Technological transformation and sustainability in the MENA region

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1 Introduction

Today, countries are increasingly judged by whether they are information-rich or information-poor. The rapid expansion of the internet in the West and the speedy transition to electronic publishing will tend to widen the gulf in the levels of science and technology between the developed and the developing countries including the Middle East and North Africa (MENA) region. There is also a growing literature in the MENA region but it is more fragmented, and often restricted to sector applications or to country specific interests. It is therefore difficult for decision-makers in these countries to access systematic information about the potential applications that are being developed and implemented and to consider how they could be applied to meet their own development needs. Equally important, we must also acknowledge that some MENA countries such as United Arab Emirates and Qatar have become regional hubs for innovation and business development.

Many scholars such as Danofsky (2005), Hamel (2005) and Mansell and When (1998) argue that information can lead to knowledge and knowledge is a prerequisite for development. Hamel (2005) and Juma (2003) argue that education and knowledge are the chief currencies and the essence of modern age and can also be a strategic resource and a lifeline for developing countries' Sustainable Development (SD). Moreover technological innovation in ICTs and liberalisation of the regulatory context of the media and telecommunications sectors have profoundly changed the global communications landscape (Nulens et al., 2001). And although these changes have originally started in the developed countries but they also are offering great opportunities for counties in the MENA region.

Moreover, a recent report by the World Information Society (WISR, 2007) indicates that the digital divide is narrowing in terms of internet usage and evolving from inequalities in basic access to ICTs and their availability, to differences in the quality of the user experience. Therefore, the debate over the future of the digital divide is now moving away from 'quantity' in basic connectivity and access to ICTs to measures of 'quality' and 'capacity', or speed of access. Table 1 shows the digital divide between the developed and developing countries by dividing the different rates in the developed world by the rates in the developing world including MENA. Rates are rounded, whereas the digital divide is calculated based on actual numbers.

Table 1 The digital divide between developed and developing countries (times more)[a]

Regions	*Fixed telephone*[a]		*Mobile telephone*[b]		*Internet users*[c]	
	1994	*2004*	*1994*	*2004*	*1994*	*2004*
Developed	48.80	53.5	5.20	76.8	2.18	53.8
World	11.54	18.8	1.00	27.4	0.46	13.8
DCs	04.40	12.8	0.19	18.8	0.03	6.70
Digital divide	11	4	27	4	72	8

[a]Fixed telephone lines per 100 inhabitants.

[b]Mobile telephone subscription per 100 inhabitants.

[c]Internet users per 100 inhabitants.

Source: International Telecommunication Union Different Reports; Telecommunication Development Bureau (BDT); World Telecommunication Reports and ITU World Telecommunication Indicators Database.

2 MENA digital opportunity index

Digital Opportunity Index (DOI) is a new index created from the set of internationally agreed core ICT indicators.[1] In an ideal world, digital opportunity would mean: the whole population having easy access to ICTs at affordable prices; all homes equipped with ICT devices; all citizens having mobile ICT devices and everyone using broadband. DOI scores will therefore allow analysis of each country's path towards the Information Society. However, in order to calculate the DOI 2005 and 2006, the World Information Society Reports (WISR) (2006, 2007) use 11 indicators (6 have a fixed line orientation and 5 are geared to mobile) (see Appendix for more details about these indicators).

The DOI 2005 and 2006 values are calculated for each indicator by calculating the data value as a proportion of the reference values for each country (usually 100% for per capita penetration, household penetration rates and broadband ratios). This gives an index value for the 11 indicators discussed above. A simple average of these index values is taken to give values for the DOI subindices of *Opportunity, Infrastructure and Utilization*, which are in turn averaged to obtain a country's overall DOI score. According to WISR (2006, 2007) reports, DOI is the only e-index based solely on internationally agreed ICT indicators, developed for 180 and 181 countries, respectively, in 2005 and 2006. This makes it a valuable tool for benchmarking the most important indicators for measuring the Information Society. The DOI is a standard tool that governments, operators, development agencies, researchers and others can use to measure the digital divide and compare ICT performance within and across countries.

