2015 Report of the Arab Forum for Environment and Development

ARAB ENVIRONMENT • 8
SUSTAINABLE CONSUMPTION
FOR BETTER RESOURCE MANAGEMENT

EDITED BY:
IBRAHIM ABDEL GELIL
NAJIB SAAB

المنتدى العربي للبيئة والتنمية
ARAB FORUM FOR
ENVIRONMENT AND DEVELOPMENT
AFED

ARAB ENVIRONMENT • 8

SUSTAINABLE CONSUMPTION

FOR BETTER RESOURCE MANAGEMENT IN ARAB COUNTRIES

Incorporating Arab Public Opinion Survey on Consumption Patterns

EDITED BY
IBRAHIM ABDEL GELIL
NAJIB SAAB

المنتدى العربي للبيئة والتنمية
ARAB FORUM FOR
ENVIRONMENT AND DEVELOPMENT

AFED

2015 Report of the Arab Forum for Environment and Development

Published with Technical Publications and Environment & Development magazine
P.O.Box 113-5474, Beirut, Lebanon

info@**afed**online.org
http://www.**afed**online.org

This report should be cited as follows:
AFED (2015). Arab Environment: Sustainable Consumption. Annual Report of Arab Forum for Environment and Development, 2015; Abdel Gelil, I. and Saab, N. (Eds.); Beirut, Lebanon. Technical Publications.
If the reference is to a specific chapter, include also number of the chapter and respective author(s).

Editors: Ibrahim Abdel Gelil and Najib Saab
Chief Advisers: Mohamed El-Ashry and Abdul-Karim Sadik

Graphics and Production Manager: Charbel Mahfoud
Copy Editor: Rosalyn Saab
Execution: Maguy Abou Jaoude
Printing: Chemaly & Chemaly, Beirut
Photos: *Environment & Development magazine archive - iStock photos -APN*

ISBN: 978-9953-437-55-2

Contents

Preface

Annual reports on the state of the Arab environment, produced since 2008 by the Arab Forum for Environment and Development (AFED), have become a main source of information and a prime driver for policy reforms in Arab countries. Findings of the seven reports produced so far have clearly underscored the pivotal role of sustainable consumption patterns in any viable environmental management scheme. The Energy-Water-Food Nexus proved specifically significant, especially with the growing impact of climate change. Increasing production alone cannot solely solve the need of food for hungry people and water for thirsty people, nor will it provide power to dark villages. Equally, building more waste dumps and incinerators cannot solve the trash crisis. The AFED report on Green Economy in 2011 already found that enhancing efficiency is much less costly than increasing supply. Inadequate consumption patterns are at the core of the problem, and any feasible solution requires a fundamental change in the way we consume resources and produce waste.

AFED reports have repeatedly emphasized the importance of promoting better efficiency and fair access to energy, water and food, and reducing waste, as there are limits to what ecosystems can provide. *The Arab Ecological Footprint Atlas* produced by AFED in 2012 showed that Arab countries consume twice as much resources as can be regenerated and assimilated by their natural systems. Thus, the 2015 AFED annual report, *Sustainable Consumption for Better Resource Management*, discusses how changing consumption patterns can help preserve resources and protect the environment, ultimately leading to sustainable development. This report comes at an appropriate time, coinciding with the adoption by the world leaders in September 2015 of the Sustainable Development Goals, which called in goal 12 to "ensure sustainable consumption and production patterns."

Over the last decades, rapidly growing populations, rural-urban migration, and perverse subsidies have contributed to a rising demand for energy, water, food, and other finite resources in the Arab region. Driven by economic growth, technological advancements, besides cultural and social factors, consumption patterns in most of the Arab region have witnessed dramatic changes. In many countries, the number of cars on the roads is increasing, leisure and business trips are becoming more frequent, and the ownership of household appliances and communication gadgets is growing. However, large disparities exist between Arab countries when looking at lifestyles and patterns and levels of consumption. Similarly, disparities exist between the rich and the poor, and between rural and urban communities. Depletion of natural resources can be caused by overconsumption of the rich, as well as desperate exploitation by the poor who are fighting for basic sustenance and survival at any cost.

Changing consumption habits requires persistent educational and public awareness efforts. This would include a combination of government policies and business strategies, encouragement of individual and societal actions and the involvement of civil society and academia, together with the media. Individuals need to change their consumption habits

and lifestyles towards more sustainable behavior. A sustainably responsible individual would consume less energy and water, and generate less wastes and CO_2 emissions.

For example, reducing consumption of red meat in the Arab region by only 25 percent, from about 17 kg per capita per year, would save about 27 billion cubic meters of water, considering that it takes about 16 cubic meters to produce 1 kg of red meat. With Arab population rising to about 650 million in 2050, water savings would amount to about 45 billion cubic meters. However, consumption is partly a social activity influenced by many socio-economic and cultural factors. It is worth noting that empirical studies on consumption behavior are rare in Arab countries – a gap that needs to be filled.

While it is true that changing consumption patterns requires adequate policies based on expert studies, the support of consumers is a prerequisite for successful implementation. In view of tracking how people perceive consumption and to what extent they are ready for positive change, AFED carried out a wide-ranging public opinion survey, which drew over 31,000 participants from 22 countries. The survey found that the Arab public is ready to pay more for energy and water and to change their consumption patterns if this will help preserve resources and protect the environment. A vast majority of over 80 percent said they would accept changing some aspects of their dietary habits, such as eating more fish and chicken than red meat, which is better for the environment as well as consumers' health. The survey showed a growing interest in resource efficiency, since about half chose electricity and fuel efficiency as the main criteria when buying an electrical appliance or a car. However, a vast majority, reaching 99 percent in some countries, thought that their governments were not doing enough to address environmental problems and that the environment in their countries had deteriorated over the past ten years.

The AFED report found that indiscriminate subsidies of water, energy and food promote wasteful consumption, and do not necessarily ease the burden on the poor – over 90 percent of the subsidies go to the rich. However, the report identified a clear trend for change in this regard, with six Arab countries implementing subsidy reforms over the past two years. AFED pioneered this drive since 2008, mainly in its reports "*Water*", "*Sustainable Energy*", "*Food Security*" and "*Green Economy*", which prioritized phasing out subsidies.

AFED wishes to thank all those who made this report possible, especially our institutional partners: Environment Agency- Abu Dhabi (EAD), Islamic Development Bank (IDB), Kuwait Foundation for the Advancement of Sciences (KFAS), Economic and Social Commission for West Asia (ESCWA), Food and Agriculture Organization (FAO), Kuwait Fund for Arab Economic Development (KFAED), United Nations Environment Program (UNEP), International Center for Advanced Mediterranean Agronomic Studies (CIHEAM), Oxford Institute for Energy Studies (OIES), American University of Beirut (AUB) and Arabian Gulf University (AGU), alongside all corporate and media partners who supported this endeavor.

AFED hopes that its report on sustainable consumption will help Arab countries adopt the appropriate policies to promote better management of natural resources, and to encourage the public to change their consumption habits to enhance efficiency and reduce waste.

Beirut, 16 November 2015

Najib Saab
Secretary General
Arab Forum for Environment and Development (AFED)

SUSTAINABLE CONSUMPTION

FOR BETTER RESOURCE MANAGEMENT IN ARAB COUNTRIES

2015 ANNUAL REPORT OF THE ARAB FORUM FOR ENVIRONMENT & DEVELOPMENT (AFED)

I. OVERVIEW

In 2009, an Arab Regional Strategy for Sustainable Consumption and Production (SCP) was adopted by the League of Arab States. This was one of the first such regional strategies to be developed before the RIO+20 summit, which had adopted the 10 Year Framework of Programs (10YFP) on SCP, in its main outcome document *The Future We Want*. Consequently, the Arab Region moved forward and became the first region to develop and adopt a Roadmap for Implementation of the 10YFP on SCP at the regional level in June 2013. However, as is the case in most Arab regional strategies, both the roadmap and the SCP regional strategy are far from being implemented at the national levels. Development and implementation of SCP strategies in most Arab countries are still lagging.

The determinants of demand on energy, water, and food in the Arab region include socio-economic contexts, level of development, population growth, rate of urbanization, scarcity of water resources, the harsh climate conditions, and pricing policies. However, the region is truly heterogeneous in terms of socio-economic contexts, level of development, and per capita income. Other factors contributing to variations of level of demand include governments' supply-oriented policies and lack of demand management. Thus, great disparities exist in per capita energy, water, and food consumption amongst different Arab countries according to differences in the preceding factors.

Over the past three decades, demand on water and energy in all Arab countries has increased dramatically as a result of increasing population and urbanization growth, improvements in the standard of living, changes in lifestyles, industrial development and efforts to increase food self-sufficiency. As most of the Arab region is among the most urbanized regions in the world, urbanization is another strong driver of demand on energy, water, and food due to changes in lifestyles and consumption behaviors.

These factors have made the Arab region one of the major energy demand centers in the world. Per capita energy consumption varies greatly between high-income group (oil producing countries) and medium and low-income group (non-oil producing countries). The per capita consumption in Qatar is 38.6 tons of oil equivalent (toe), which is the highest among Arab countries and twenty-fold the world average (1.9 toe). The per capita electricity consumption in Kuwait – the highest in the Arab region – is about seven folds the average Arab, and nearly five folds the world average. A Kuwaiti national would consume as much electricity as 13 Sudanese households of five persons each.

The AFED 2015 survey on sustainable consumption reveals, to some extent, the impacts of energy efficiency policies adopted by governments on consumers' purchasing decisions. Only 42 percent of the survey respondents considered electricity consumption as a criterion while purchasing an electrical appliance. The lowest percentage of those who buy electrical appliances based on efficiency was recorded in Qatar (9 percent) and the highest in Tunisia (57 percent) and Jordan (56 percent). These results clearly reflect the importance of adopting Minimum Energy Performance Standards (MEPS) for electrical appliance by governments. Similarly, 46 percent of the survey respondents consider fuel consumption while purchasing a new vehicle. Brand name and model of cars were the main purchasing factors in the GCC (countries with high income and very low fuel prices), at above 50 percent of the total. Fuel efficiency and price dominated as the main factors

for purchasing a car in Jordan, Egypt, Morocco, Lebanon, Iraq and Tunisia. The highest percentage of those who choose a car for its fuel efficiency was in Jordan (72 percent) and the lowest in Saudi Arabia (17 percent) and Qatar (16 percent), which reveals a clear direct relationship between car purchase decisions and fuel prices. The same survey results showed that the use of energy-saving lamps (like CFL and LED) is expanding in Arab countries, as 85 percent of the respondents use them. This indicates the wider availability of energy-saving lamps in the market with easy access to consumers due to governments' initiatives. Saudi Arabia and Qatar recorded low levels of domestic use of energy-saving lamps (35 percent) due to heavily subsidized electricity prices. On the other hand, high levels of penetration of efficient lamps came from Jordan and Syria (95 percent), Egypt (94 percent) and Lebanon (91 percent). Over the past few years, most of these countries have undertaken energy-saving initiatives, including price reforms.

The Arab region is one of the world's most water-stressed regions. However, the level of per capita consumption in many countries has inflated municipal/domestic water demands. The municipal water tariffs in the majority of the Arab countries are low, providing no incentive for the consumer to save water. Moreover, it seems that per capita municipal water consumption is closely related to the income levels of the countries as high-income GCC countries consume a significantly larger amount of water compared to other countries. The AFED survey results revealed that only 6 percent of the respondents consider low tariff as a main reason of excessive water consumption, whereas 77 percent are willing to pay more for their water consumption in return for better social benefits. Thus, governments' worries of water pricing need to be revisited if enhanced social benefits are considered.

The AFED survey results indicate, interestingly, that 72 percent of the respondents are aware of the facts concerning water scarcity in the region and 77 percent are aware that per capita water consumption is high as well. Furthermore, ironically, respondents from countries of the highest per capita water consumption have high level of awareness (UAE has a high awareness level of 92 percent, and Kuwait (90 percent)). Though 90 percent of respondents from the UAE are aware of the high levels of per capita water consumption, only 50 percent of them indicate that they use water-saving devices at home. This result raises questions on the reasons behind it – whether it is because of availability of those devices in the market, lack of awareness on their availability or economics of their use, or a combination of all – remains to be further investigated. These results show, as well, that public awareness is not enough to change consumption habits. Governments' interventions through demand side initiatives are inevitable to complement public awareness.

While many Arab countries are heavily dependent on food imports, the food consumption levels are generally in the upper middle range. Increased welfare is a major driver of food demand and changes in consumption habits in the region. So, Arab countries are experiencing a nutrition transition characterized by a shift away from a traditional, more seasonal, and more diverse diet, rich in whole grains, fruits, and vegetables, towards a 'westernized' diet that is high in refined cereals, animal protein, fats, sugar, and salt. Although the rate of under-nutrition and underweight, particularly among under-five years children, has been on the decline in some Arab countries, there has been a parallel dramatic increase in the prevalence of overweight, obesity, and diet-related non-communicable diseases such as diabetes, cardiovascular disease, and cancers.

Many harmful components of the Arab diet are also examples of foods that have a negative impact on the sustainability of the current food system and hence on food and nutrition security. For example, red meat is currently over-consumed which has negative impacts on both human health and sustainability of the food system, while fish and poultry are protective foods that are under-consumed although they have the potential to be produced in a sustainable manner with less impact on the environment. Thus, changing dietary habits is a crucial issue involving intricate social and cultural values and traditions. When asking the Arabs whether they are ready to change their dietary habits to protect the environment or the public health, the answers were surprisingly positive: 84 percent of the respondents were ready to do so to save the environment, while an astounding majority of 99 percent went for it if it would protect health, such as fighting obesity, diabetes and blood fats. Thus, a good approach to promote positive change in food consumption patterns in the region is to put more emphasis on the health benefits, as they are more easily noticed by the public.

For example, reducing consumption of red meat in the Arab region by only 25 percent, from about 17 kg per capita per year, would save about 27 billion cubic meters of water, considering that it takes about 16 cubic meters to produce 1 kg of red meat. With Arab population rising to about 650 million in 2050, water savings would amount to about 45 billion cubic meters.

Water security, energy security and food security are inextricably linked in the Arab region, perhaps more than in any other region in the world. The region is known to be energy rich, water scarce, food deficient, and one of the world's most economically and environmentally vulnerable regions to climate change. This calls for the adoption of the nexus approach when addressing the management of the three vital resources of energy, water, and food. In addition, climate change, which is mostly driven by energy use and land use changes, is another challenge that would exacerbate the scarcity situation of natural resources. With a high proportion of arid and semi-arid land and scarce water supplies, alongside in some cases poor and unsustainable agricultural practices, the Arab region finds itself facing a food security challenge. With the current limited cultivated land in the region and considering the dominant method of agriculture being rain-fed, the region's food supplies and agricultural needs are highly vulnerable to the adverse effects of climate change, especially incidents of extreme weather events such as droughts and floods that have been notably more prevalent in the region.

This strong interdependency between energy, water, food, and climate change makes it imperative that policy formulation becomes coordinated, particularly with respect to mitigation of and adaptation to climate change. Conventional policy-making in 'silos' therefore needs to give way to an approach that reduces trade-offs and builds synergies across sectors. This new development has created unprecedented opportunities for fundamental policy changes in various economic, institutional, technological, and social systems. However, it is important to acknowledge that there has been weak or lack of real coordination in the Arab region in terms of policies and strategies for water, agriculture land, energy, and climate change. Climate change policies, in infancy stages in the Arab region, are still being fragmented between different entities.

Most of the Arab countries have had a long history of subsidizing energy, water, and food prices for different reasons. The long history of energy subsidy has been a major barrier to promoting energy efficiency and other sustainable energy options.

Pricing water has been a contentious issue in most of the Arab countries due to perceived cultural and religious considerations. For example, the average price charged for water in the Arab region is about 35 percent of the cost of production, and in the case of desalinated water it is only 10 percent. Setting proper pricing policies can convey to consumers the real value of water and motivate users to treat it as such, driving them to increase its productivity and rationalize its use. In addition, Arab governments maintain their obligations to the social contract by providing low-priced food and other goods and services to the population. As a result, food subsidies are perceived to be important in promoting political stability.

Experience shows that subsidies in the region only promote wasteful consumption behavior, and do not help to ease the burden on the poor, as over 90 percent of the general subsidies go to the rich. A recent study by the World Bank show that low-income households in Tunisia receive only 2 percent of energy subsidy while high income households receive about 67 percent of the subsidy on gasoline and 60 percent of the subsidy on diesel. The same World Bank study showed that for food subsidies in rural Upper Egypt, the richest quintile received about 48 percent more in per capita benefits than the poorest group.

AFED public survey results underline the fact that the rich are benefiting most from subsidies in the region. They showed that the cost of food constituted the largest portion of the family income – over 10 percent for 62 percent of the survey respondents. In contrast, only 4 percent of the respondents spent more than 10 percent of the family income on water and electricity. Those who paid the lowest percentages for electricity compared to family income were residents of the GCC (countries with high per capita income and heavy energy subsidies). Furthermore, when asked about the major causes of energy and water inefficiency, only 6 percent of the respondents consider heavy subsidy as the main reason, while 43 percent think it is a combination of harsh climate conditions, lack of public awareness, and subsidies.

