards the objectives it was established for, i.e. opening the markets for exports without allowing obstacles that would limit developing countries ability to compete for these markets" (UN Economic and Social Council, 2001). It is obvious that until 2001, the priority issue for the Arab countries within the WTO was only the issue of market access.

Recently, Kuwait, Morocco, Yemen, and Lebanon established their committees on trade and environment. Consequently, Arab countries have become more active in the WTO Committee on Trade and Environment. It is also remarkable that the issue of trade and environment appeared on the agenda of the 19th session of CAMRE held in Algeria in 19-20 December, 2006. This was followed by an Expert Group Meeting on Trade and Environment Priorities in the Arab Region that was held in Cairo 11-13 November, 2007. In this meeting, the League of Arab States (LAS) summarized the priorities of the Arab countries as follows (Al Mallah, 2007):

- Strengthening the Arab negotiating capacity in trade end environment issues.
- Improving Arab participation in the Committee on Trade and Environment (CTE) within WTO.
- Enforcement of the MEAs and fighting illegal trade.
- The liberalization of trade in wastes and used goods.
- Environmental goods and services.

There is little specific information on the Arab position with respect to conflicts between WTO and the trade provisions of MEAs, despite the inclusions of these relationships as a subject for discussion within the Doha Development Agenda. This is supported by the fact that there was only one submission by an Arab country –

namely, a "non-paper" submitted by Egypt in 1996 – in the CTE prior to the Doha Declaration in 2001; and only one submission that refers to MEAs after Doha, by Saudi Arabia (Makdisi and Chouchani Cherfane, 2005).

Current concerns about trade and environment issues in the Arab region are focused on points raised in the Doha Development Agenda, as well as other measures that involve the implementation of trade-related MEAs and progress towards sustainable development in the region. The majority of governments have addressed most of their attention to the negative impact of environmental requirements on market access for Arab exports (particularly in OECD markets). The impact of energy subsidies in developed countries for oil-based economies is also of concern, as well as to some degree the liberalization of environmental goods and services. Attention to trade-related MEAs currently focuses on the implications of the Kyoto Protocol for the region. Sometimes media and NGOs started to focus on the issue of biosafety, especially as related to GMOs. The Basel Convention and illegal trafficking of hazardous wastes also frequently received significant attention, especially when some cases of illegal trafficking were made visible by NGOs or media. The enforcement of Trade Related Intellectual Property Rights (TRIPS) remains high on the agenda of many Arab countries and NGOs, many of whom are very concerned about public-health issues and access to affordable medicine. Egypt is a good example in this case.

The most recognized trade and environment issue in the Arab countries has been the issue of market access and its effects on Arab exports. The Doha Development Agenda calls for negotiations on the reduction or elimination of all tariffs and non-tariff barriers on all non-agricultural products, particularly those of interest to developing countries. Arab concerns were well spelled out in the official statements of the Arab countries delivered during the Doha Ministerial Conference in 2001 and the Cancun Ministerial Conference in 2003. The second issue of concern to the Arab countries is the issue of regulations as technical barriers to trade. Arab countries are also particularly concerned whether the application of the increasing number of environmental, health and safety standards are protectionist in nature or legitimate according to free trade provisions. Another trade

and environment issue of concern to the Arab countries has been the issue of subsidies and environmental taxes. Arab petroleum exporting countries consider the environmental taxes imposed on oil products in many OECD countries to be a non-tariff barrier that harms their competitiveness and the ability of consumers to choose their preferred source of energy. A submission by Saudi Arabia to the Commission on Trade and Environment (CTE) states that both Europe and the USA continue to tax oil under the environmental umbrella while heavily subsidizing highly polluting coal-burning plants, which raises the question of double standards. On the other hand, another major policy issue for petroleum-exporting countries in the Arab region is found in subsidizing petroleum products prices in domestic markets. It is believed that this has enabled some oil producing countries to use their natural resources as a means to promote industrialization or attract investment in a manner that can strengthen the development and the competitiveness of their national industrial sector. For instance, aluminium and steel production are energy intensive industries that are expanding in the GCC region, particularly in Bahrain and Saudi Arabia. Expansion in the aluminium sector is largely attributed to the low cost of energy inputs. This has been a contentious issue for Saudi Arabia in the accession negotiations, particularly as Saudi Arabia pursues an aggressive economic diversification policy based on expanding manufacturing and heavy industries.