Table 2 shows the DOI for MENA countries in the period 2001–2006 and also the overall world ranks for each country in 2005 and 2006.

While the Republic of Korea scores the highest DOI in the world in the last two years followed by Japan, Denmark and Iceland, Niger and Chad are placed in the bottom of the table in both years. The USA ranks 21st and 20th in 2005 and 2006, respectively and the UK's rank moved from 7th in 2005 to 10th in 2006.

Table 2 MENA DOI 2006 (2004/2006)

Countries	*DOI*						*World rank*	
	2001	*2002*	*2003*	*2004*	*2005*	*2006*	*2006*	*Change 2004/2006*
Israel	0.50	0.53	0.56	0.62	0.66	0.69	14	–1
Bahrain	0.44	0.47	0.50	0.52	0.57	0.60	35	–2
United Arab Emirates	0.48	0.50	0.52	0.53	0.55	0.59	37	–5
Qatar	…	…	…	0.50	0.53	0.58	38	+1
Turkey	0.37	0.39	0.41	0.41	0.45	0.52	52	+13
Kuwait	…	…	…	0.47	0.49	0.49	60	–12
Morocco	…	…	…	0.33	0.40	0.47	68	+36
Saudi Arabia	…	…	…	0.41	0.43	0.46	75	–9
Jordan	0.32	0.37	0.38	0.39	0.41	0.45	79	–8
Oman	…	…	…	0.40	0.41	0.44	81	–11
Algeria	…	…	…	0.35	0.39	0.42	83	+9
Tunisia	…	…	…	0.37	0.39	0.41	87	–5
Egypt	0.29	0.31	0.35	0.37	0.38	0.41	91	–10
Lebanon	…	…	…	0.38	0.39	0.40	93	–18
Palestine	…	…	…	0.35	0.37	0.39	98	–9
Syria	…	…	…	0.34	0.36	0.37	104	–6
Iran (I.R.)	…	…	…	0.36	0.36	0.37	105	–19
Libya	…	…	…	0.35	0.35	0.36	109	–21
Yemen	…	…	…	0.22	0.25	0.28	128	+1
Djibouti	…	…	…	0.20	0.23	0.26	132	+1
Sudan	…	…	…	0.23	0.24	0.24	136	–10
Mauritania	…	…	…	0.14	0.16	0.17	154	–8
Eritrea	…	…	…	0.01	0.04	0.07	177	+2
Iraq	…	…	…	…	…	…	…	…

Source: WISR (2006, 2007); ITU World Telecommunication Indicators Database.

There is enormous variety in the socioeconomic context of MENA countries, and a related large variability between them in terms of their current status with respect to IT, in areas such as their existing equipment base, the availability of trained personnel and their current levels of usage of IT/S. In the MENA region,[2] Israel is leading the region and Sudan and Muritania placed at the bottom of table. The index reveals an alarming picture for many countries in the region moving backward across the table from 2005 to 2006 world ranking. Morocco on the other hand is progressing very fast moving 35 steps towards the top of the table.

The ranking of rich countries like Kuwait (moved from 49th in 2005 to 60th in 2006) and Saudi Arabia (moved from 72nd place in 2005 to 75th place in 2006) showing that a

nation's economic status does not always correspond to its path towards the Information Society. Bartholomew (1997) argues that technology development is embedded in a country's history, cultural values and attitudes. Therefore, attitude to IT could also have something to do with national culture. Therefore, in the case of Saudi Arabia and Kuwait and indeed most parts of the region issues to do with Freedom of Information could be one of the reasons behind their lack of success as access to the internet brings with it free access to information and therefore if the political climate of the country does not permit such access, then rapid progress towards information society cannot succeed in that country.