In their search to reverse these trends, Arab countries have varying price reform experiences. During the period of 2013-2015, six Arab countries implemented subsidy reform efforts: Egypt, Jordan, Tunisia, Sudan, Yemen, and the UAE. In addition, four countries – Morocco, Jordan, Tunisia, and the UAE – have implemented price adjustment mechanisms where domestic fuel prices are periodically reviewed and adjusted in accordance with international levels. An interesting response of the AFED survey, worth to consider while planning to reform energy and water pricing in the region, shows that 77 percent of the respondents agree to pay more for water and energy if compensated with additional social benefits such as education, health insurance and adequate pensions. Thus, if accompanied by effective mitigation measures, reforming subsidy regimes in the Arab region could be a powerful tool for governments to simultaneously address those very profound socio-economic grievances that have contributed to the outbreak of social unrests known as the “Arab Spring”.

In order for the Arab countries to gradually shift to SCP, every country, based on its respective socio-economic circumstance, needs to identify priority actions and enabling conditions necessary to facilitate that transition. These enabling conditions include: good governance, integrated policy planning, sound regulatory regime, use of market-based instruments, capacity development, access to finance and investments, research and development, public awareness, and green procurement.

II. REGIONAL CONTEXT OF SCP

Sustainable consumption and production (SCP) was defined by the Norwegian Ministry of Environment during the Oslo Symposium in 1994 as: "The use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations" (UNEP, 2010).

It was first recognized during the UN Conference on Environment and Development (UNCED) held in 1992 in Rio de Janeiro. The conference's major outcome, Agenda 21, identified in its chapter 4 unsustainable consumption and production patterns as a major cause of the persistent deterioration of the global environment (UNCED, 1992). Ten years later at the World Summit on Sustainable Development (WSSD) in 2002 in Johannesburg, Chapter 3 of the Johannesburg Plan of Implementation (JPOI) was on "Changing Unsustainable Patterns of Consumption and Production", and it called for the development of a 10-Year Framework for Programs (10 YFP) to accelerate the shift towards sustainable consumption and production (SCP).

The JPOI emphasized the need to accelerate the shift towards SCP, to promote social and economic development within the carrying capacity of ecosystems by addressing and, where appropriate, delinking economic growth and environmental degradation by improving efficiency and sustainability in the use of resources and production processes, and to reduce resource degradation, pollution and waste (WSSD, 2002). A global multi-stakeholder initiative, the so-called Marrakech Process, was launched in 2003. As a global effort to promote progress on the implementation of Sustainable Consumption and Production, it responded to the call of the JPOI by supporting the implementation of SCP programs, projects and policies and helping to construct the 10 YFP. In addition, seven task forces have been launched voluntarily in the context of Marrakech Process. These task forces support the development of SCP tools, capacity building and the implementation of SCP projects on some specific issues such as sustainable products, sustainable lifestyles, sustainable public procurement, sustainable tourism, sustainable buildings and construction, and education for sustainable consumption (UNEP, 2010).

The council of Arab Ministers Responsible for the Environment (CAMRE) organized in 2008 in Al-Ain, UAE, a roundtable meeting of experts on sustainable consumption and production, in cooperation with international organizations. The main objectives of the meeting were to identify key regional priorities on sustainable consumption and production, present ongoing initiatives on SCP in the Arab region, contribute to the Marrakech Process and provide regional feedback on the elaboration of the 10-Year Framework of Programs on SCP, and build more cooperation between the region and Marrakech's stakeholders such as development agencies, business and NGOs. The meeting called for preparing a draft regional sustainable consumption and production strategy in the Arab region as a contribution to the Marrakesh 10 Year Framework process (10YFP). The main outcome of the roundtable included the identification of the Arab regional SCP priorities as energy, water, waste, rural development and poverty eradication, education, sustainable lifestyles and tourism. Those regional priorities address a set of major development challenges facing the Arab region including scarcity of water

and land resources, food security, unsustainable consumption patterns, rapid urbanization, inadequate waste management, and the urgency of promoting the concepts and tools of sustainable tourism in order to preserve cultural and natural heritages.

Consequently, in 2009 an Arab Regional Strategy for Sustainable Consumption and Production was adopted by the League of Arab States to "promote the concept of sustainable consumption and production in the Arab region through encouraging the utilization of products and services that ensure environmental protection conserve water and energy as well as other natural resources, while contributing to poverty eradication and sustainable lifestyle" (LAS, 2009). The Arab Strategy on SCP was among the first such regional strategies to be developed and adopted at the regional level prior to the RIO+20 summit in 2012, of which the outcome was the 10 Year Framework of Programs on Sustainable Consumption and Production. This was consequently adopted by the main outcome document of Rio+20, entitled "The Future We Want" and was a major step to enhance international and regional cooperation, and to accelerate the shift towards SCP in both developed and developing countries.

The implementation of SCP as an integrated approach helps to achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty. One of the SCP's main goals is to 'decouple' economic growth and environmental degradation by improving resources efficiency in the production, distribution and use of products, and aiming to keep the energy, material and pollution intensity of all production and consumption activities within the carrying capacities of the natural ecosystems. Further, SCP promotes "lifecycle thinking" to enhance sustainable management of resources. With this lifecycle approach, SCP would accelerate the transition to an eco-efficient economy and turn environmental and social challenges into business and employment opportunities, while decoupling economic growth from environmental degradation.

The Arab region moved forward and became the first region to develop a Roadmap for the Implementation of the 10YFP on SCP at the regional level, during the 4th Arab Roundtable on SCP in June 2013. During the same year the Roadmap was adopted by CAMRE. However, as is the case in most Arab regional strategies, both the roadmap and the SCP regional strategy are far from being implemented at the national levels. SCP policies are not identified as such at the national level in most Arab countries, and development and implementation of SCP strategies in all Arab countries are still lagging. Some elements of SCP policies are integrated in national development plans or strategies aimed at achieving economic sustainability, as in the case of the Tunisia Sustainable Development Strategy, Bahrain's Vision 2030, and others. Many Arab countries, according to their respective circumstances, have adopted policies that focus on energy, water, food, waste, and poverty eradication. For example, the National Cleaner Production Centers (NCPCs) in Egypt, Morocco, UAE, Jordan, and Lebanon have been supporting industries by generating knowledge on resource-efficient practices and providing technical assistance to small and medium enterprises (SMEs). NCPCs contribute to improved resource efficiency through the implementation of cleaner production methods, by providing technical assistance to enterprises, training for national experts, information dissemination and technology transfer, policy advice, and Cleaner Production technology and investment promotion. Civil society organizations (CSOs), such as AFED, have also played a key role in making sure that SCP remains on both government and business agendas. AFED's flagship reports on energy, water, food security, climate change, green economy and sustainable consumption shed light on SCP priorities of the Arab region and contribute to achieving the objectives of Arab regional strategy on SCP.

III. DRIVING FORCES FOR DEMAND ON ENERGY, WATER, AND FOOD

Arab countries are truly heterogeneous in terms of socio-economic contexts, level of development, and per capita income. Human development indicators vary dramatically between the rich hydrocarbons-endowed countries such as the GCC and the least developed countries as in Yemen, Sudan, and Mauritania. Thus, the

determinants of demand on energy, water, and food, as well as lifestyles and patterns of consumption, vary accordingly. In the Arab region, one can generally summarize the drivers of demand on energy, water, and food as follows:

A. Economic structure and growth

Since 2005, the Arabs' GDP increased from nearly US$1.2 trillion to about US$1.6 trillion, with a compound annual growth rate of 4.7 percent, which surpassed the population growth (2.2 percent) leading to a growth of per capita income at 2.8 percent annually (Table 1). The growth of income is typically a strong driver of demand on resources, goods and services. It is worth to note, however, that economic performance of Arab countries in 2011 was affected by the historic political transition in a number of countries such as Tunisia, Egypt, Libya, Syria, and Yemen. This political turmoil has led to unprecedented decline in total output, exports, tourism inflows, foreign direct investment (FDI) and decline in workers' remittance, leading in turn to economic recession in most of these countries.

In terms of energy consumption, the economic structures of Arab countries also vary between energy intensive economies as in the GCC, and more diversified economies as in Egypt, Tunisia, and Sudan. Great disparities exist in energy consumption per capita amongst different Arab countries according to their levels of income. Energy poverty is strongly correlated to per capita income, with more than 30 million Arabs lacking access to modern energy services.

Domestic water consumption per capita varies considerably in the Arab region as well, both among and within countries. In the GCC countries, it ranges from 300 to 750 liters per day, which ranks among the highest in the world. These differences are attributable to many factors, including government subsidies, lack of demand management, and governments' supply-oriented policies.

In addition, whilst many of the Arab countries are heavily dependent on food imports, they span a wide range of income levels ranging from low income (e.g. Sudan), through those in middle-income range (e.g. Egypt) to the high-income range (e.g. GCC).

While extraction and manufacturing represent more than 50 percent of the Arab economy, the majority of water resources in the region are being used for agriculture (85 percent), which contributes 5.6 percent to the total GDP (JAER, 2012). In addition, municipal and the industrial sectors consume about 8 percent and 7 percent of the total water use, respectively (Figure 1).

B. Population growth

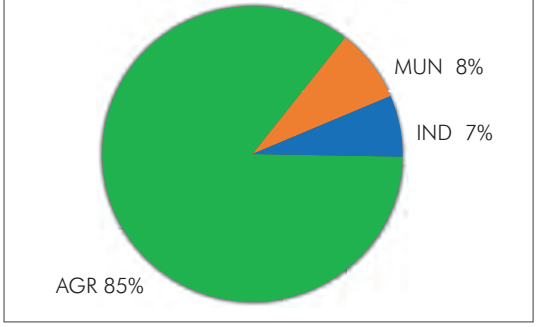
Table 1 shows that population of the Arab countries grew by 2.2 percent annually between 2005 and 2012, which represents another major

TABLE 1 GROWTH OF PRIMARY ENERGY, POPULATION, INCOME, AND GDP IN THE ARAB REGION

	2005	2006	2007	2008	2009	2010	2011	2012*	CAGR
Primary Energy (MTOE)	2,477	2,473	2,558	2,603	2,909	2,965	2,782.14	2,856.4	2.05
Population (million)	309	317	326	337	344	352	361	360	2.22
GDP (billion US$)**	1,161	1,245	1,315	1,363	1,386	1,456	1,508	1,602	4.70
Per capita income (US$)	3757.3	3927.4	4033.7	4044.5	4029	4136.4	4178.8	4443.8	2.84

*Figures of 2012 exclude South Sudan. UN Population Prospects Revision shows that the Arab population reached over 370 million in 2013. In 2015, the figure is about 392 million and is projected to reach about 659 million in 2050 (Medium Variant). **Source: GDP (constant 2005US$), World Bank, WDI

FIGURE 1 SECTORIAL WATER DEMAND



driving force for energy, water, and food demand. During the past three decades, water and energy demands in all Arab countries have increased dramatically as a result of increasing population and urbanization growth, improvement in the standard of living, industrial development and efforts to increase food self-sufficiency. The total primary energy consumption has increased from nearly 2.5 billion ton oil equivalent (TOE) in 2005 to about 2.9 billion TOE in 2012 (5.7 percent annually). Similarly, total water use for all sectors in the Arab region increased dramatically from about 190 billion cubic meters (BCM) in the mid 1990s (ACSAD, 1997) to about 255 BCM in 2010 (UNDP, 2013), while during the same period the population increased from about 260 million to about 360 million (UNDESA, 2012).

C. Rate of urbanization

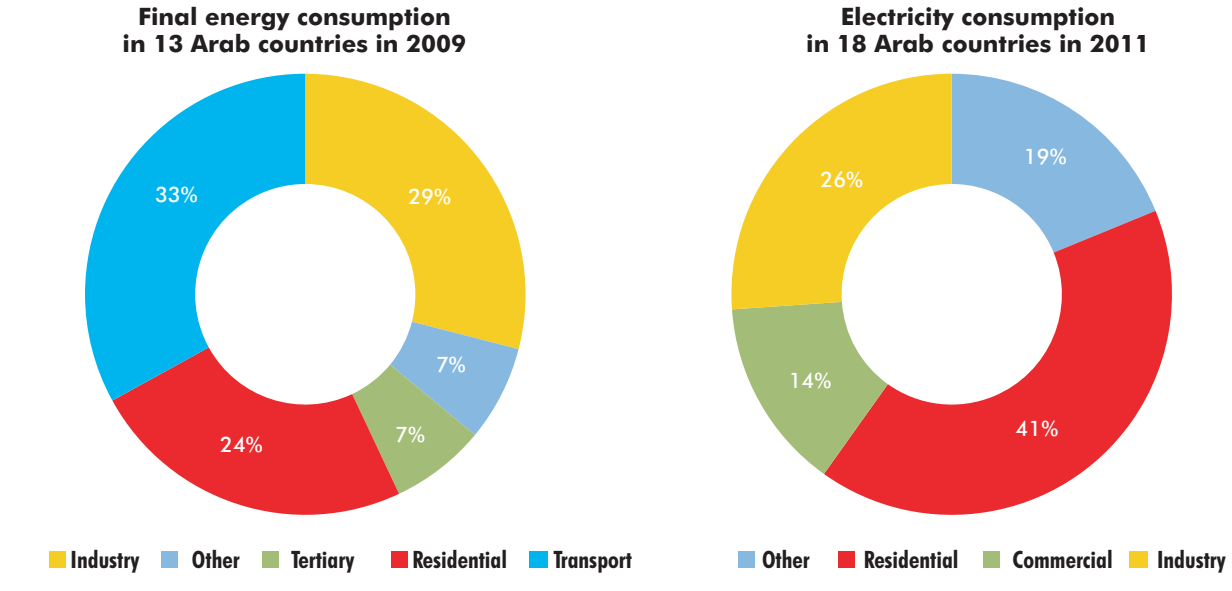
The Arab region is one of the most urbanized regions in the world. In 2010, the Arab population reached 352 million, with 56 percent living in cities. By 2050, the population will reach 646 million, of which 68 percent will live in urban areas. Disparities exist across sub-regions such as the GCC, where urbanization levels reach 80 percent, and the least developed Arab countries, which are characterized by rapid urbanization based on conflict, environmental degradation, severe droughts, and rural poverty (Habitat, 2013). Urbanization is another strong driver of demand on energy, water and food due to changes in lifestyles and consumption behaviors.

D. Welfare

According to the World Bank, the average per capita income of the Arab countries has increased from US$3,796 in 2005 to US$4,449 in 2013 with an annual growth rate of 2.56 (World Bank, 2015). A huge difference exists in the income of Mauritania of US$1,189 and Qatar of US$107,427. Increase in income would drive households to buy more electrical appliances or cars, and thus induce growth of energy demand. Empirical data of car and appliances ownerships in the region rarely exists. Home surveys need to be done in different countries to collect this data, as a crucial pre-requisite to energy demand analysis at the end use. This is especially important in the region as the residential sector consumes more than 40 percent of the total electricity (Figure 2).

Generally, enhanced welfare is a major driver

FIGURE 2 ENERGY DEMAND



Source: RECREEE & Plan Bleu study (2012); AUE (2011)

of food demand as well. Arab countries are experiencing a nutrition transition characterized by a shift away from a traditional, more seasonal, and more diverse diet, rich in whole grains, fruits, and vegetables, towards a 'westernized' diet that is high in refined cereals, animal protein, fats, sugar, and salt (Johnston et al., 2014). Factors driving this transition include economic growth and increased incomes, globalization of trade and marketing, and rapid urbanization.

E. Scarcity of water resources

Though the Arab region is energy rich, it is one of the most water-scarce regions in the world. Most of the Arab countries cannot meet current water demand, and the situation is likely to get worse due to changes of precipitation patterns as a result of climate change. Some 60 percent of the region's water flows across international borders, further complicating the water resource management situations. Drinking water services will become more erratic than they are already, cities will come to rely more and more on energy intensive desalination, driving more energy demand and producing more GHG emissions. Water and energy are also strongly interdependent in the whole value chain of both water and energy, such as pumping and transferring underground water or use of water resources to produce hydropower, and using fresh water for cooling of thermal power plants. Furthermore, agriculture uses 85 percent of the water consumption with a very low level of water productivity (Fig 1). The different nexus between energy, water, food, and climate change in the region is evident, an issue that is further elaborated in the energy background paper.

F. Harsh climate conditions

Most of the Arab region is characterized by harsh climate conditions of arid and semi-arid areas. This necessitates the use of air-conditioning during a prolonged time of the year. For example, the air-conditioning load in buildings in the UAE constitutes more than 60 percent of the total energy consumption (Afshari et al., 2014). Water demand in the GCC depends mainly on seawater desalination, which is an energy-intensive process. Thus, harsh climate is a major cause of increased energy and water demands in the region, a situation that will worsen due to projected global warming.