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Acronyms and Abbreviations

ABSP	Agricultural Biotechnology Support Programme
ACSAD	Arabic Centre for the Studies of Arid Zones and Drylands
AEPC	African Environmental Protection Commission
AEPS	Arctic Environmental Protection Strategy
AEWA	African-Eurasian Waterbird Agreement
AFED	Arab Forum for Environment and Development
AGERI	Agricultural Genetic Engineering Institute
AIA	Advance Informed Agreement
AIDS	Acquired Immunodeficiency Syndrome
AMCEN	African Ministerial Conference on the Environment
AMU	Arab Maghreb Union
AoA	Agreement on Agriculture (WTO Uruguay Round)
AU	African Union
BCH	Biosafety Clearing House
BMP	Best Management Practices
BOD	Biological Oxygen Demand
CAB	Centre for Agriculture and Biosciences
CAN	Competent National Authority
CAMP	Coastal Area Management Project
CAMRE	Council of Arab Ministers Responsible for the Environment
CBC	Community-Based Conservation
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
CDM	Clean Development Mechanism
CDRs	Certified Emissions Reductions
CEIT	Countries with Economies in Transition
CEDARE	Centre for Environment and Development for the Arab Region and Europe
CERES	Coalition for Environmentally Responsible Economics
CFC	Chloro-Fluoro-Carbon
CGIAR	Consultative Group on International Agricultural Research
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CNA	Competent National Authority
CNG	Compressed Natural Gas
COP	Conference of the Parties
CPB	Cartagena Protocol on Biosafety
CSD	Commission on Sustainable Development
CZIMP	Coastal Zone Integrated Management Plan
DESA	Department of Economic and Social Affairs

EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative
EMS	Environmental Management System
EPI	Environment Performance Index
ESBM	Ecosystem-Based Management
ESI	Environment Sustainability Index
EU	European Union
EVI	Environmental Vulnerability Index
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
G7	Group of Seven: Canada, France, Germany, Italy, Japan, United Kingdom, United States
G8	Group of Eight: Canada, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States
GAPs	Good Agricultural Practices
GATT	General Agreement on Tariffs and Trade
GBIF	Global Biodiversity Information Facility
GCC	Gulf Cooperation Council
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GEO	Global Environment Outlook
GHGs	Greenhouse Gases
GIWA	Global International Waters Assessment
GLASOD	Global Assessment of Soil Degradation
GM	Genetically Modified
GMEF	Global Ministerial Environment Forum
GMO	Genetically Modified Organism
GNI	Gross National Income
GNP	Gross National Product
GRI	Global Reporting Initiative
GRID	Global Resource Information Database
GWP	Global Water Partnership
HACCP	Hazardous Analysis and Critical Control Points
HDI	Human Development Index
HIV	Human Immunodeficiency Virus
ICAM	Integrated Coastal Area Management
ICARDA	International Center for Agricultural Research in Dry Areas
ICC	International Chamber of Commerce
ICGEB	International Center for Genetic Engineering and Biotechnology
ICM	Integrated Coastal Management
ICT	Information and Communication Technology
IFA	International Fertilizer Industry Association
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
IMF	International Monetary Fund
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPF	Intergovernmental Panel on Forests
IPM	Integrated Pest Management

IPR	Intellectual Property Rights
ISO	International Organization for Standardization
IUCN	World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
IWRM	Integrated Water Resources Management
IWMI	International Water Management Institute
LADA	Land Degradation Assessment of Drylands
LAS	League of Arab States
LEED	Leadership in Environmental Design
LDCs	Least Developed Countries
LMG	Like Minded Group
LMO	Living Modified Organism
LPG	Liquefied Petroleum Gas
MAP	Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MDGs	Millennium Development Goals
MEA	Multilateral Environmental Agreement
MECTAT	Middle East Centre for the Transfer of Appropriate Technology
MEMAC	Marine Emergency Mutual Aid Centre
MPA	Marine Protected Area
NBC	National Biosafety Committee
NBF	National Biosafety Framework
NEAP	National Environmental Action Plan
NFP	National Focal Point
NGO	Non-Governmental Organization
NPK	Nitrogen, Phosphates and Potash
OAU	Organization for African Unity
ODS	Ozone-Depleting Substance
OECD	Organisation for Economic Co-operation and Development
PACD	Plan of Action to Combat Desertification
PCB	Polychlorinated biphenyls
PERSGA	Protection of the Environment of the Red Sea and Gulf of Aden
PICs	Pacific Island Countries
POPs	Persistent Organic Pollutants
RA	Risk Assessment
REMPEC	Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea
RM	Risk Management
ROPME	Regional Organization for the Protection of the Marine Environment of the sea area surrounded by Bahrain, I.R. Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates
RSA	Ropme Sea Area
RSGA	Red Sea and Gulf of Aden
SCP	Sustainable Consumption and Production
SEA	Strategic Environmental Assessment
SLR	Sea Level Rise
SoE	State of the Environment
SRES	Special Report on Emission Scenarios
TRAFFIC	Trade Records Analysis for Flora and Fauna in International Commerce
TRI	Toxics Release Inventory
TRIPs	Trade-Related Aspects of International Property Rights
UN	United Nations

UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre for Human Settlements (now UN-Habitat)
UNCLOS	United Nations Convention on the Law of the Sea
UNCOD	United Nations Conference on Desertification
UNCTAD	United Nations Conference on Trade and Development
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commission for Refugees
UNICE	United Nations Children's Fund
US	United States
USEPA	United States Environmental Protection Agency
UV	Ultraviolet (A and B)
WBCSD	World Business Council for Sustainable Development
WCED	World Commission on Environment and Development
WCD	World Commission on Dams
WCP	World Climate Programme
WCS	World Conservation Strategy
WEF	World Economic Forum
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WSSCC	Water Supply and Sanitation Collaborative Council
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWAP	World Water Assessment Programme
WWC	World Water Council
WWF	World Wide Fund for Nature