3 Managing the environment

The 1992 Earth Summit stipulated that countries at the national level and international governmental and non-governmental organisations at the international level should develop indicators of sustainability in order to help countries making informed decisions concerning sustainability issues (UNECE, 2004). Indicators for sustainability were set out by the United Nations Commission for Sustainable Development (UNCSD), UN Statistics Division, OECD, Eurostat, NGOs and other international organisations. However, the major challenges for the measurement of sustainability are the lack of a widely accepted operational definition of both sustainability and SD and the difficulties in measuring the interlinkages of economic, social and environmental dimensions are often mentioned and still not yet solved.

There are currently more than 400 definitions of sustainability available in the literature (see Ahmed and Stein, 2004; Elliot, 2001; Holmberg, 1992; Morita et al., 1993; Murcott, 1997; Pearce et al., 1989) providing different concepts, perspectives, concerns and solutions for sustainability. How they relate to each other and provide a clear understanding of our common future still remain a key question to be addressed.

The concept of sustainability is multidimensional and often unclear and there is no single definition or perspective necessarily fully captures the concept, but by being clear about our meaning of the concept and the underlying assumptions, we can progress our understanding of sustainability and our future challenges. It is therefore essential that research and policy development fully takes account of the differing perspectives of sustainability and make explicit the particular perspective(s) that they are taking. Differing concepts are likely to direct our thinking in certain ways. However, the most frequently quoted definition is from the report *Our Common Future* (also known as the Brundtland Report). The Brundtland report (WCED, 1987, p.43) defined SD as "development that meets the needs of the present without comprising the ability of future generations to meet their own needs".

3.1 MENA environmental sustainability index

Environmental Sustainability Index (ESI) is the most commonly indicators referred to during the last period to measure environmental sustainability which is a set of indicators established by Yale University[3] and Columbia University[4] in collaboration with World Economic Forum and Joint Research Centre of the European Commission. The ESI is constructed around the concept of 'sustainability', it tracks the environmental past, present and future. It includes metrics related to underlying natural resource

endowments, past pollution control and the existing degree of ecosystem degradation as well as current environmental policy results and forecasts of a society's ability to change negative trends.

However the ESI is a measure of overall progress towards environmental sustainability, developed for 142 and 146 countries, respectively, in 2002 and 2005. The ESI scores are based upon a set of 21 core 'indicators', each of which combines two to eight variables for a total of 68 underlying variables. The ESI permits cross-national comparisons of environmental progress in a systematic and quantitative fashion. It represents a first step towards a more analytically driven approach to environmental decision-making. The high ESI scores are attributed to substantial natural resource endowments, low population density and successful management of environment and development issues.

According to the recent ESI (2002, 2005) rankings, Finland leads the world in environmental sustainability (as it did in the 2002 ranking), the USA ranks 45th (2002 and 2005) and the UK's rank moved from 91st in 2002 to 46th in 2005.

The performance of the entire MENA region (Table 3) is not very satisfactory with most countries scoring very low.

Table 3 MENA environmental sustainability index (2002/2005)

Country	*ESI 2002*[a]	*ESI 2005*[b]	*Change 2002/2005*
Tunisia	61	55	+6
Israel	63	62	+1
Oman	120	83	+37
Jordan	53	84	–31
Turkey	62	91	–29
Algeria	70	96	–26
Morocco	73	105	–32
United Arab Emirates	141	110	+31
Egypt	74	115	–41
Syria	107	117	–10
Mauritania	126	124	+2
Libya	124	126	–2
Lebanon	106	129	–23
Iran	104	132	–28
Saudi Arabia	138	136	+2
Yemen	Not included	137	n/a
Kuwait	142	138	+4
Sudan	102	140	–38
Iraq	139	143	–4

[a]ESI 2002 calculated from 142 countries.

[b]ESI 2005 calculated from 146 countries.

Source: Adopted from Yale Centre for Environmental Law and Policy (2002, 2005) and World Economic Forum (2002, 2005).