G. Urban planning, and communication technology

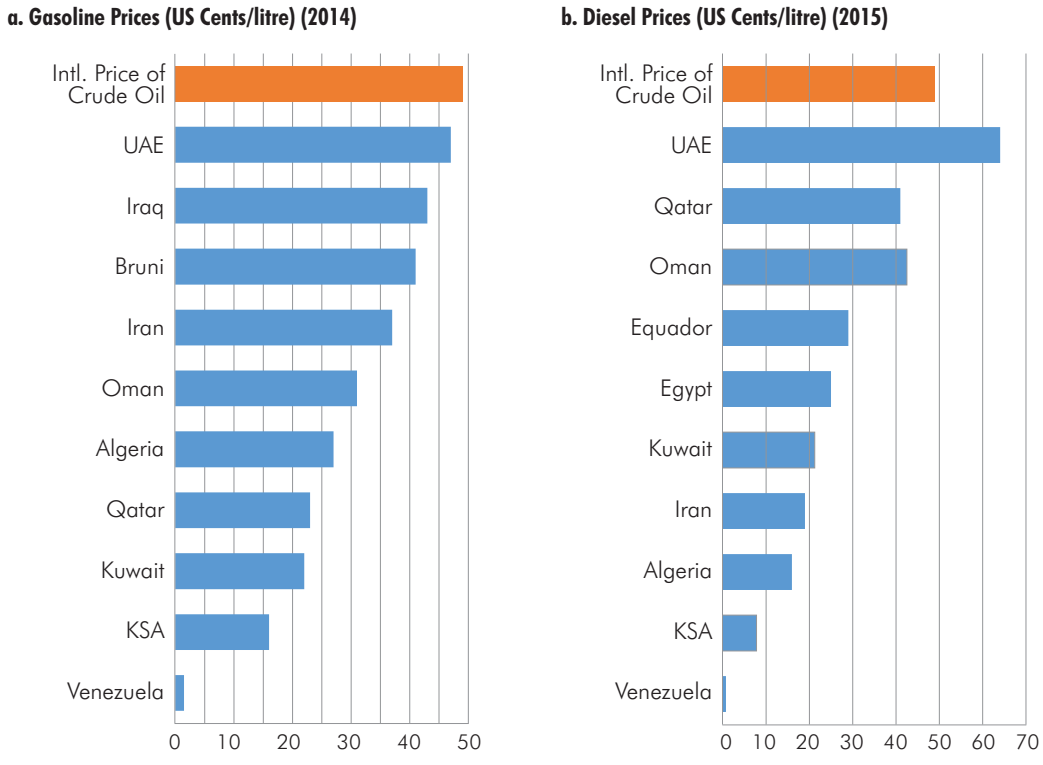
Urban planning is an important determinant of demand on transport fuels. Proper urban planning would reduce travel needs by changing land-use patterns and improving communications. Land-use, transport, and fuel demand are closely related. Some parts of the Arab region, as is the case in the GCC, have the unique advantage of their urban expansion with appropriate incentives for more efficient and environmentally sound patterns. Old Arab cities such as Cairo, Damascus, and Baghdad have limited opportunities for proper urban expansions, leading to traffic congestions and deteriorated air quality. In addition, recent advances of communication and information technology (ICT) offer a range of modern user services for increasing efficiency of travel and transportation of freight, leading to dramatic fuel savings. For instance, Dubai Transport Corporation (DTC) provides taxi services using an automatic vehicle location (AVL) and tracking system based on Global Positioning System (GPS) technology.

H. Pricing policies

Most of the Arab countries have had a long history of subsidizing energy, water, and food prices for different reasons. Governments rely on subsidies as a form of social protection to meet several objectives including fighting poverty. Moreover, subsidies are used to shield the population from shocks caused by large swings in commodity prices, particularly in fuel and food importing countries. They are also being used to distribute natural resource wealth among the population, especially in oil-producing countries, as is the case in the GCC. Some governments also use producers' subsidies to boost certain industries in order to address social issues such as unemployment. Producers' subsidies of some energy-intensive industries, such as petrochemicals, are also being used to enhance economic competitiveness and diversification in the GCC sub-region.

In the hydrocarbon–rich countries (e.g. GCC, Libya, Iraq), fuel subsidies are reflecting the low cost of domestic extraction. On average, diesel and gasoline prices in the Arab region are lower than in any other region. Gasoline and diesel prices are below the lowest price in the European

FIGURE 3 **GASOLINE AND DIESEL PRICES (US CENTS/LITRE)**



Source: GTZ, 2010

Union, and in a majority of countries, prices at the pump are lower than the prices in the United States (Figures 3a & 3b)

Electricity subsidies are wide spread in the region, but their magnitude is difficult to be accurately estimated, due to lack of data. The International Energy Agency (IEA) estimated that energy subsidies amount to more than 10 percent of the GDP in some Arab countries (Table 2)

Pricing water has been a contentious issue in most of the Arab countries due to perceived cultural and religious considerations. While water pricing has been advocated for a long time, particularly in irrigation, it is seldom enacted even though it is central to increased investment in the sector. Artificially low prices for water services (and sometimes no pricing at all) are a major cause of inefficiency, overuse, and excessive environmental degradation. Yet most of the Arab countries continue to resist water pricing and phasing out of subsidies, arguing that the poor cannot afford to pay (AFED, 2012). For example, the average price charged for water in the Arab region is about 35 percent of the cost of production, and in the case of desalinated water it is only 10 percent. However, setting proper pricing policies can convey to consumers the real value of water and motivate users to treat it as such, driving them to increase their productivity and rationalize their use. The attachment of economic value to water, based on the perception that water is a marketable commodity, whose value is set by the law of demand and supply, would promote conservation, efficiency, and encourage privatization in the development, treatment, and distribution of water resources. A progressive water tariff ensures that basic human needs for fresh water are met at a low price, while excessive use is priced at a tariff that reflects cost.

The provision of food subsidies in many Arab countries is a powerful symbol of the broader social contract between governments and the population, in a system where political

participation is limited and governments maintain their obligations to the social contract by providing low-priced goods and services to the population. As a result, food subsidies are perceived to be important in promoting political stability. On the other hand, food subsidies in the Arab region have mostly been seen as biased against farmers and in favor of urban consumers. The downward pressure on agricultural prices leads to low agricultural revenue, which increases rural to urban migration, with all the adverse socioeconomic consequences. For all these reasons, poverty in the Arab region is usually associated to rural areas or slum urban areas, where population is of a rural origin.

Generally, the most common type of subsidy in the Arab countries is the generalized price subsidy, whereby goods and services are made available at artificially low prices to the entire population. Across-the-board food-subsidy programs, which are wide spread in the region, create a substantial fiscal burden, especially during the food-price shocks. In countries such as Syria, Jordan, and Egypt, which have across-the-board subsidies, the food subsidies exceed one percent of the GDP and could become a major fiscal problem in the event of future price shocks (Figure 4).

Despite food subsidies in the region, according to the AFED public survey results, cost of food constituted the largest portion of the family income, compared to water and energy, as it was over 10 percent for 62 percent of the respondents. In contrast, only 4 percent of the respondents spent over 10 percent of the family income on water and electricity.

Subsidized foods that are made available to all sectors of the population may encourage overconsumption by those above the poverty line. For example, subsidies on unhealthy foods such as sugar and cooking oil can make a balanced diet less attractive because unhealthier alternatives become more affordable. Obesity, high intake of animal fat, and low intake of dietary fiber are risk factors for chronic non-communicable diseases such as coronary disease, diabetes mellitus, and colon and breast cancer.

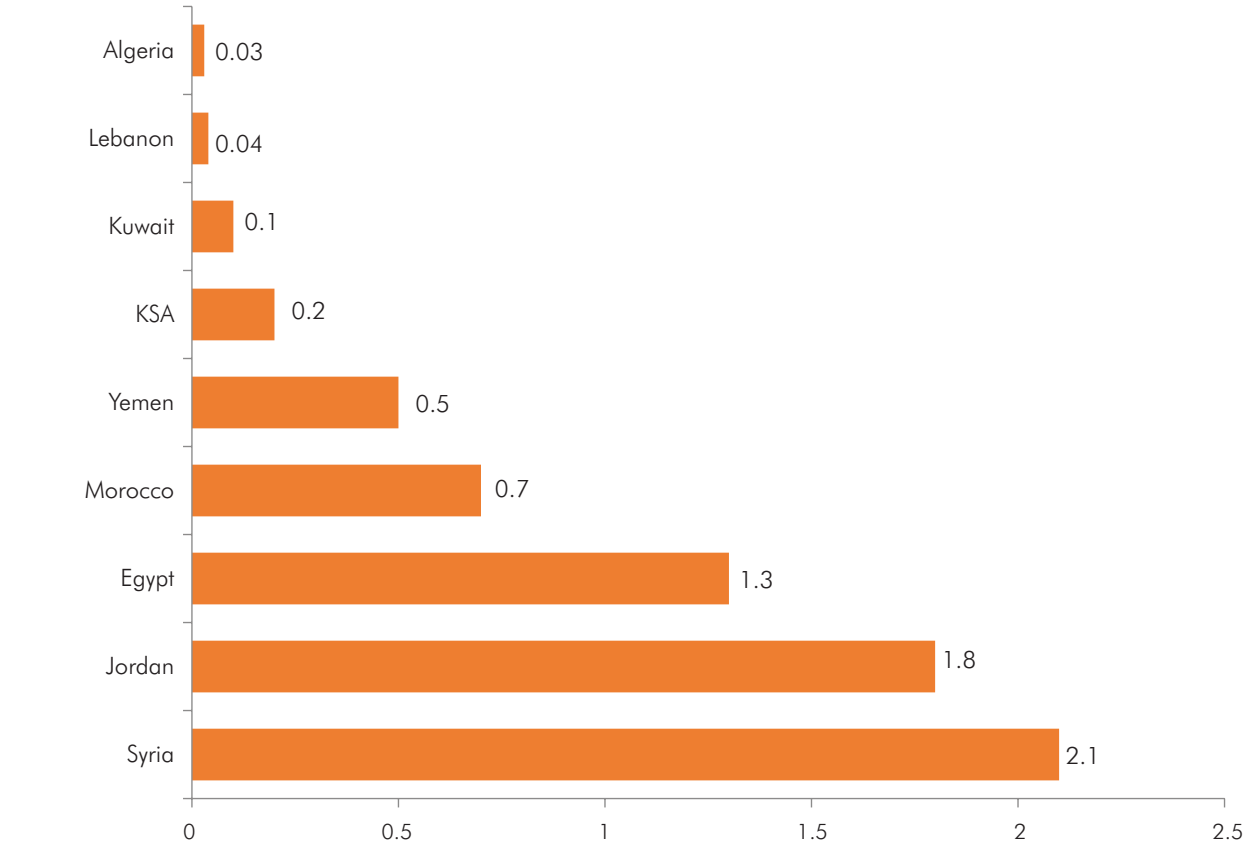
The experience of subsidies in the region only promotes waste, and does not help to ease the burden on the poor, as over 90 percent of the general subsidies go to the rich (AFED, 2014). A recent study by the World Bank showed that low-income households in Tunisia receive only 2 percent of energy subsidy while high-income households receive about 67 percent of the subsidy on gasoline and 60 percent of the subsidy on diesel. In Egypt, inflatable subsidies (9 percent of GDP) have kept Egypt's fiscal deficit at an exceptionally high 13.7 percent of GDP. The same

TABLE 2 **ESTIMATES OF ENERGY SUBSIDIES IN SELECTED ARAB COUNTRIES, 2010**

	Average Rate of Subsidization (%)	Subsidy ($ per person)	Total Subsidy (% of GDP)	Subsidy by Fuel			Total Subsidy (US$ bn)
				Oil	Gas	Electricity	
Algeria	59.80	298.40	6.60	8.46	0.00	2.13	10.59
Libya	71.00	665.00	5.70	3.17	0.26	0.78	4.21
Egypt	55.60	250.10	9.30	14.07	2.40	3.81	20.28
Saudi Arabia	75.80	1,586.60	9.80	30.57	0.00	12.95	43.52
Iraq	56.70	357.30	13.80	8.87	0.28	2.16	11.31
Kuwait	85.50	2,798.60	5.80	2.81	0.90	3.91	7.62
Qatar	75.30	2,446.00	3.20	1.15	1.41	1.59	4.15
UAE	67.80	2,489.60	6.00	2.65	9.99	5.51	18.15

Source: IEA

FIGURE 4 **FOOD SUBSIDIES AS PER CENT OF GDP IN SELECTED COUNTRIES (2007)**



Source: World Bank, FAO, IFAD (2009)

World Bank study showed that for food subsidies in rural Upper Egypt, the richest quintile received about 48 percent more in per capita benefits than the poorest group (World Bank, 2014).

It is thus evident that subsidies have been a major cause of over consumption of the three resources of energy, water, and food in the Arab region. Though subsidies are generally considered a crucial element of the social safety nets, experience proves that they encourage wasteful consumption behavior while they are not benefiting the targeted poor population.

On search for reversing these trends, different Arab countries have a variety of price reforms experiences. During the period of 2013-2015, six Arab countries implemented subsidy reform efforts: Egypt, Jordan, Tunisia, Sudan, UAE and Yemen. In addition, four countries, Morocco, Jordan, UAE and Tunisia, have implemented price adjustment mechanisms where domestic fuel prices are periodically reviewed and adjusted in accordance with international market levels. Very recently, the UAE announced that a fuel committee would review local fuel prices against average international levels every month, and make adjustments accordingly. Given the current relatively low price of oil, it would seem to be an opportune time to reform fuel subsidies without causing a sharp spike in inflation or the cost of living in the short term. In addition, increases in fuel prices will make public transport more viable, and would push people to change their transportation habits such as encouraging the use of public transportation or use of more efficient vehicles. Overall, lower car use will translate into less congestion and reduced pollution, and is a key part of meeting the country's environmental goals. Furthermore, successful implementation in

OPINION

USING THE ECOLOGICAL FOOTPRINT INITIATIVE TO DRIVE SUSTAINABLE CONSUMPTION AND PRODUCTION IN THE UAE

Razan Khalifa Al Mubarak

We all consume resources every day, some directly and some unseen as a result of the full life cycle of goods. In general, wealthier individuals tend to consume more, meaning that the growth of the middle class and an increase in the overall population leads to consumption accelerating at an unsustainable rate. This produces a vicious circle with economic growth leading to increased consumption of raw materials and energy, increased emissions, pollution and generation of waste.

The starting point to break this circle is to understand patterns of consumption and then try to decouple consumption and emissions from growth. In 2006, the Living Plant Report ranked the UAE as the country with the highest per capita ecological footprint when compared to 150 countries. In response, a federal project, the Ecological Footprint Initiative, was launched to fully investigate our footprint, to verify the data that goes into the calculation of the footprint value, understand the impacts of a high footprint, and to develop science-based policies that will result in a measurable reduction in the UAE's footprint. This made the UAE only the third country to conduct a detailed ecological footprint investigation after Japan and Switzerland.

The UAE Ecological Footprint Initiative is a partnership between the Ministry of Environment and Water, Environment Agency – Abu Dhabi, Emirates Authority for Standardisation and Metrology, Emirates Wildlife Society in association with WWF (EWS-WWF), and the Global Footprint Network. It is a collaborative effort that involves both government and civil society. The Initiative is governed by a Steering Committee chaired by HE Dr Rashid bin Fahad, the UAE Minister of Environment and Water, and includes representatives from the partnership as well as those from other key energy and environment agencies – both federal and emirate-level.

With over 6,000 data points for each country, the Ecological Footprint approach developed by the Global Footprint Network is comprehensive. At a global level there has been a shift in the trends over time. In the 1960s cropland represented approximately 50 percent of humanity's footprint, yet by 2008 this had dropped to 10 percent. In contrast, in the 1960s the carbon footprint component represented approximately 10 percent, but by 2008 this had risen to 50 percent. The differences between the footprint of high, medium and low-income countries is also evident. Carbon represents 25 percent of the footprints of low-income countries while it represents 46 percent of middle and 76 percent of high-income countries in 2005. At a global level it is clear where we need to focus our efforts. We need to significantly reduce the carbon emissions of high-income countries and take the appropriate action to prevent middle and low-income countries following the same trajectories that will also lead to them becoming high carbon emitters. The profile of the UAE footprint is consistent with that of high-income countries and is dominated by carbon emissions, and we have found that our per capita consumption of electricity and water is very high compared to other countries.

In terms of greenhouse gas emissions, we find that in Abu Dhabi in 2010 the biggest contributing sector is energy, contributing 72.6 percent of emissions. After energy, the other contributing sectors are industrial processes (18.1 percent), waste (6.9 percent) and agriculture (2.4 percent). According to the UAE GHG Inventory 2013, electricity and water contribute 33 percent of the total GHG emissions, followed by road transportation at 22 percent.

Armed with this knowledge, we have started to take appropriate actions to reduce our carbon emissions.

On the electricity supply side, the UAE is diversifying away from 100 percent fossil fuels to reduce carbon emissions and enhance security of supply by including nuclear and renewables in the mix. By 2021, we aim to have 24 percent from these sources. In March 2013, His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the United Arab Emirates and Ruler of Abu Dhabi, officially inaugurated Shams 1, at the time the largest concentrated solar power plant (CSP) in operation in the world. Located in the Western Region of Abu Dhabi, the 100-megawatt, grid connected power plant is generating enough clean energy to power 20,000 homes in the UAE. Work on the nuclear power plants is well underway with the first of four units due to be operational by 2017.

On the demand side we have also made progress

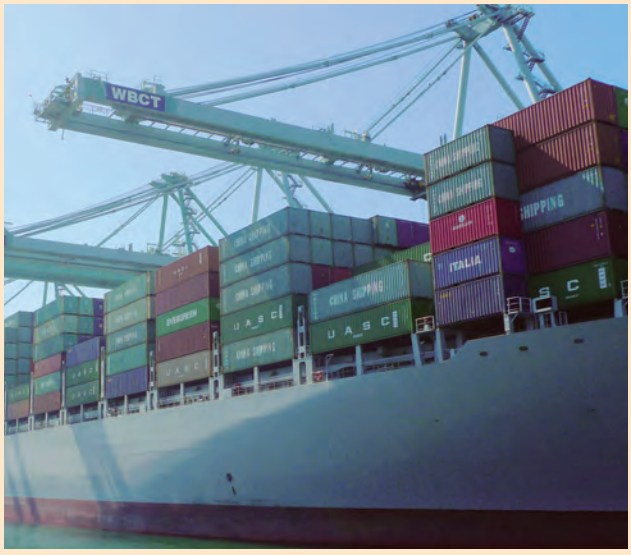
and are targeting cooling, lighting, overall building design, transport, and consumer behaviour change, by increasing awareness and the introduction of more cost reflective tariffs.

The Emirates Authority for Standardisation and Metrology (ESMA) has an energy efficiency rating system for air conditioning systems. ESMA's scheme is targeted at improving the quality of air conditioners available in the market and moving consumer choices towards more efficient products. In Abu Dhabi, based on the results of the 2010 Air Conditioning Maintenance Pilot Project, the Executive Affairs Authority was given a mandate in 2012 to develop a comprehensive cooling plan for the Emirate. This plan reflects five key activities including chiller maintenance, system balancing, and isolation of excess chiller capacity. The pilot study found that there was a potential to reduce electricity use for cooling by approximately 31 percent if appropriate measures are taken. A full-scale implementation is now being planned.

Energy used for lighting has also been targeted with the introduction of the UAE indoor lighting regulation, which came into force on 1st January 2014. This standard bans the import and sale of inefficient and low quality light bulbs, leading to significant energy reductions and cost savings. A retail ban on inefficient lighting products that do not meet the standard was enforced in January 2015.

Sustainability of buildings and community design has been improved through the implementation of ESTIDAMA and the Pearl Rating System (PRS). The PRS encourages water, energy and waste minimization, local material use and aims to improve supply chains for sustainable and recycled materials and products. In Abu Dhabi there are now over 12,000 villas that have a pearl rating, with the majority achieving two pearls. The aim is for more buildings to be brought within the pearl rating system in the future and to encourage developers to achieve a higher pearl rating.

We have also reduced carbon emissions related to transport by progressing mass transport options. In Abu Dhabi, the first phase of the Etihad Rail network for freight transport is now operational on a testing basis. A single freight train can carry the load of 250 trucks, and results in a 60 percent reduction in carbon emissions. The metro in Dubai also transports over 500,000 passengers per day, leading to a significant reduction in car journeys. Next we aim to focus on the emissions from road vehicles by developing a UAE vehicle fuel economy policy, which has the theoretical potential to reduce carbon emissions by ten times more than the lighting standard.



WHAT HAVE WE LEARNT FROM THE ECOLOGICAL FOOTPRINT INITIATIVE?

Embarking on the federal project to fully assess the UAE footprint has enabled us to verify and refine data where necessary, to better understand the detailed breakdown of the overall footprint and carbon emissions, and to target our response. The verification of UAE National Footprint Accounts has aimed at ensuring that the most accurate and locally representative data is used for the calculation of the country's footprint. Also, the footprint has directed our focus on reduction in carbon emissions. The activities undertaken as part of the Ecological Footprint Initiative, in conjunction with other efforts such as the annual compilation of the UAE GHG Inventory, have enabled us to forecast the potential benefits of different policy options and enabled more informed decision making.

The UAE's per capita ecological footprint remains high. We will continue to use the ecological footprint as a tool and a framework to help us to identify key initiatives to reduce our consumption as we strive to decouple economic growth from consumption, emissions and waste.

Razan Khalifa Al Mubarak, Secretary General, Environment Agency – Abu Dhabi (EAD).

the UAE while oil prices are low could increase public acceptance of subsidy reform elsewhere in the region. Exchanging success and failure stories of those price reform efforts could be a good learning tool for Arab-Arab cooperation. Furthermore, if accompanied by effective mitigation measures, reforming energy subsidies in the Arab region could be a powerful tool for governments – addressing those very profound socio-economic grievances that have contributed to the outbreak of social unrest in various countries (El-Katiri and Fatouh, 2015).

IV. THE WATER, ENERGY, FOOD, AND CLIMATE NEXUS

A better understanding of the interdependence of water, energy, food, and climate policy in the Arab region would provide an informed framework for determining trade-offs and synergies that meet demand on resources without compromising sustainability. Water security, energy security and food security are inextricably linked in the Arab region – perhaps more than in any other region in the world. Generally, the region is known to be energy rich, water scarce, food deficient, and one of the world's most economically and environmentally vulnerable regions to climate change. This calls for adoption of the nexus approach when addressing the management of the three vital resources of energy, water, and food. Fortunately, this was recently well recognized in the Arab Strategic Framework for Sustainable Development (ASFSD) adopted by the League of Arab States in 2013. The ASFSD aims at addressing the key challenges faced by the Arab countries in achieving sustainable development during the period 2015-2025. It asserts the commitment of the Arab countries to implement Agenda 21 and the development objectives included in the Millennium Declaration, the Millennium Development Goals, and the outcomes of the World Summit on Sustainable Development and Rio+20, taking into consideration the principle of common but differentiated responsibilities, and other principles. The strategic framework seeks to enhance the participation of the Arab countries with the aim of strengthening their efforts to realize sustainable development in light of emerging challenges.

The interactions between water, energy and food security sectors can be easily seen across the Arab region. The region's population is currently over 390 million and is expected to increase by 50 percent by 2050 ("Food security and nutrition in the Arab region: key challenges and policy options," FAO, WFP, UNICEF and AOAD, 2012). Poverty, resource depletion and degradation are present throughout the region. Despite containing 43 percent of the world's oil reserves and having an immense potential for renewable energy, more than 50 million people in the region remain without access to modern energy services, mainly electricity (AFED, 2013). Additionally, the region merely contains 0.3 percent of the world's freshwater sources, making it the most water scarce region in absolute and relative terms (Siddiqi & Anadon, 2011). Over 50 percent of Arab countries are already below the water stress level of 500 cubic meters per capita per year and water availability is expected to decrease by 50 percent by 2050, while demand will continue to grow. The Arab region is the world's largest importer of wheat and recent economic instability has left its population even more vulnerable to food insecurity (World Bank, 2009). Utilizing the nexus approach in the Arab region has the potential to benefit all three sectors and reduce poverty through the improvement of livelihoods and job creation.

Climate change, which is mostly driven by energy use and land use changes, is an additional challenge that would exacerbate the scarcity situation of water and food resources. Climatic variability adds further pressures such as accelerating the deterioration of dry lands, more frequent and intense extreme weather events (such as droughts or floods), and less reliable water supplies, as well as less reliable agricultural productivity. Worldwide, the food sector alone contributes to about a third of the global greenhouse gas emissions through energy use, land use change, methane emissions from livestock and rice cultivation, and nitrous oxide emissions from fertilized soils (Sachs J. et al., 2010). With a high proportion of arid and semi-arid land and scarce water supplies, alongside in some cases poor and unsustainable agricultural practices, the Arab region finds itself facing a food security challenge. The current cultivated land in the region accounts for nearly 5 percent of the global cultivated land, and the dominant

method of agriculture is rain-fed. This makes the region's food supplies and agricultural needs highly vulnerable to the adverse effects of climate change, with a great emphasis on the incidents of extreme weather such as droughts and floods that have been notably rising in the region.

At the same time, climate change mitigation places new demands on water and land resources, such as production of biofuels, carbon sequestration and carbon capture and storage (CCS). Climate adaptation measures, such as intensified irrigation or additional water desalination, are often energy intensive. Further, increased groundwater use and water storage may require additional pumping. Thus climate policies can have an impact on water, energy and food security, and adaptation action can in fact be maladaptive if not well aligned in a nexus approach and implemented by appropriately interlinked institutions (SEI, 2011).

Furthermore, this interdependency has manifested itself over the past few years in new and increasingly interconnected crises (the food, energy, and financial crises, together with extreme climate events such as droughts and floods). These crises had impacted the Arab population heavily on varying degrees, hitting the poor the hardest. The vulnerabilities highlighted above can impact directly on people's lives and livelihoods. A clear example of climate change migration is that which took place in Syria in recent years. In the period of 2006-2011 nearly 60 percent of Syria suffered the worst drought and severe failure crop in the country's modern history. This drought and crop failure has set a vast social and economic strain on the population susceptible to such events. In 2009 over 800,000 Syrians lost their entire livelihood as a result of the droughts, with a further exposure of nearly one million people in 2011 to food insecurity. In 2010, an estimated 200,000 people migrated from their agricultural farmlands to urban areas due to such weather events.

Rural and agricultural populations often have a higher vulnerability to volatile weather variation and extreme weather events, ranging from droughts to floods, and migration is one of the solutions at the disposal of many rural and agricultural populations in the Arab region. This migration however is not only limited to such communities. While many are expected to migrate due to the effects of climate change on water resources and agricultural capacities, many others are at the same level of risk based on inundation and sea level rise. This remains as a matter of integral significance to the region, with dwindling resources highly vulnerable to climate change and highly congested urban centers, while farmlands are under threat of low rainfall and weak crop productivity. Urban centers are at risk of further population concentration, resource stress and an unsustainable development path.

In addition, the social impact will be severe as many workers will lose their jobs in agriculture, fishing, and some oil industries as a result of a world shift toward renewable energy sources. The economic impact in the oil producing countries will be more severe, as they mainly depend on revenues from oil and gas exports. If the world shifts fast to other low-carbon renewable sources of energy, those countries will suffer seriously.

The different relationships between energy, water, and food in the Arab region are discussed below.

A. Energy for water

A large amount of energy is needed to extract, convey, treat, and deliver potable water. Additionally, energy is required to collect, treat, and dispose of wastewater. Due to water scarcity, the region hosts more than 50 percent of the world desalination capacity. Desalination is an energy intensive industry; specific energy consumption depends on technology used and ranges from 5-9 Kwh/m^3 for less intensive reverse osmosis (RO) technology up to 15-25 Kwh/m^3 for energy intensive multi-stage flash distillation (MSF) technology, which is prevailing in the region (ESCWA, 2001). Energy is being used in pumping and distributing ground and surface water. The actual energy consumption can vary significantly for each process due to a host of geographical, physical, and technological factors. A key feature of energy consumption in the water value chain is that desalination and long distance conveyance are one of the most energy intensive (per unit volume) processes. These are increasingly the most common options that are being explored for expanding water supplies in many Arab countries (WW, 2007). The large difference in

THE ARAB REGIONAL STRATEGY ON SUSTAINABLE CONSUMPTION AND PRODUCTION

Fareed Bushehri

The Arab Regional Strategy on Sustainable Consumption and Production (SCP) was launched in September 2009, in a joint initiative of the League of Arab States (LAS), the United Nations Economic and Social Commission for Western Asia (ESCWA) and the United Nations Environment Programme (UNEP). The strategy was subsequently endorsed by the Council of Arab Ministers Responsible for the Environment (CAMRE) in November 2009.

The strategy aims to promote the concept of a sustainable consumption and production in the Arab region through encouraging the utilisation of products and services that ensure environmental protection and conserve water and energy as well as other natural resources, while contributing to poverty eradication and a sustainable lifestyle.

The strategy was the Arab region's contribution to the Marrakesh process, which highlighted the priority action areas to achieve the objectives of alleviating poverty, while using goods and services which conserve natural resources.

The strategy's main priority areas include:

- Energy for sustainable development
- Water resources management
- Waste management
- Rural development and eradication of poverty
- Education and sustainable lifestyles
- Tourism

In terms of energy for sustainable development, the document emphasized that the Arab energy sector has played and will continue to play an important role in the region and globally. Oil revenue is the main driver for economic development in most Arab countries, and Arab economies are heavily dependent on oil and gas to meet their domestic energy demand. On the other hand, the region also enjoys good potential of renewable energy resources which have not been fully utilized yet. The strategy recommends enabling policies to improve energy efficiency, particularly in energy intensive industries, transport, and power; promote the wide use of cleaner fuels; develop and wide use of renewable energy technologies; and support the promotion of cleaner production in the energy sector and encourage private sector participation in the energy sector.

Another key priority area is sustainable management of the region's water resources. Water scarcity is one of the major development challenges in the Arab region. The region accounts for about 3 percent of the world's population, 10 percent of its land, but only 1.2 percent of the renewable water resources. The ten most water stressed countries in the world are Arab countries and about 50 million Arab people lack access to safe drinking water. Water use efficiency barely exceeds 40 percent in most of the Arab countries. The strategy recommends enabling policies to adopt integrated water resources management (IWRM) taking into account socio-economic goals to achieve sustainable development; advancement and wide use of new desalination technologies; enhancing the role of civil society and NGOs to improve water efficiency; enhancing regional cooperation and integration in water resources management to achieve water and food security; and water demand management to improve water use efficiency in different consuming sectors.

The strategy recommends the adoption of the Integrated Solid Waste Management (ISWM) strategy (cradle-to-grave), and aims at achieving a 'cradle-to-cradle' approach. It also advances the promotion of waste avoidance and minimization practices, thus utilising waste as a resource wherever possible. Emphasis is also placed on the importance of developing policies for the sustainable management of hazardous waste, including E-waste.

Agricultural development constitutes another major core area for development in the region, where it remains the primary user of freshwater, consuming about 85 percent of available resources. Poverty in the Arab region can be found mostly in the rural areas and rural development is inevitable for poverty eradication.

In order to facilitate sustainable rural development and to eradicate poverty, the strategy suggests implementing policies promoting sustainable agriculture practices to achieve food security. Another issue is the importance of improving access to water and sanitation in rural areas in line with the Millennium Development Goals (MDGs). Enhancing access to modern energy services to foster economic and social development in rural areas is also emphasized, alongside the improvement of access to education and health services.

The strategic plan also highlights the inter-linkages between education and sustainable development in the Arab region.

Considering that the Arab world has the largest share of youth among developing regions, a key initiative in this regard is the Youth-Xchange initiative which shows young people how sustainable consumption directly relates to quality of life, efficient use of resources, reduction of waste, and ethical issues such as child labor, for example.

Recommended policies included in the strategy focus on the inclusion of internationally agreed upon objectives on education in national development plans. More specifically, they focus on supporting the development of strategies and national programs for education and illiteracy eradication and introducing SCP issues and sustainable lifestyle into education (formal and non-formal).

In this regard policy recommendations revolve around the promotion of eco-labels, fuel efficiency standards and energy efficiency standards for appliances, in relation to public procurements, green building standards and public transport systems.

Sustainable Tourism is the last of the priority sectors identified by the strategy. It promotes sustainable eco-tourism through development of sustainable ecotourism strategies: policies and guidelines including disseminating and adapting existing tools and policies to the local context. The strategy also promotes mainstreaming sustainability in the tourism sector by adopting sustainable management practices for the hospitality sector and integrated costal zones management and capacity building for small and medium enterprises (SME's) and government institutions at all levels.

The strategy emphasises the importance of approaching SCP from a multi-stakeholder perspective including governments, business and industry, media, non-governmental organizations (NGOs) and civil society, individuals and regional and international intergovernmental organizations.

Finally the strategy concludes by emphasizing the importance of monitoring and evaluation. It highlights that indicator-based monitoring is one of the most effective forms of monitoring and evaluation, and demonstrates how the indicators are valuable tools for tracking progress on set priorities and targets. It calls for Arab indicators for SCP to be incorporated within broader sets of development, poverty reduction, environment or sustainable development indicators. It lists a set of recommended indicators which include those within the Arab framework that are relevant to sustainable consumption and production, in addition to 'decoupling' growth from consumption and other indicators relevant to the sustainable consumption and production priorities outlined above.