The deterioration of the environment is a major challenge for all MENA countries with 87% of the region's surface consists of desert (Gnesotto and Grevi, 2006). More seriously rich countries such as Kuwait and Saudi Arabia are placed at the bottom of the table, Kuwait stood last in 2002 in the entire world, showing that a nation's economic status does not always correspond to its ESI performance.

3.2 MENA environmental performance index

Early last year the Environmental Performance Index (EPI) released during the 2006 World Economic Forum. The EPI is not a replacement of the ESI; instead, the two indices supplement each other. The EPI focuses on current on-the-ground outcomes across a core set of environmental issues tracked through 16 indicators in 6 policy categories for which all governments are being held accountable. These categories include: Environmental Health, Air Quality, Water Resources, Biodiversity and Habitat, Productive Natural Resources and Sustainable Energy. As a quantitative gauge of pollution control and natural resource management results, the index provides a powerful tool for improving policymaking and shifting environmental decision-making onto firmer analytic foundations.

The index reveals that nations at all levels of economic development face serious environmental challenges. The top-ranked countries all commit significant resources and effort to environmental protection, resulting in strong performance across most of the policy categories. EPI ranks New Zealand first in the world in environmental performance and the USA placed 28th in the rankings which reflects top-tier performance on environmental health issues, but also indicates that the USA is under-performing on critical issues such as renewable energy, greenhouse gas emissions and water resources.

The performance (world ranks) of all MENA countries included in the EPI (except Iraq, Libya and Kuwait) is shown in Table 4.

The rankings of some countries (Lebanon, United Arab Emirates, Turkey, Iran and Saudi Arabia) are notably higher on the EPI than the ESI. This result suggests that these countries face significant long-term sustainability challenges but are managing their present circumstances well. Meanwhile a number of countries (Sudan, Yemen and Mauritania) have lower EPI than ESI scores. According to the results these countries are relatively unpolluted due to their underdevelopment, but they are not meeting the challenge of providing environmental infrastructure (drinking water and waste water treatment) for their people and creating systems for pollution control and ecosystem protection.

Despite considerable public investment in potable water supply services (World Water Forum, 2006), deteriorating environmental conditions will lead to a serious water shortage problem. The EPI also reveals serious concerns regarding water resources in the region with most countries score very low compare to other categories. According to a recent report by the EU's Institute for Security Studies (Gnesotto and Grevi, 2006), the current annual per capita water availability of about 1200 cubic metres (compared to a world level of 7000) may well drop to only 550 cubic metres by 2050 (Nasr, 2003). Also countries like Egypt and Syria depend largely on water resources originating from other countries and are therefore vulnerable to the water policies of their neighbours. The sustainability of the human and economic development of the region will thus depend on long-distance water transfers and massive desalination projects.

Table 4 MENA environmental performance index (2006)

Country	*Health*	*Air*	*Water*	*Habitat*	*Resources*	*Energy*	*Overall*
Lebanon	34	77	71	125	69	97	36
Israel	25	84	121	79	124	59	45
United Arab Emirates	35	107	109	57	59	118	47
Turkey	45	87	79	109	89	79	49
Iran	41	117	99	76	41	117	53
Saudi Arabia	46	119	113	50	28	119	59
Oman	52	122	106	90	28	103	60
Algeria	43	105	131	101	82	99	63
Jordan	42	102	122	56	128	110	64
Morocco	58	70	133	61	86	64	68
Tunisia	56	86	128	133	116	62	82
Egypt	61	130	100	119	124	104	85
Syria	62	116	118	128	76	122	97
Yemen	95	103	115	131	40	101	122
Sudan	115	125	81	89	53	22	124
Mauritania	112	118	127	133	105	112	131

[a]EPI 2006 calculated from 133 countries.

Source: Adopted from Yale Centre for Environmental Law and Policy (2006) and World Economic Forum (2006).