The Arab Strategy on SCP was among the first such regional strategies to be developed and adopted by the countries of the region before the RIO+20 summit and before the adoption of the 10 Year Framework of Programs (10YFP) on Sustainable Consumption and Production (SCP) by the Summit in 2012. The Arab Strategy provided an excellent enabling tool for the Arab countries to move forward and become the first region to develop a roadmap for the implementation of the 10YFP on SCP at the regional level, based on the Arab Strategy on SCP, during the 4th Arab Roundtable on SCP in June 2013. During the same year the roadmap was adopted by CAMRE.

The priority sectors identified in Arab Strategy on SCP enable countries to select and focus on any combination of these sectors that meet their respective national sustainable development priorities for transforming existing unsustainable consumption and production patterns to more sustainable patterns. These sectors are common to most countries of the region and were developed through a consultative process involving all relative stakeholders, including government representatives.

Despite the Arab Strategy being a comprehensive document supported by a roadmap for the implementation of 10YFP programs, the adoption and implementation of the Arab Strategy on SCP at the national level has been very weak. The majority of Arab countries have appointed 10YFP National Focal Points, but SCP has not become a priority area for most of them. Jordan has been leading the region in its quest to integrate SCP policies into its national development plan. It has identified priority sectors and is developing its roadmap for the implementation of its SCP strategy accordingly. Egypt is also progressing with its national roadmap, alongside Morocco, Lebanon and Palestine.

UNEP is working with the countries of the region to integrate SCP policies into their national development plans and policies, by adopting the Arab Strategy on SCP at the national level and utilising the roadmap as a guide towards active involvement under the global agenda for the 10YFP on SCP.

Dr. Fareed Bushehri, Regional Resource Efficiency Officer, United Nations Environment Programme (UNEP), Regional Office for West Asia (ROWA).

energy requirements for wastewater treatment and desalination is significant. From an energy standpoint, wastewater treatment and reuse can be much more efficient than desalination (Siddiqi and Anadon, 2011).

B. Water for energy

In addition to hydropower, water use in the energy sector primarily occurs in three areas: hydrocarbon extraction, oil refining and electricity generation. Cooling of thermal power stations and oil refining, hydropower, energy mineral extraction and mining, fuel production (including fossil fuels, biofuels, and other non-conventional fuels), and emission controls all rely on large amounts of water. In the Arab region, thermal electricity generation constitutes more than 90 percent of the total installed capacity. Water consumption in oil extraction is much lower than what is consumed through evaporation in cooling processes in power plants. The Arab region is a large producer of oil and petroleum products, so the collective effects on water consumption can be significant.

Table 3 provides a summary of the water consumption values. Empirical data on how much water is used in energy production in the region is rarely found.

C. Energy for food

Production of food depends on energy resources. Fossil fuels have increased farm mechanization, boosted fertilizer production and improved food processing and transportation. Energy is used mainly for pumping water, housing livestock, cultivating and harvesting crops, heating protected crops, drying and storage. In addition, indirect energy demands include fuels for operating farm machinery as well as for fertilizer manufacturing. In addition, energy is consumed in the food processing industries. The total amount of energy needed for food processing and packaging is estimated to be between 50-100 mega joule (MJ) per kg of total retail food product. The food processing industry requires energy for heating, cooling, and electricity. Energy is also embedded in the packaging, which can be relatively energy-intensive due to the use of plastics and aluminum. For processing fish, the direct energy demand for ice, canning, freezing, drying or curing and producing fish meal and fish oil by-products is around 0.5 pet joule (PJ) per year. Finally, energy is needed for food storage and cooking for households and food retailers. It is estimated that the total energy used to put food on the table in the USA represents 16 percent of the nation's total energy consumption (FAO, 2011).

There is a link between food prices and energy prices. Between 2007 and 2008, world oil prices dramatically increased, reaching close to US$150 per barrel at its highest peak. According to FAO, the higher fuel costs heavily increased the cost of producing and transporting agricultural commodities. Recent studies have further established that energy was one of the key drivers that caused food prices to surge to their highest levels in nearly 50 years. Because climate change will likely reduce agricultural yields globally, world market prices for major food commodities are projected to rise. Given the high dependence of Arab countries on imported food (combined with relatively limited agricultural potential), these global dimensions are particularly important for the Arab world (World Bank, 2012).

TABLE 3 **WATER CONSUMPTION IN ENERGY PRODUCTION**

Process	Min.	Max.	Average
Primary–secondary range (oil extraction) (gal/MMBtu)	1.4	62	31.7
Oil refining (gal/MMBtu)	7.2	13.4	10.3
Steam turbine - once through cooling (gal/MWh)	300	330	315
Hydro power - evaporative losses (gal/MWh)	1429	6882	4500

Source: (Siddiqi, A. and Anadon, L., 2011)

D. Water for food

Food and water are strongly linked. The Arab region is water scarce with annual renewable water resources per capita about 800 m^3, compared to a world average of about 7240 m^3. This regional average masks the disparities that exist with 13 Arab countries classified in the severely water scarce category, at less than 500 m^3 per capita. Agriculture consumes about 85 percent of total water withdrawals in the Arab region, which is characterized by low irrigation efficiency and crop productivity. Water scarcity is a critical constraint to agriculture. This will be exacerbated over the coming years by rising populations and the potential impacts of climate change.

Average irrigation efficiency in 19 Arab countries is below 46 percent. It is estimated that raising this figure to 70 percent would save about 50 billion m^3 of water annually. Producing more agricultural outputs with less water is an option of significant importance for enhancing food security in the Arab region by utilization of more efficient irrigation methods, such as sprinkler and drip irrigation. The application of drip irrigation in most parts of the Arab region has proved to reduce water losses and increase agricultural productivity; for instance, its application in the Jordan Valley to irrigate 60 percent of the area has increased average yields of vegetables and doubled fruit yields. In most of the Arab region there is still a lack of economic and fiscal incentives based on cost recovery for irrigation improvement. Thus, high priority should be given to improved management of irrigation water demand by encouraging farmers to invest in water-saving technologies and to cultivate crops with low water demand. In addition to increasing irrigation efficiency, water productivity can be increased in either economic or physical terms, through the allocation of water to higher value crops or by achieving 'more crop per drop' of water, respectively. In addition, water productivity can be further improved by shifting consumption habits towards less water-intensive crops of similar nutritional value (AFED, 2014).

E. The nexus approach

The nexus approach is meant to integrate management and governance across sectors. Additionally, it can boost resource efficiency and productivity by addressing externalities across sectors. Productivity and availability of water, energy and land vary enormously between regions and production systems. There is a large potential to increase overall resource use efficiency and benefits in production and consumption, e.g. by addressing intensive agriculture (which often has higher water productivity but lower energy productivity than other forms of agriculture). Similarly, the nexus thinking would address energy intensity of desalination, water demand on hydropower, or land demand in renewable energy production (e.g. solar and wind). 'No regret' adaptation actions, including Integrated Water Resource Management, (IWRM), as an adaptation tool, and up scaling decentralized renewable energy technologies are crucial to help build resilience to the increasing number of extreme weather events. Mitigation options with adaptation co-benefits such as water conservation, solar desalination, and better management of livestock are all good opportunities to capture the benefits of the nexus approach.

This strong interdependency between energy, water, food, and climate change makes it imperative that policy formulation becomes coordinated, particularly with respect to mitigation of and adaptation to climate change. Conventional policy- and decision-making in 'silos' therefore needs to give way to an approach that reduces trade-offs and builds synergies across sectors. This new development has created unprecedented opportunities for fundamental policy changes in various economic, institutional, technological, and social systems.

It is important to recognize that there has been weak or lack of real coordination in the Arab region in terms of policies and strategies for water, agriculture land, energy, and climate change. Climate change policies, in infancy stages in the Arab region, are still being fragmented between different entities. However, the nexus thinking offers real opportunities for synergies such as coordinated investments in infrastructure related to water, food and energy, and innovation to improve resource use efficiency. This should be coupled with the use of economic instruments for stimulating investment, including: pricing of resources and ecosystem services, maximizing the beneficial uses of water and energy amongst

other competing demand, applied and adaptive research to enhance adaptation to climate change in the agricultural sector to ensure its resilience, capacity building and sharing of experiences and good practices at national and regional levels, and finally bridging the present science-policy gap.

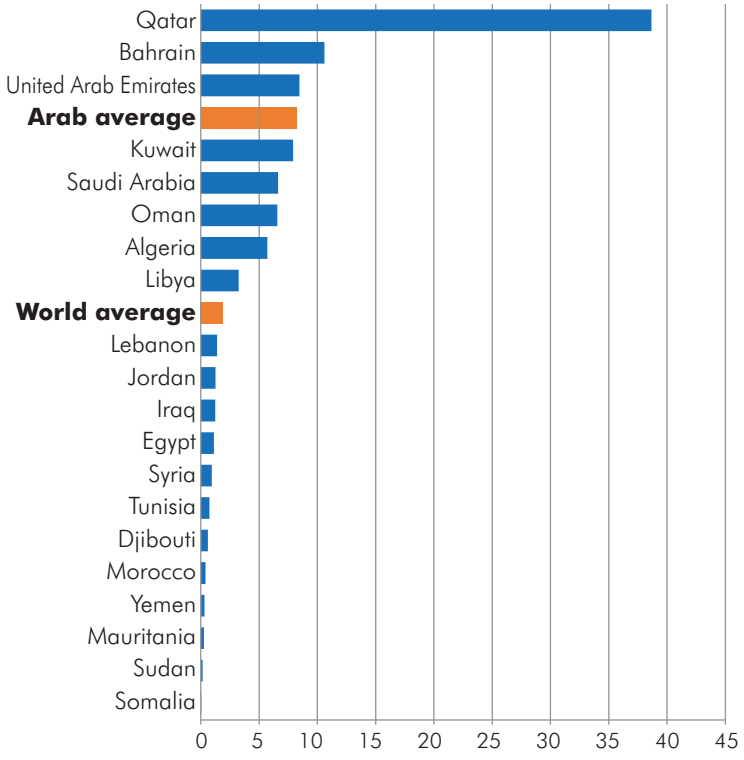
V. PATTERNS OF CONSUMPTION AND RESOURCES EFFICIENCY

Consumption patterns of energy, water, and food in the Arab countries are strongly affected by a myriad of socio-economic factors as discussed in section 3. These patterns will be further examined below in conjunction with the results of the public opinion survey on consumption patterns undertook by AFED.

A. Energy consumption patterns

Economic growth, growing population, high rate of urbanization, and dramatic changes in lifestyle have made the Arab region one of the major energy demand center in the world. Due to differences in those socio-economic factors, per capita energy consumption varies greatly between high-income group (oil producing countries) and medium and low-income group (non-oil producing countries). The per capita consumption in Qatar is 38.6 tons of oil equivalent (toe), highest among Arab countries and twenty fold the world average (1.9 toe). Per capita energy consumption of the oil rich GCC, Libya and Algeria is higher than the world average, while the rest of the Arab countries have a per capita primary energy consumption lower than the world average (Figure 5).

FIGURE 5 ENERGY CONSUMPTION PER CAPITA (TOE)



Source: OAPEC, 2015

The same disparity can be observed in the per capita electricity consumption between different Arab countries. Figure 6 shows that while the average Arab per capita electricity consumption is less than the world average, the per capita electricity consumption in the GCC countries and Libya exceeds the world average. The per capita electricity consumption in Kuwait, the highest in the Arab region, is about seven folds the average Arab, and nearly five folds the world average. Such a large disparity exists among different Arab countries to the extent that a Kuwaiti national would consume as much electricity as 13 Sudanese households of five persons each.

Although some Arab countries are rich in energy resources, about 50 million Arabs have no access to electricity, especially in the least developed countries Yemen, Sudan, Mauritania, Comoros, Djibouti, and Somalia (World Bank, 2010 and AFED, 2012). These wide disparities in access to affordable modern energy services between different countries and between urban and rural populations within the same country aggravate inequality, worsen poverty, and threaten social stability. The majority of Arab people with no access to electricity live in least developed countries such as Yemen, Sudan and Mauritania (Figure 7).

The high level of energy consumption in most Arab countries and the inefficiency of use can be attributed to, among other factors, the historically pervasive adoption of energy subsidies. However, through the AFED public opinion survey, only 6 percent of the respondents considered heavy subsidy as the main reason,

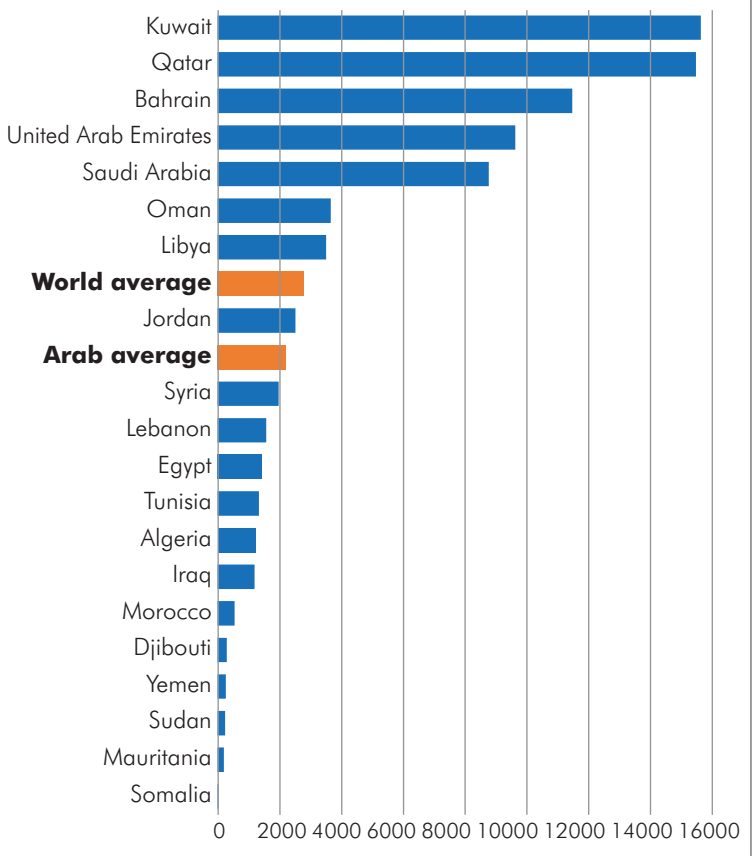
while 43 percent thought it was a combination of harsh climate conditions, lack of public awareness, and subsidies.

In most countries of the region, fuel and electricity are subsidized at rates averaging in excess of 50 percent of the cost of supply (see section 3).The AFED survey reveals that 64 percent of the respondents pay between 5 and 10 percent of the family income on electricity bills. Those who paid the lowest percentages compared to family income were residents of Qatar, UAE, Saudi Arabia, Bahrain and Kuwait (countries with high per capita income and heavy energy subsidies). These results underline the fact discussed earlier, that the rich are benefiting most from energy subsidies in the region. An interesting response of the survey, worth to be considered while planning to reform energy and water pricing in the region, is that 77 percent of the respondents agree to pay more for water and energy if compensated with additional social benefits, such as education, health insurance and adequate pensions.

The availability of fossil fuels at low production costs encouraged oil-producing countries to invest in energy-intensive industries such as desalination, petrochemicals, and aluminum smelting. This has led, in addition to the harsh climate conditions and poor energy efficiency, to high-energy intensity. Primary energy intensity is measured as the ratio between the total primary energy consumption and the country's Gross Domestic Product (GDP). It measures the amount of energy input required to generate one unit of GDP. In other words, it is a proxy to energy productivity in an economy. By expressing at Purchasing Power Parity (PPP), GDP is adjusted to reflect the differences in the cost of living in different countries.