4 Plan of the book

In addition to the above overall introduction, there are five sections in the book, namely *Information and Knowledge Management* (five chapters), *Science Technology and Innovation* (six chapters), *Food Safety and Public Health* (four chapters), *Water Resources* (three chapters) and *Managing the Environment* (four chapters).

In the first section (*Information and Knowledge Management*) of the book, *Kolo* (Chapter 2) argues that the ability of a society to gestate and sustain growth and development within its jurisdiction, and the capacity to compete effectively and efficiently in the global arena, depend, to a large extent, on the level of technology transformation in the society in question. *Kolo* examines the penetration rates and trends of ICT in the Middle East. Using the sustainability prism concept as an analytical framework *Kolo* analyses key issues and challenges faces the region faces in adapting ICT for purposes of growth and development. Within this framework, the cardinal four 'E' sustainability principles of economy, ecology, equity and enlightenment are used to identify and assess key ICT issues facing socioeconomic productive capacity in the Middle East. In his conclusion, *Kolo* states that ICT penetration rates in the region must rise significantly and quickly in order to 'indigenise' operation systems, acquire more

intellectual property rights, and become a region of producers and suppliers instead of the region of voracious consumers of ICT products and services from everywhere else but the ME region.

Chapter 3 presents and examines a proposed E-Learning Partnership (ELP) model involving various societal institutions regarding its risks, benefits and outcomes, along with roles and responsibilities. In this case study, *Martin, Feghali and Sahyoun* discuss critical issues and activities that appear necessary for the development and implementation of the proposed model to enhance technological transformation for ME economies.

In Chapter 4, *Al-Roubaie and Al-Zayer* highlights the knowledge readiness in the Gulf Cooperation Council (GCC) countries and the potential impact that global knowledge could have on the future development in these countries. Given the availability of financial capital and strategic location of the GCC countries, *Al-Roubaie and Al-Zayer* argue that these countries could take advantage of the global economy by building knowledge capacity backed by strong infrastructure, sound macroeconomic policies, good governance, efficient institutions, cutting-edge skill development and robust research and development. *Al-Roubaie and Al-Zayer* recommend the GCC countries must develop new production techniques and invent new products to enable the region to compete in global markets. Closing the digital divide and building a scientific and technological capacity must become an integral part of regional and national governmental policies in GCC countries.

In Chapter 5 *Kamel* assess the evolution of the ICT sector in Egypt since the establishment of the Ministry of Communications and Information Technology (MCIT) in 1999 while mapping the ICT potentials for socioeconomic development. *Kamel* argues that it is becoming a real-time challenge for developing nations to keep pace with the developments taking place worldwide. He also argues that building the infrastructure will not realise quantum leaps in the development process unless it is coupled with concrete projects and activities that engage the community at large with its different segments and groups irrespective of their locations whether urban or remote, gender or background.

Following on Kamel's case study on Egypt, *Rena* presents in Chapter 6 a comprehensive theme of ICT in Eritrea. With ICT access remains a serious problem in Africa Eritrea in particular has a very low density of personal computers and internet. *Rena* examines the challenges that were and are faced by Eritrea and identifies the specific challenges of Eritrean Information Technology (IT) education and provides some solutions.

The next section (*Science Technology and Innovation*) of the book (Chapter 7) starts with an investigation of the hypothesis that Foreign Direct Investment (FDI) inflows yield positive technology spillovers to MENA countries. To investigate this hypothesis, *Elmawazini* reviews the literature and empirical studies, identifies the channels of technology diffusion from FDI and finally applies the absorptive capacity measures to 13 MENA countries. *Elmawazini*'s results show that FDI may yield insignificant technology spillovers to many MENA countries due to the weakness of technological and human capabilities in these countries compared with that in other developing countries. In addition, most of FDIs do not flow to manufacturing sector, which is most relevant for deepening technology spillovers. In consequences, the significance of human and technological capabilities may reflect the important role of government policies in deepening the magnitude of technology spillovers from FDI in MENA countries.