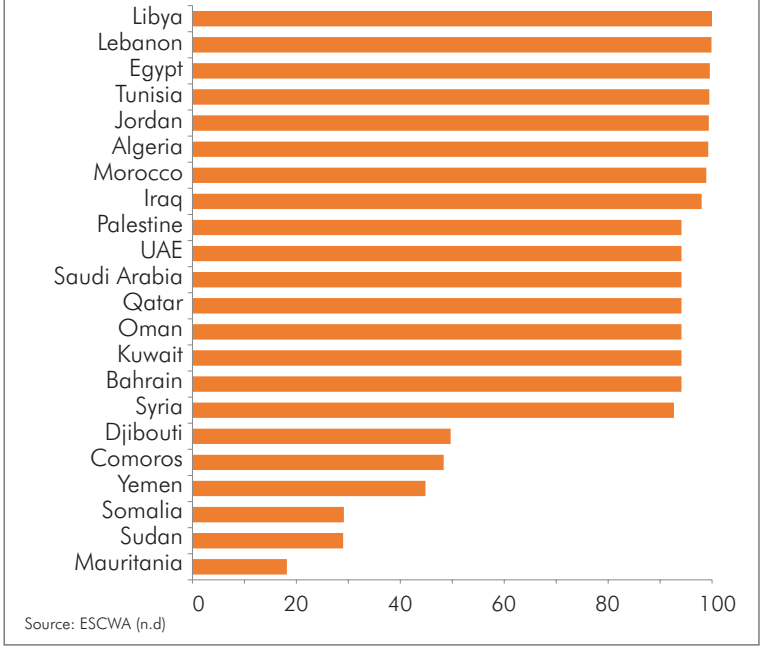
Figure 8 indicates that in 2010 the average primary energy intensity in the region was nearly 8.7 MJ/ US$ 2005 (PPP) compared to a world average of 7.7 MJ/US$ 2005 (PPP) and the energy intensities of all the GCC countries are higher than the world average. It is also clear that only seven countries have improved energy intensity between 1990 and 2010, which are Tunisia, Syria, Sudan, Mauritania, Iraq, Egypt, and Bahrain. Whether these improvements occurred due to efficiency improvement or

FIGURE 6 ELECTRICITY CONSUMPTION kWh PER CAPITA (2012)



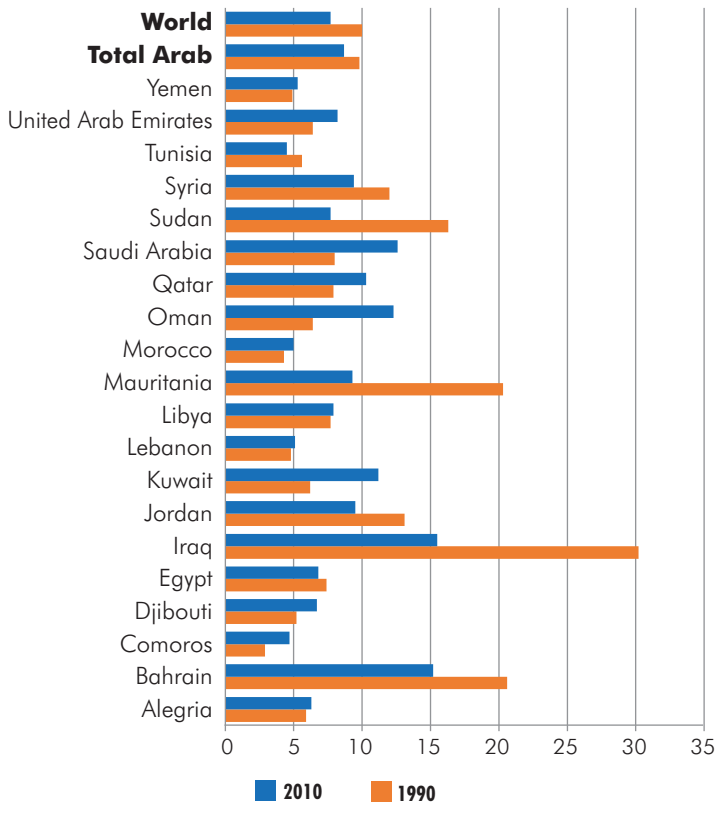
Source: OAPEC

FIGURE 7 ACCESS TO ELECTRICITY (%)



Source: ESCWA (n.d)

FIGURE 8 **ENERGY INTENSITY (MJ/$2005 PPP)**



Source: SE4ALL

structural changes in the economy remains to be clarified by more analysis. Within the Arab group, results are widely divergent, separating Iraq on the high end and Tunisia on the low end of energy intensity.

As the region relies almost entirely on fossil fuel for meeting its energy demands, and as most countries are heavily subsidizing energy prices, the region continues to be one of the most energy-intensive regional economies in the world, resulting in an increase of associated greenhouse gas (GHG) emissions. Figure 9 indicates the high level of per capita carbon emissions of the GCC countries and Libya, with the level in Qatar exceeding the world average by eight folds.

Energy consumption in the Arab region continues to be dominated by fossil fuels. In 2013, the primary energy consumption mix was dominated by oil products (47 percent) and natural gas (51 percent). As can be observed in Figure (10), the situation has not changed significantly since 2005. The main trend is the increasing use of natural gas, with a relative reduction in share amongst all other sources.

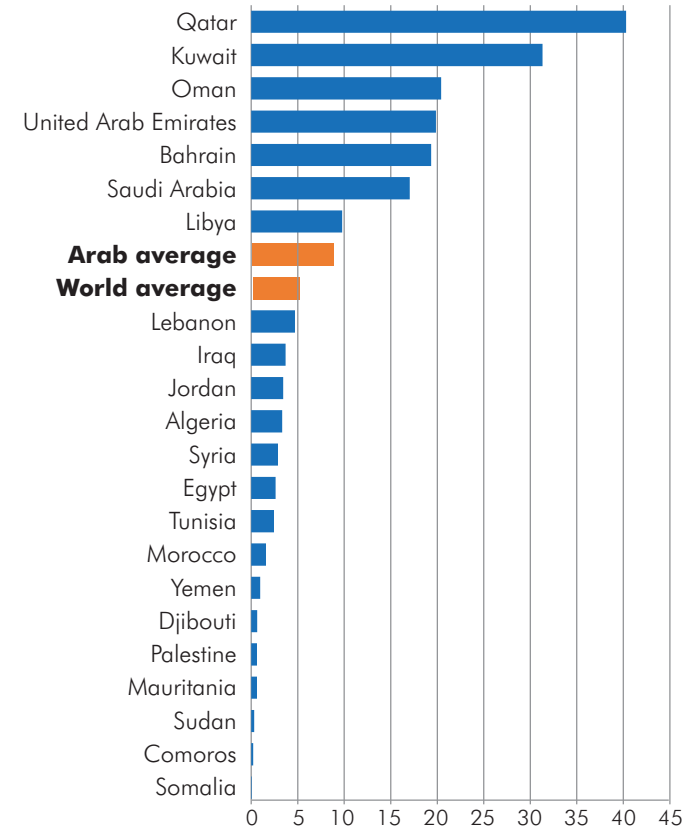
The current level of energy intensity as described in Figure 8 and the large share of residential and commercial consumption of electricity (Figure 10) indicate a low level of energy efficiency. The results of the AFED 2015 survey on sustainable consumption reveals, to some extent, the impacts of energy efficiency policies adopted by governments on consumers' purchase decisions. Only 42 percent of the survey respondents consider electricity consumption as a criterion while purchasing an electrical appliance (Figure 11). The lowest percentage of those who buy electrical appliances based on efficiency was recorded in Qatar (9 percent) and the highest in Tunisia (57 percent) and Jordan (56 percent). These results clearly reflect the importance of adopting Minimum Energy Efficiency Standards (MEPS) for electrical appliance by governments. Tunisians ranked high in considering energy efficiency because of the rigorous energy efficiency policies adopted by the government, and probably a higher level of public awareness. Similarly, 46 percent of the survey respondents consider fuel consumption while purchasing a new vehicle (Figure 12). Brand name and model of cars were the main purchasing factors in Qatar, Saudi Arabia, Bahrain, Kuwait and the UAE, well above 50 percent of the total (countries with high income and very low fuel prices). Fuel efficiency and price dominated as the main factors in Jordan, Egypt, Morocco, Lebanon, Iraq and Tunisia. The highest percentage of those who choose a car for its fuel efficiency was in Jordan (72 percent) and the lowest in Saudi Arabia (17 percent) and Qatar (16 percent), which is a clear direct relationship with fuel prices (see detailed results of AFED consumption survey per country on www.afedonline.org).

The same survey results showed that the use of energy-saving lamps (like CFL and LED) is expanding in Arab countries, as 85 percent of the respondents use them. This indicates the wider availability of energy-saving lamps on the market with easy access to consumers due

to governments' initiatives. Saudi Arabia and Qatar recorded low levels of domestic use of energy-saving lamps (35 percent) due to heavily subsidized electricity prices. On the other hand, high levels of penetration of efficient lamps came from Jordan and Syria (95 percent), Egypt (94 percent) and Lebanon (91 percent), countries that undertook energy-saving initiatives, including price reforms, in the past years.

It is clear that the efficiency of energy production and consumption patterns in the region reveals a huge potential for improvement. Energy efficiency is a development necessity both for oil producing and exporting countries, such as the GCC group, and for oil importing countries such as Jordan and Morocco. The driving forces for improving energy efficiency include alleviating the financial burden of oil imports in the oil importing countries, reducing demand on energy investment, making the best use of existing supply capacities to improve energy accessibility, improving economic competitiveness, reducing local pollution, and mitigating greenhouse gases (GHG) emissions. In addition, for oil producers, energy efficiency would extend the lifetime of their hydrocarbon resources, availing more oil for exports, and reducing their carbon footprint.

FIGURE 9 EMISSIONS METRIC TONS PER CAPITA CO_2 (2010)



Source: World Bank, 2010

FIGURE 10 CHANGE OF CONSUMPTION PATTERNS OF ENERGY RESOURCES IN THE ARAB REGION

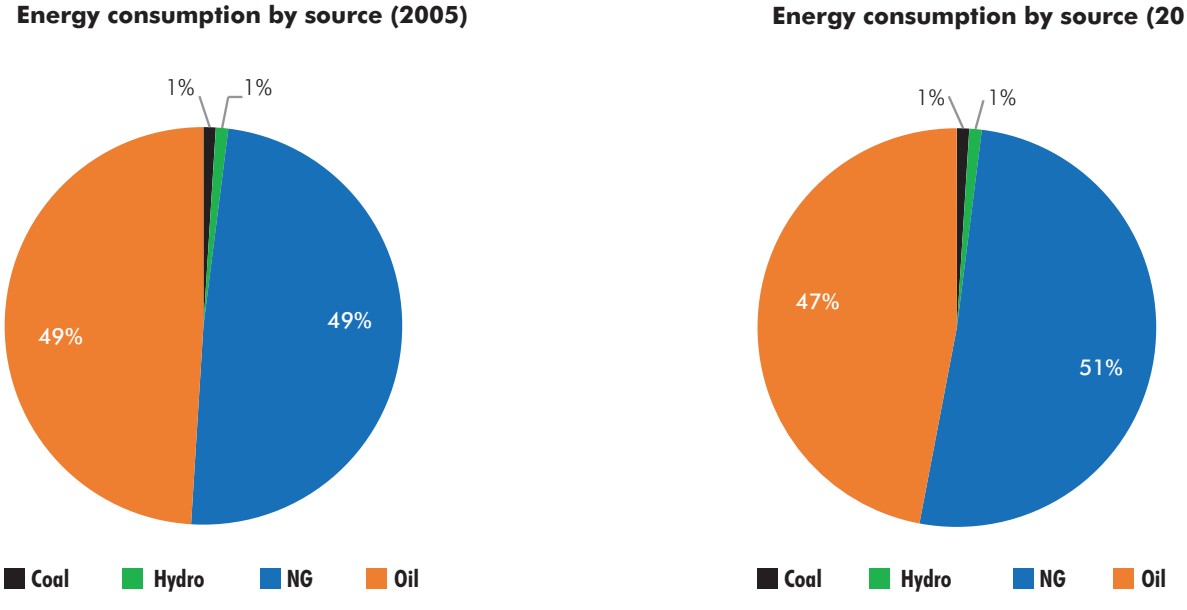


FIGURE 11 MAIN CONCERN WHEN YOU BUY ELECTRICAL APPLIANCE

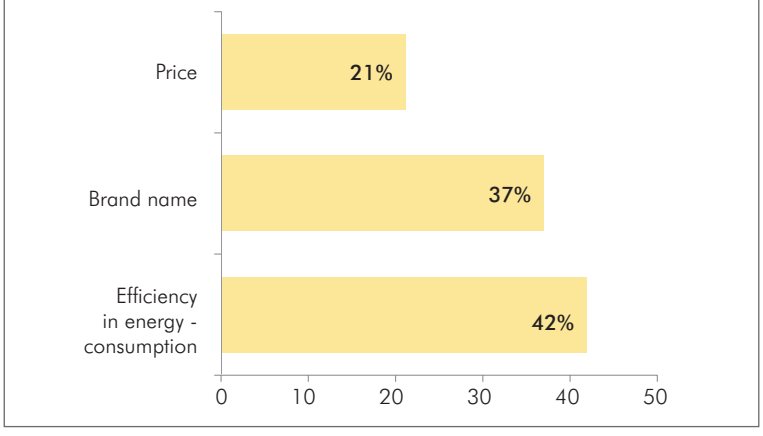
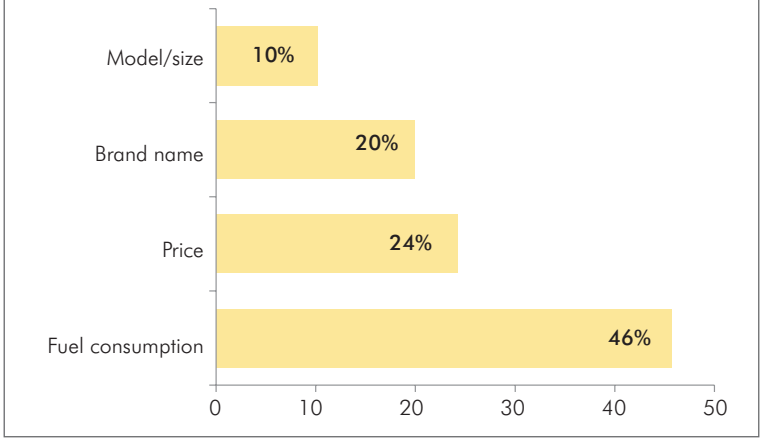


FIGURE 12 MAIN CONCERN WHEN YOU BUY A CAR



B. Water consumption patterns

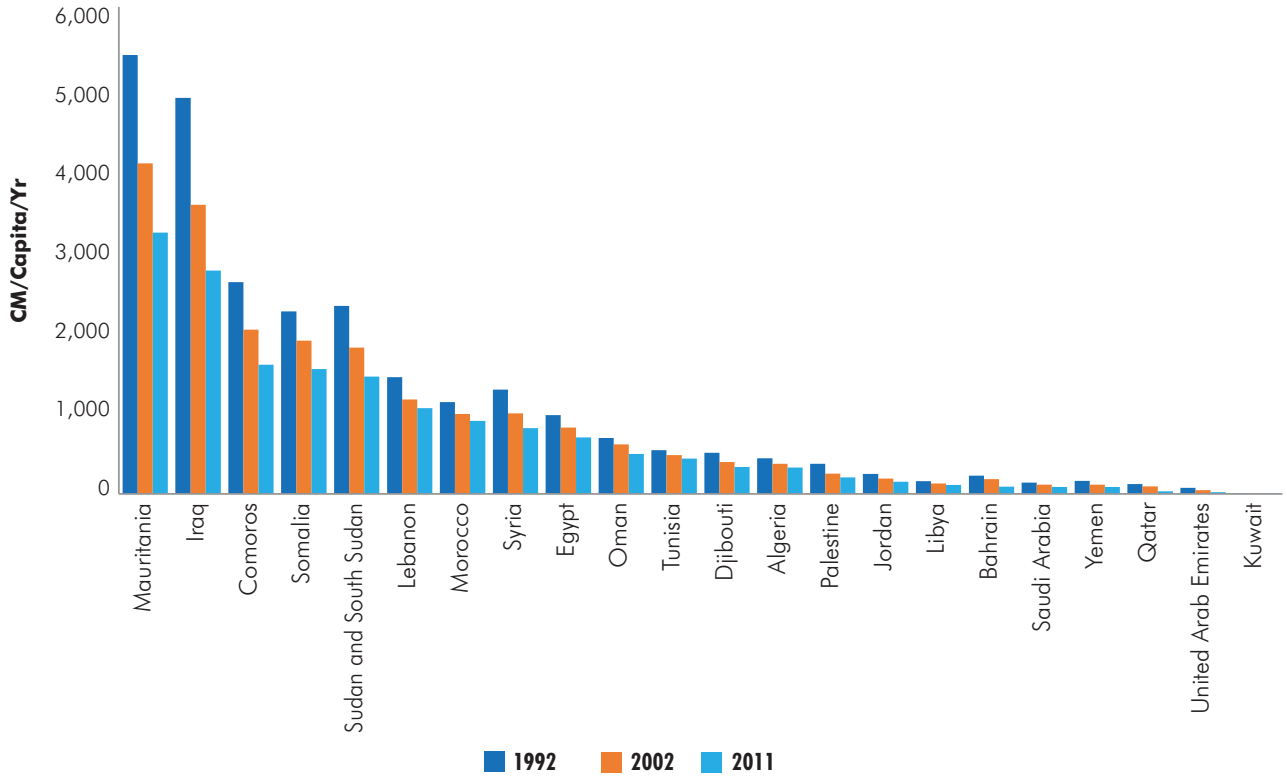
The Arab region is one of the world's most water-stressed regions. Rainfall scarcity and variability, coupled with high evaporation rates, have characterized this part of the world as having limited renewable freshwater resources. Under theses climatic conditions and poor endowment of water resources, and as a consequence of the rapid population growth experienced by the region since the mid 1970s, per capita freshwater availability decreased dramatically in all the Arab countries (Figure 13), with the majority of these countries currently below the border line for water poverty of 1,000 m^3/capita/year. While the world average for water availability is about 7,240 m^3/capita/yr, the average per capita freshwater availability in the Arab region is at about 800 m^3/capita/yr (AFED 2014). Based on projected population increase, it is expected that this indicator will continue to decrease to reach about 500 m^3/yr by the year 2030 when the Arab population surpasses 500 million, meaning that the whole region will experience absolute water poverty, where water will become a major constraint for development, impacting the standard of living, health and environment (Falkenmark, 1989 and AFED, 2014). Furthermore, by then, climate change is expected to have led to 20 percent reduction in renewable water resources and more droughts in the region (Doumani, 2008), which would further exacerbate the current water scarcity situation.