In Chapter 8, *Gonel* examines the changes of MENA countries over the past two decades in the trade of high-technology industries. Although there is a vast literature on the relationship between technological change and economic performance but according to *Gonel* empirical studies about MENA countries' weak economic performance on high technology are limited. *Gonel* found that a strong specialisation in a very limited number of industries can be found in some of the MENA countries.

Following Gonel's examination of the trade of high-technology in the MENA region, in Chapter 9, *Shamsavari and Taha* criticise traditional approaches to and models of technology transfer in the new age of openness to trade and FDI. Using an empirical study of Egypt's car industry, *Shamsavari and Taha* argue that these ideas and models, such as technological independence, need to be reexamined.

In Chapter 10, *Khor and Elkamel* survey the widespread use of optimisation or mathematical programming approaches in the upstream sector of the petroleum industry in the ME. *Khor and Elkamel* specifically focus on problems relating to the production systems design and operations, lift gas and production rate allocation and reservoir development, planning, management and optimisation. Using different optimisation, simulation and computational techniques, *Khor and Elkamel* explore various algorithms and approaches such as genetic algorithms to address non-smooth objective functions; techniques for simultaneous decision making in design, planning and scheduling and stochastic programming to handle uncertainty in reservoir information, with the ultimate aim of improving solution quality while reducing computational intensity.

Chapter 11 investigates the connection between economic progress and the entrepreneurial environment using deductive analysis regarding the forms of capital contributing to the entrepreneurial environment of society. *Abouzeedan and Busler* argue that innovation capital can be used as an indicator for the degree of richness of the entrepreneurial environment. In this chapter *Abouzeedan and Busler* also introduce the Innovation Balance Matrix (IBAM) as an analytical tool to classify the Arab economies based on their entrepreneurial conditions. Finally *Abouzeedan and Busler* argue that the best solution to the lack of individual entrepreneurial economies in that region is through what they called the 'additive solution'.

Using SWOT analysis in Chapter 12, *Ghazinoory and Ghazinoori* examine 10 essential elements comprising 6 major functions and 4 major interactions of the Iran's innovation system. Although Iran has made significant progress in many areas of science and technology in the last decade, yet the performance of its innovation system remains weak. Development of science, technology and innovation, particularly developing high technologies has been an important focus of Iran's leaders in recent years. Excellence in science and technology and promoting a knowledge-based economy have been considered in the national 20 year vision (2005–2025) and the fourth five-year development plan (2005–2010).

In the next section (*Food Safety and Public Health*) of the book, *Tewfik and Tewfik* (Chapter 13) highlights the importance of food irradiation as a robust measure to reduce the devastating consequences of post-harvest food losses in poor communities in the ME. According to *Tewfik and Tewfik* the lack of simple and rapid identification methods for use in the control and surveillance of such foods has been one of the principal concerns in the acceptance of irradiated foods by governments and consumers in the region. Coupled with technology transfer, food irradiation will improve productivity and enable SD in the region.

Chapter 14 aims to identify the number, types and nature of fast food outlets in Qatar, in order to classify them into risks based on physical and microbiological parameters and to implement and assess the Hazard Analysis Critical Control Point (HACCP) procedures within a selected number of fast food outlets and restaurants before and after implementation. *Al-Hamaq, Zeyadah, Ahmed, Amuna and Tewfik* argue that HACCP is an effective, specific and critical system in controlling hazards during food production procedures by providing a greater degree of confidence that processed food is both wholesome and traceable. Implementation of HACCP programmes in different establishments in Qatar has profoundly enhanced their role in the protection of public health beyond the traditional emphasis on facility and equipment design and maintenance and adherence to the principles of sanitation, good manufacturing and food preparation practices.

In Chapter 15, *Madani* explores recent changes in disease trends in Saudi Arabia from infectious, parasitic diseases and severe cases of under nutrition, to affluence related health problems like obesity, diabetes, cancer and cardiovascular diseases. In doing so, *Madani* reviews the current situation of these chronic diseases which are related to change in diet and lifestyle in Saudi Arabia. According to *Madani* diet-related non-communicable diseases have become major public health problems in Saudi Arabia, and there is an urgent need for a health strategy to prevent and control these diseases.

In the last chapter in this section of the book (Chapter 16), *Ahmed and Ahmed* assess the performance of Sudan to halve malaria mortality by 2010 as pledged during the 2000 Abuja Declaration. *Ahmed and Ahmed* provide a clearer understanding of the constraints and challenges facing Sudan in compacting malaria. They also critically assess the performance and efforts of the Sudanese Government in compacting malaria in comparison with the internationally agreed targets to RBM and finally provide a conclusion.

The following section (*Water Resources*) of the book starts with Chapter 17 in which *El Hefnawy* examines the virtual water controversy and its importance in the food security debate in the MENA region, to show the limitations as well as the potentials of the proposed solutions. *El Hefnawy*'s analysis shows that including virtual water as a policy option requires thorough understanding of the impacts and interaction of virtual water trade on the local social, economic, environmental and cultural situation in a country context. The MENA region is the most water short region in the world and since agriculture consumes by far the largest percentage of water, most of these countries will have to take and rely on increased food imports to meet their needs.

In Chapter 18, a Tunisian case study is presented by *Belloumi and Matoussi*. The objective of their study is to develop a Data Envelopment Analysis (DEA) model with water salinity as a non-discretionary input and estimate a model of irrigated water demand function based on the role of water in the farm production function. *Belloumi and Matoussi* model production technology by distinguishing six inputs and four outputs. *Belloumi and Matoussi* applied their adjusted-DEA model on a transversal data of 138 water users associations farms. Results show that farms are technically inefficient and they operate under the optimal scale. The shadow prices of irrigated water are found to be positive. The estimation of a model of irrigated water demand function enables *Belloumi and Matoussi* to derive the shadow price elasticity's of the inputs. *Belloumi and Matoussi* argue that the own price elasticity of water is significant and quite high. Thus, the high responsiveness of water demand to price, suggests that pricing policies can be a potential instrument for water conservation.

Following on similar issues relating to water resources, Chapter 19 explores a number of negative impacts resulted from phosphate discharges from point and diffuse sources into the water environment in Lebanon. *Ayoub and Kalinian* evaluate the effects of a number of parameters such as, system operating mode, adsorbent particle size, rates of flow through the bed, applied phosphate concentration, dolomite on effluent water quality and competing solutes, on the efficiency of the process. To achieve this objective, *Ayoub and Kalinian* conduct series of laboratory tests using different system operating configurations, different sizes of the adsorbing medium, different rates of flow and different phosphate concentrations. *Ayoub and Kalinian* are able to establish the competing effect of dissolved solutes by carrying out adsorption tests on water having different chemical characteristics, namely, Distilled Water (DW), Tap Water (TW), Synthetic Ground Water (SGW) and secondary treated sewage effluents. The results indicate that the fluidised bed configuration was the most effective mode of operation for the system. *Ayoub and Kalinian* also note the presence of some solutes in the influent compete with phosphate on adsorption sites thus hindering the efficiency in phosphate removal.

The last section (*Managing the Environment*) of the book is devoted to different environmental issues. In Chapter 20, *del Río and Hernández* analyse the potential contribution of renewable energy Clean Development Mechanism (CDM) projects to a sustainable technological transformation in the MENA countries. A renewable energy-based technological transformation can have beneficial effects for MENA countries. The CDM was devised in the Kyoto Protocol as an instrument to encourage the realisation of Greenhouse Gas (GHG) emissions reduction projects with sustainability benefits (both socioeconomic and environmental) in host countries. *del Río and Hernández* also discuss the potential benefits of those projects for the region as well as key barriers to their implementation.