During the past three decades, water demand in all the Arab countries has increased dramatically as a result of increasing population and urbanization, improvements in the standard of living, accelerated industrial development and efforts to increase food self-sufficiency. The total water use for all sectors in the Arab region increased dramatically from about 190 billion cubic meter (BCM) in the mid 1990s (ACSAD, 1997) to about 255 BCM in 2010 (UNDP, 2013), while during the same period the population has increased from about 260 million to about 360 million (UNDESA, 2012).

The AFED survey results indicate, interestingly, that 72 percent of the respondents are aware of the above-mentioned facts of water scarcity in the region, and 77 percent are aware that per capita water consumption is high as well. Ironically, respondents from countries with the highest per capita consumption have a high level of awareness (UAE has a high awareness level of 92 percent, and Kuwait 90 percent). Though 90 percent of respondents from the UAE are aware of the high levels of per capita water consumption, only 50 percent of them indicate that they use water-saving devices at home. This result raises questions on the reasons behind it – whether it is because of availability of those devices in the market, or lack of awareness on their availability, or economics of their use, or a combination of all, remains to be further investigated.

These results show, as well, that public awareness is not enough to change consumption habits.

FIGURE 13 **TRENDS IN TOTAL RENEWABLE FRESHWATER RESOURCES PER CAPITA IN THE ARAB COUNTRIES, 1992, 2002, AND 2011**

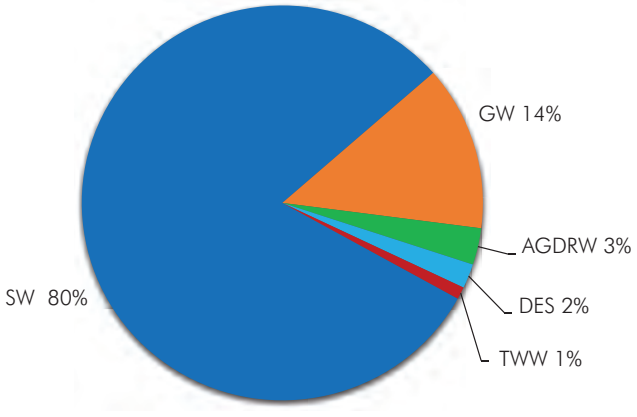


(Graph source: UNDP, 2013, Data source: FAO AQUASTAT, 2013)

Demand side management interventions are needed to complement public awareness.

To meet these escalating demands, Arab countries rely on both traditional water resources (including surface and groundwater resources) and non-traditional water resources (including desalinated water, treated wastewater, and irrigation drainage water), but with varying degrees (Figure 14). Most of the Levant, Nile Valley, and North Africa countries rely mainly on surface water resources, while the Arabian Peninsula countries rely mainly on renewable and non-renewable groundwater resources. All Arab countries are increasingly using treated wastewater, while desalinated water represents progressively a major component in the water budget of the GCC countries. Reuse of agricultural drainage water is practiced mainly in Egypt and Syria. The majority of water resources in the region is being used for agriculture (85 percent), while the municipal and the industrial sectors consume about 8 percent and 7 percent of the total water use, respectively (Figure 15).

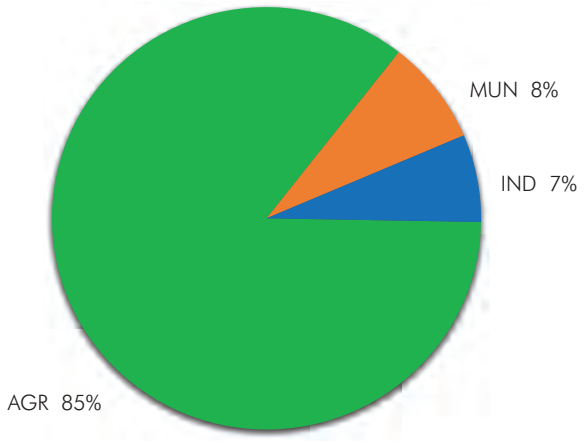
FIGURE 14 **WATER RESOURCES IN THE ARAB REGION**



SW=surface water, GW=groundwater, AGDRW=reused agriculture drainage water, DES=desalinated water, TWW=treated wastewater

In almost all Arab countries, rapid urbanization challenges efforts to meet rising domestic water demand, especially in countries with tight budget constraints. During the period 2005-2015, urbanization has increased from 67 percent to

FIGURE 15 **WATER USES**



AGR=agricultural sector, MUN=municipal sector, IND=industrial sector

about 70 percent of the Arab population, and is expected to continue to increase by the same rate in the next 10 years to reach 73 percent by the year 2025 (UN Urbanization Prospects, 2014). Along with this relatively rapid urbanization rate, domestic water consumption has increased from about 14 BCM in the early 2000s to about 20.4 BCM in 2011 (UNDP 2013), and is expected to increase to about 30 BCM in 2025 (Hamoda, 2004), translating into a more than 50 percent anticipated increase in the next 10 years.

Municipal/domestic water demand has been exaggerated by the level of per capita consumption in many countries in the Arab region. Average per capita domestic water consumption in the region is about 200 liters/day, but varies considerably, both among and within countries (Figure 16). For example in the GCC, which ranks amongst the highest in the world, it is over 500 liters. This volume has dramatically increased over the last three decades. For example, in Kuwait per capita water consumption was only around 200 liters in the 1980s and has increased to around 500 liters in the 2000s. This upward trend has been observed in all the GCC countries. The reasons for this trend are many; in general, the GCC relatively high per capita income and changing life style on one hand, and low municipal water tariffs on the other, are the most important.

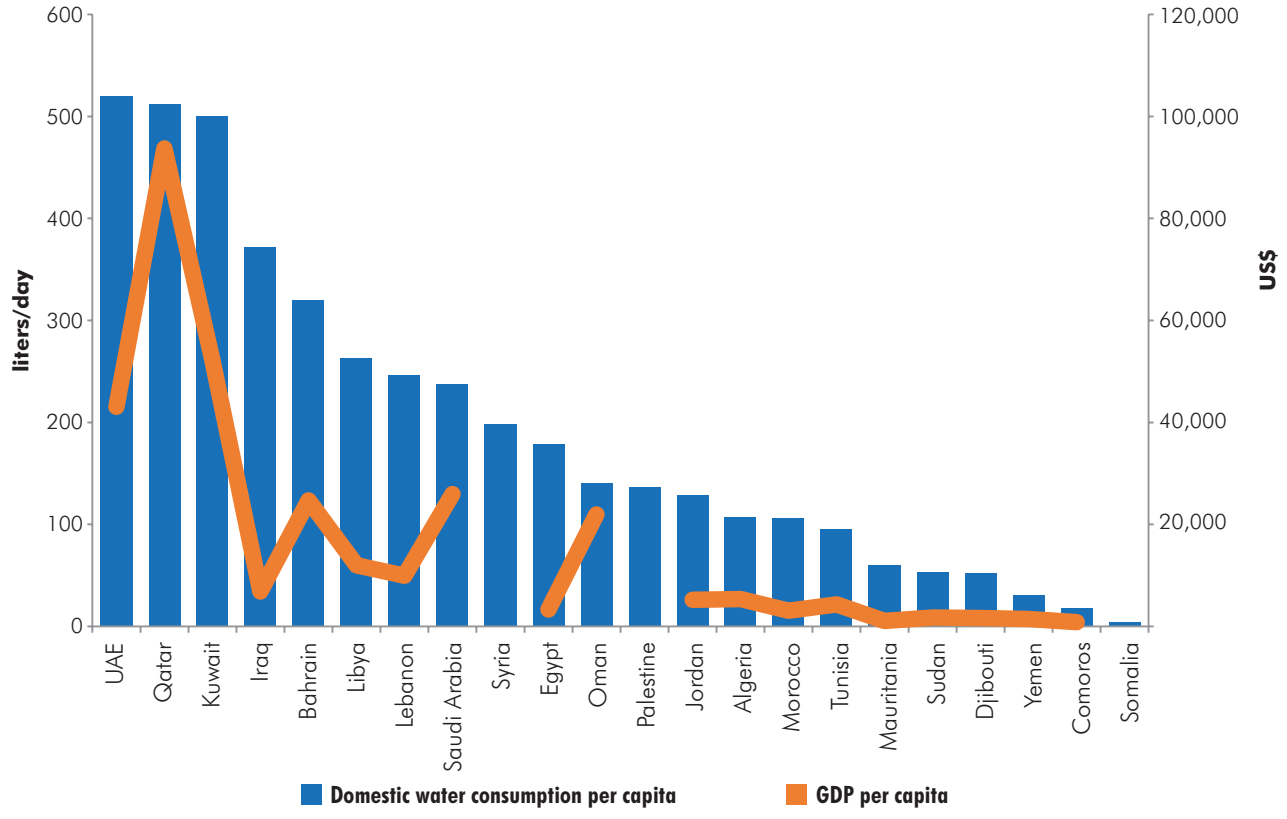
Supply-oriented government policies and subsidies for water supply (i.e., water production from aquifers and desalination plants), without giving adequate attention to efficiency of water use, conservation and demand side management, provide no incentives for consumers to save water (World Bank, 2005). The municipal water tariffs in the majority of the Arab countries are low, also providing no incentive for the consumer to save water. Moreover, it seems that per capita municipal water consumption is closely related to the income levels of the countries, as high-income GCC countries consume a significantly larger amount of water compared to other countries (Figure 16). This analysis suggests that regionally, domestic water consumption can significantly increase with the rise of living standards if water use efficiency and demand management policies and measures are not put in place. The AFED survey results reveal that only 6 percent of the respondents consider low tariffs as a main reason of excessive water consumption, while 77 percent are willing to pay more for their water consumption in return for better social benefits. Governments' fears of water pricing need to be revisited if enhanced social benefits are considered.

C. Food consumption patterns

Agricultural production and food distribution have always been major concerns for governments and social organizations as they seek to feed their populations and prevent extreme outcomes like hunger and famine. Fortunately, improvements in food production technology, processing, and transportation have helped to make food more available, affordable, and convenient. Unfortunately, these changes have negatively impacted diets, making food less diverse, less healthy and less sustainable, and have delivered negative outcomes for human health and the natural environment. While the debate around food security generally focuses on how to secure sufficient food calories for every human, issues of sustainable food consumption and sustainable diets have drawn wider attention.

Arab countries are generally falling short in achieving food security: in its 2014 report on "The State of Food Insecurity in the World," the FAO reveals that the Near East and North Africa is the only region in the world experiencing an increase in both the absolute number and the proportion of undernourished people within

FIGURE 16 PER CAPITA DOMESTIC WATER CONSUMPTION IN THE ARAB COUNTRIES IN 2011 AND GDP PER CAPITA IN 2010-2014 (WORLD DEVELOPMENT INDICATORS: HTTP://DATA.WORLDBANK.ORG/INDICATOR).



the total population. This might be partially attributed to wars and conflicts in countries such as Syria, Iraq, Yemen and Somalia. At the national level, high-income countries with the financial resources to procure food through imports, such as the GCC countries, are sometimes considered much more food-secure than countries with limited agricultural production, poor infrastructure, and weak economic development (Ahmed et al., 2013, and Breisinger et al., 2010). However, even in these resource-rich countries, ensuring adequate energy availability and intake has not been sufficient to achieve total food and nutrition security, as micronutrient deficiencies remain problematic in these countries (Micronutrient Initiative, 2009). In many Arab countries, efforts to achieve food security have focused on increasing agricultural production without considerable attention to the quality and sustainability of the food supply, or to the distribution, allocation, and diversity of food consumed by the population (Meerman et al., 2013). Moreover, issues of environmental, health-related, social, and economic sustainability have been neglected.

Concurrently, Arab countries are experiencing a nutrition transition. Factors driving this transition include economic growth and increased incomes, rapid urbanization, dramatic changes in lifestyle, and globalization of trade and marketing. Although the rate of under-nutrition and underweight, particularly among under-five children, has been on the decline in some Arab countries, there has been a parallel dramatic increase in the prevalence of overweight and obesity and diet-related non-communicable diseases such as diabetes, cardiovascular disease, and cancers (Popkin, 2000). For instance, the rising prevalence of malnutrition has been illustrated by an increase in the number of undernourished children over the past two decades in the Near East and North Africa. While approximately 9 percent of the population was undernourished in 1990-1992, a higher prevalence rate of 10 percent was reported in

2011-2013 (FAO, 2014). Moreover, at least one third of the population in the region is anemic and at risk of iodine deficiency, while 13 million young children suffer from Vitamin A deficiency (WHO, 2011). On the other hand, an estimated 65 percent of adults in Arab countries are overweight and obese, approaching the highest rates worldwide (WHO, 2011).

However, this generalization masks significant variations between Arab countries. WHO (2011) has classified Arab countries into four groups with regard to nutrition transition stages and dominant nutrition problems, major risk factors and underlying causes for non-communicable diseases, intervention programs in response to these problems, and enabling environmental factors for improved action. It is worth mentioning that even relatively wealthy Arab countries are subject to the triple burden where they simultaneously report stunting, overweight and obesity, and micronutrient deficiencies and, as such, are classified in advanced stages of the nutrition transition (Table 4). An important factor behind the above-mentioned nutrition transition in Arab countries is possibly the change in per capita energy (calories intake) consumption pattern. WHO reports a substantial increase in energy consumption in the Near East and North Africa region in recent decades, with levels that have exceeded the global average and that are expected to remain so in the next decade (Table 5).

These regional trends in food consumption patterns again mask significant variation at the national level. Table 6 shows a gradual and significant increase in daily energy supply across most Arab countries, as well as variations therein over the past few decades. For example, while per capita energy supply has increased by only 19 percent in Yemen over the period 1965-2011, it has more than doubled in Algeria (102 percent) over the same period. A sharp increase in daily energy supply has also been observed in Egypt (60 percent), Saudi Arabia (68 percent) and Libya (80 percent). Only five Arab countries

TABLE 4 **CLASSIFICATION OF ARAB COUNTRIES ACCORDING TO NUTRITION TRANSITION**

Category	Characteristics	Countries
Countries in advanced nutrition transition	• high levels of overweight and obesity • moderate levels of undernutrition and micronutrient • deficiencies in some population subgroups	GCC countries Tunisia
Countries in early nutrition transition	• moderate levels of overweight and obesity • moderate levels of undernutrition in specific population and age groups • widespread micronutrient deficiencies	Egypt Jordan Lebanon Libya Morocco Palestine Syria
Countries with significant undernutrition	• particularly high levels of acute and chronic child malnutrition • widespread micronutrient deficiencies • emerging overweight, obesity and malnutrition of affluence in certain socioeconomic subgroups	Djibouti Iraq Yemen population subgroups in GCC countries, Palestine (Gaza) and Tunisia
Countries in complex emergency	• severe child and maternal undernutrition • widespread micronutrient deficiencies	Somalia Sudan

Source: Adapted from WHO, 2011

TABLE 5 GLOBAL AND REGIONAL PER CAPITA ENERGY CONSUMPTION OF FOOD (KCAL/CAPITA/DAY)

	1964-1966	1974-1976	1984-1986	1997-1999	2015	2030
World	2,358	2,435	2,655	2,803	2,940	3,050
Near East and North Africa	2,290	2,591	2,953	3,006	3,090	3,170

Source: WHO, n.d.

TABLE 6 NATIONAL PER CAPITA ENERGY SUPPLY OF FOOD (KCAL/CAPITA/DAY)

Country	1965	1975	1985	1995	2005	2011	Percent Increase, 1965-2011 (%)
Algeria	1,591	2,058	2,613	2,785	2,958	3,220	102
Bahrain	-	-	-	-	-	-	-
Comoros	-	-	-	-	-	-	-
Djibouti	1,586	1,661	1,562	1,707	2,264	2,526	59
Egypt	2,229	2,430	3,069	3,315	3,367	3,557	60
Iraq	2,054	2,200	3,321	2,202	2,354	2,489	21
Jordan	2,158	2,138	2,651	2,687	3,119	3,149	46
Kuwait	2,556	2,538	2,922	3,214	3,576	3,471	36
Lebanon	2,472	2,437	2,933	3,287	3,128	3,181	29
Libya	1,783	2,995	3,251	3,225	3,190	3,211	80
Mauritania	2,129	1,959	2,449	2,533	2,632	2,791	31
Morocco	2,173	2,617	2,864	2,952	3,207	3,334	53
Oman	-	-	-	-	-	-	-
Palestine	-	-	-	-	2,237	2,032	-
Qatar	-	-	-	-	-	-	-
Saudi Arabia	1,857	1,795	2,703	2,852	2,973	3,122	68
Somalia	1,863	1,898	2,028	1,624	1,779	1,696	-9
Sudan	1,610	1,907	2,006	2,169	2,296	2,346	46
Syria	2,143	2,559	3,039	2,967	3,101	3,106	45
Tunisia	2,393	2,674	3,064	3,129	3,223	3,362	40
UAE	2,587	3,141	3,477	3,261	3,210	3,215	24
Yemen	1,842	1,870	2,054	2,043	2,093	2,185	19

FAOStat (2015) and authors' calculations

(Iraq, Palestine, Somalia, Sudan, and Yemen) have reported an energy supply of less than 2,500 kcal/capita/day, while nearly all other countries have reported an energy supply of over 3,000 kcal/capita/day.