Chapter 21, highlights serious environmental contaminants of two groups including Radionuclides which emit different types of radiationand heavy metals that, like radionuclides, are persistent in the environment and are accumulated in the food chain. These two groups of environmental parameters are the main concern of the study in Western Turkey by *Baba, Ereeş, Başsarı, Hiçsönmez, Çam and Özdilek*. Comparison with worldwide averages, both radiation and some heavy metals and some elements in the study area were found elevated mainly due to stipulation of the regional geology. Analyses of 15 samples revealed that gamma absorbed dose rate of potassium and rubidium, gamma absorbed dose rate of uranium and thorium, titanium and zirconium concentration, iron and zinc concentration, iron and copper concentration and finally copper and zirconium concentration are positively and strongly related.

Similar to Chapter 21, in Chapter 22, *DafaelSeed, Eltayeb, Hassan and Babiker* assess daily environmental contamination in the Sudan. Five types of fresh vegetables were collected from three different sites in Khartoum State (roadside farm, roadside market and open market) and analysed for heavy metal content and pesticides residues before and after washing. Results show that for all sites lead concentration was very high for all vegetables and exceeded the maximum level recommended by FAO/WHO even after washing. Results also show that pesticides residue for all vegetables in all sites below the hazard concentration. Given the increase vegetable consumption in Sudan, *DafaelSeed, Eltayeb, Hassan and Babiker* anticipate that he situation would be worsen in the future and therefore recommend that the level of toxic metals should be reduced to minimise the health risk.

In the last chapter (Chapter 23) of the book, *Kalantari, Fami, Asadi and Mohammadi* attempt to find out individual and social factors affecting environmental behaviour of urban citizens. To achieve this objective, the authors formulate a conceptual framework to examine relationships among personal factors, attitude towards environment and environmental behaviour. To examine this conceptual model, 1200 individuals of Tehran residents were randomly chosen and interviewed. *Kalantari, Fami, Asadi and Mohammadi* analyse the data using correlation analysis, student's *t* test, Analysis of Variance (ANOVA) and path analysis by SPSS software. It is emerged from the study that education and improving problem-based knowledge of Tehran residents can change their environmental attitude and increase their feeling of stress towards environment. The results of *Fami, Asadi and Mohammadi* study show that the environmental behaviour of people in urban areas directly and indirectly are under the influence of variables like age, gender, income, education, problem-based knowledge, environmental legislation, environmental attitude, feeling of stress and preparedness to act of the residents. All these together can influence and change people's behaviour to preserve urban environment.

Finally, as we work towards achieving SD, we must strive not to lose sight of the big picture and that we must think *and* act both globally and locally.

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[1]Partnership on Measuring ICT for Development, Core ICT Indicators, November 2005, Available at: www.itu.int/ITU-D/ict/partnership/material/CoreICTIndicators.pdf.

[2]No data available for Iraq.

[3]Yale Centre for Environmental Law and Policy.

[4]Centre for International Earth Science Information Network.

Appendix

Digital opportunity index

Eleven core ICT indicators are used by the World Information Society Report (WISR) to calculate the Digital opportunity index (DOI) ranks. The 6 of the 11 indicators have a fixed line orientation and five are geared to mobile. Indicators are:

(a) Indicators that provide an *opportunity* for the country's citizen to use ICTs:

1. percentage of population covered by mobile cellular telephony
2. internet access tariffs as a percentage of per capita income
3. mobile cellular tariffs as a percentage of per capita income.

(b) Indicators that represent the *infrastructure* needed by any country to use ICTs:

1. proportion of households with a fixed line telephone
2. proportion of households with a computer
3. proportion of households with internet access at home
4. mobile cellular subscribers per 100 inhabitants
5. mobile internet subscribers per 100 inhabitants.

(c) Indicators show the extent of ICTs *utilisation* within the country:

1. proportion of individuals that used the internet
2. ratio of fixed broadband subscribers to total internet subscribers
3. ratio of mobile broadband subscribers to total mobile subscribers.