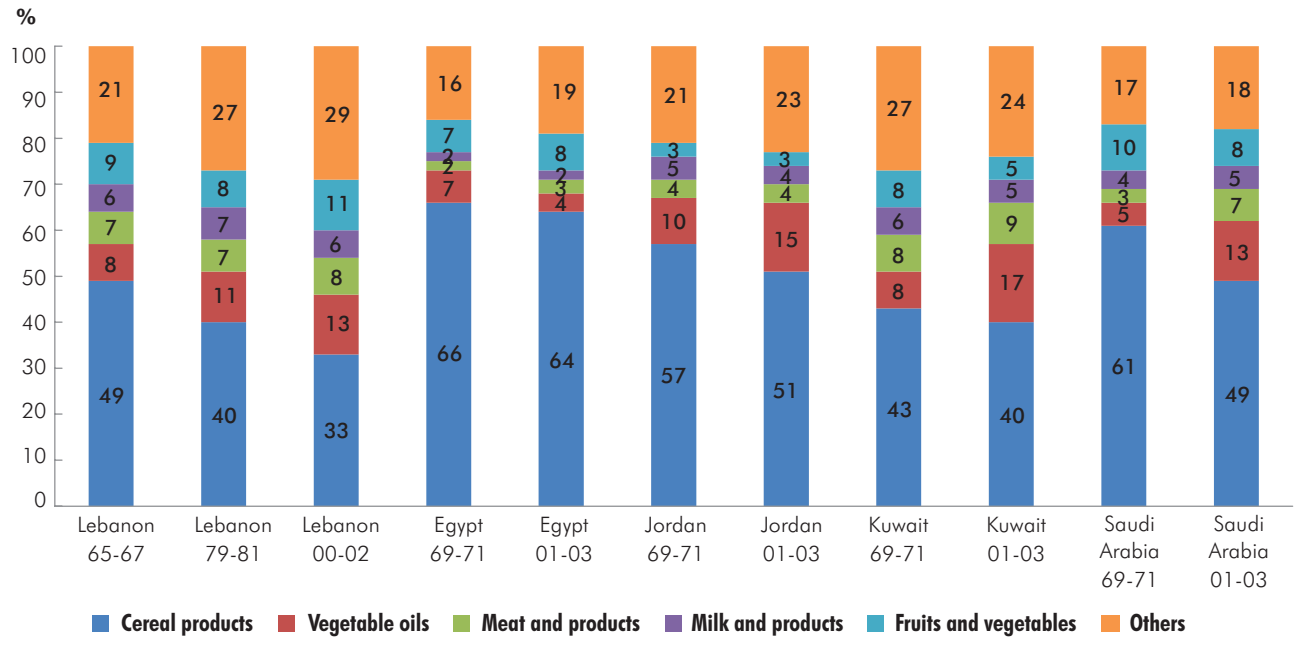
It is worth to emphasize that total energy supply, as noted above, does not fully reflect food and nutrition security. A diversity of nutrients is also required to ensure good health and prevent disease. No single food can provide all of the nutrients necessary for optimal health. Rather, a varied diet that is nutritionally complete is needed to ensure adequate amounts of essential macro- and micronutrients (Horwath et al., 1999; Bernstein et al., 2002; Hollis and Henry, 2007). Data on changes in percent dietary energy supply from various food groups in selected Arab countries over the past few decades are shown in Figure 17. A dramatic increase in the proportion of energy from vegetable oils has been particularly documented in Kuwait, Saudi Arabia, and

Lebanon, and to a lesser extent in Egypt and Jordan. The proportion of energy from fruits and vegetables has also decreased in Kuwait and Saudi Arabia, but increased in Lebanon.

It should be noted, as well, that supply levels should be treated with caution, as they do not reflect actual consumption. More recently, Afshin et al. (2015) evaluated national intakes of harmful and protective foods in countries of the MENA region using 2010 consumption data. Most, if not all, Arab countries showed insufficient per capita consumption of protective foods (fruits, vegetables and beans, nuts and seeds, whole grains, and seafood omega-3 fatty acids) that fell well below recommended levels. In fact, all Arab countries consumed fruits in amounts less than the recommended level of above 300 g/day. Similarly, no Arab country consumed the recommended level of vegetables and beans of above 400 g/day. Only three countries (Tunisia, Syria, and Lebanon) met or exceeded the recommended level of above 16 g/day for nuts and seeds. As for whole grains, the majority of Arab countries consumed 59-63 g/day, below the recommended level of above 125 g/day. Similarly, the majority of Arab countries consumed 50-75 mg/day of seafood omega-3 fatty acids, well below the recommended level of above 250 mg/day. Lowest intakes of protective food components were observed in Libya for fruits, vegetables and beans; in Saudi Arabia for nuts and seeds; in Egypt for whole grains; and in Lebanon for seafood omega-3 fatty acids. Figure 18 displays national consumption data of protective food components across Arab countries as reported by Afshin et al. (2015).

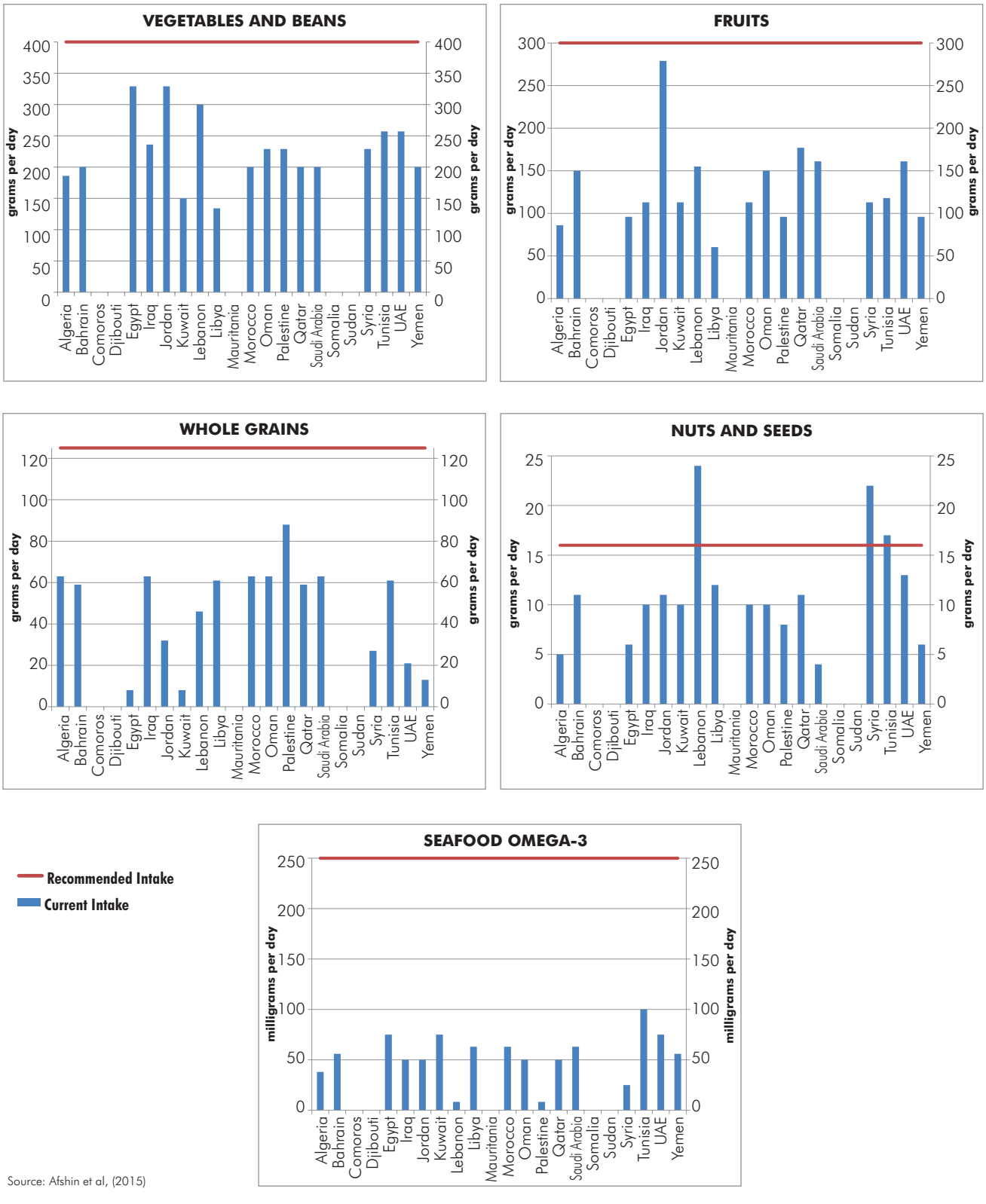
As for harmful food components, all Arab countries showed higher than recommended per capita consumption of selected food components (processed meat, red meat, trans-fatty acids, sugar-sweetened beverages, and sodium). For instance, while consumption of processed meat is not recommended, intake ranged between 3.4-6.5 g/day across most countries (an average of 1.5 kg per year). As for red meat, while the recommended level is 100 g/week, all Arab countries consumed levels ranging between 300-700 g/week. Regional consumption of trans-fatty acids was in the range of 1-3 percent E/day, higher than the recommended level of below 0.5 percent E/day. While consumption of sugar-sweetened beverages is not recommended, most

FIGURE 17 **PERCENT DIETARY ENERGY SUPPLY FROM FOOD GROUPS: A COMPARISON OF MENA COUNTRIES (FAOSTAT)**



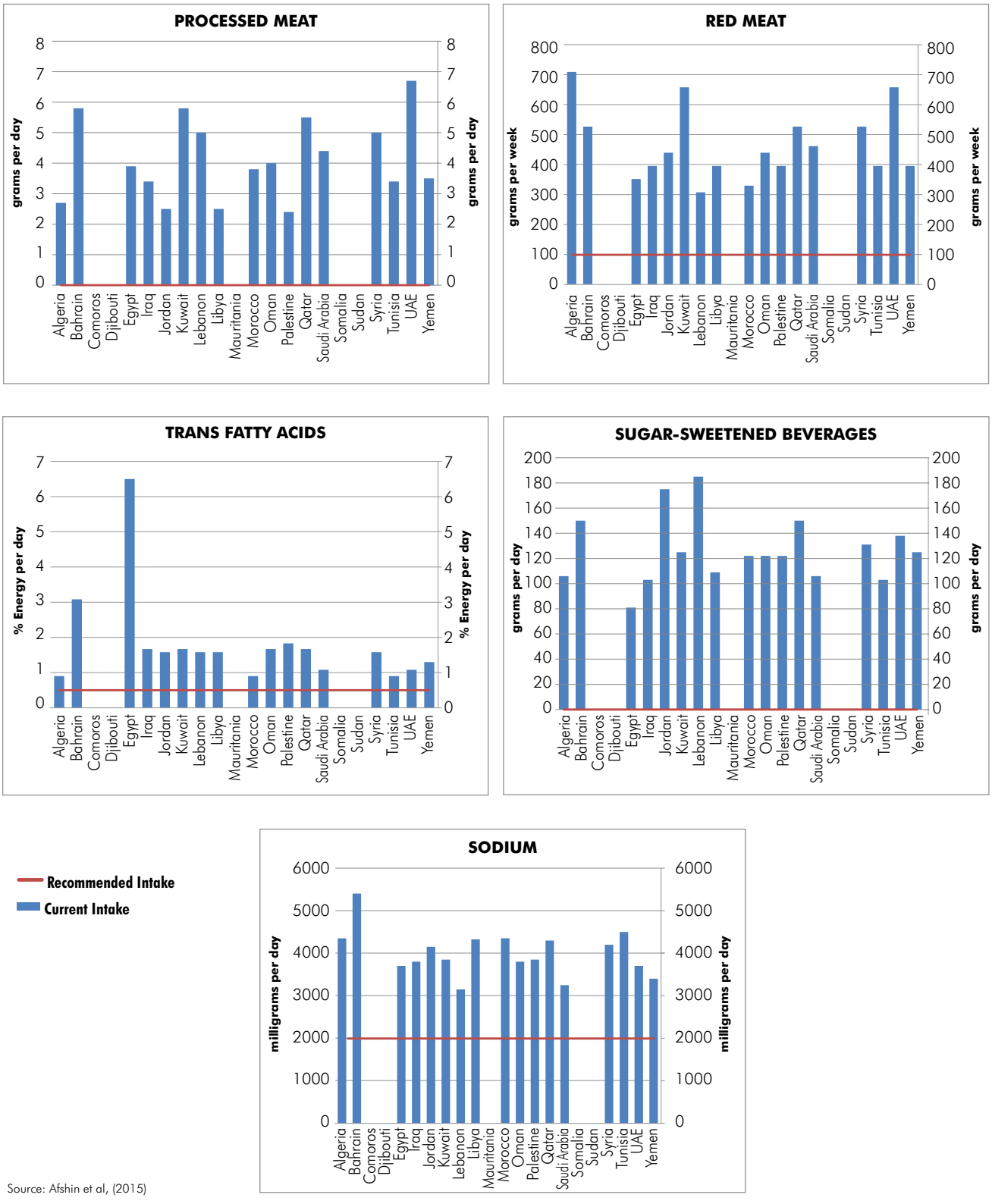
Source: Sibai et al., 2010

FIGURE 18 NATIONAL CONSUMPTION AND RECOMMENDED INTAKES OF PROTECTIVE FOOD COMPONENTS IN ARAB COUNTRIES



Source: Afshin et al, (2015)

FIGURE 19 NATIONAL CONSUMPTION AND RECOMMENDED INTAKES OF HARMFUL FOOD COMPONENTS IN ARAB COUNTRIES



Source: Afshin et al, (2015)

Arab countries had intakes between 100-185 g/day. The MENA region also suffers from high sodium intake above the recommended level of below 2,000 mg/day, as evident by the majority of Arab countries consuming 3,500-5,000 mg/day of sodium. Highest intakes of harmful food components were observed in the UAE for processed meat; in Algeria for red meat; in Egypt for trans-fatty acids; in Lebanon for sugar-sweetened beverages; and in Bahrain for sodium. Figure 19 shows national consumption data of harmful food components across Arab countries as reported by Afshin et al. (2015).

Additionally, many such possibly harmful components of the Arab diet are also examples of foods that have a negative impact on the sustainability of the current food system and hence on food and nutrition security. For example, red meat is currently over-consumed, with negative impacts on both human health and sustainability of the food system while fish and seafood are protective foods that are under-consumed but whose production can be more sustainable. Thus, changing dietary habits is a crucial issue involving intricate social and cultural values and traditions. For example, dwindling water resources is likely to prevent some countries from producing enough of a certain traditional crop, like rice, for an ever-growing population. The same applies to red meat, as raising cattle is a water-intensive activity. Moreover, cows in particular produce a very high level of greenhouse gases, which intensifies climate change. When asking the Arabs whether they are ready to change their dietary habits to protect the environment or the public health, the answers were surprisingly positives, as 84 percent of the respondents were ready to do so to save the environment, while an astounding majority of 99 percent went for it if it would protect their health, such as fighting obesity, diabetes and blood fats. Since considering that what is better for the health is better for the environment, as most cases show, the results might indicate that a good approach to promote positive change in food consumption patterns is to put more emphasis on the health benefits, as they are more easily recognized by the public.

VI. CONCLUSION AND RECOMMENDATIONS

Though the Arab region was one of the first to adopt a regional strategy for SCP, development and implementation of SCP strategies in most Arab countries are still lagging. The Arab demand on energy, water, and food is driven by a myriad of socio-economic and geographic factors including level of development, population growth, urbanization, scarcity of water resources, climate conditions, government policies and pricing schemes. Yet, the region is truly heterogeneous in terms of those factors and the level of per capita consumptions varies accordingly.

The AFED 2015 survey on sustainable consumption reveals the impacts of governments' interventions on purchasing decisions and patterns of consumption. Only 9 percent of the Qataris buy electrical appliances based on their energy efficiency, while the same figure increases to 57 percent in Tunisia. Similarly, brand name and model of cars were the main purchasing criteria in the GCC (countries with high income and very low fuel prices), while fuel efficiency and price dominated as the main factors for purchasing a car in Jordan, Egypt, Morocco, Lebanon, Iraq and Tunisia. Only 17 percent of Saudis would choose a car for its fuel efficiency, while the number increases to 72 percent in Jordan, which reveals a direct relationship between car purchase decisions and fuel prices. The same survey shows that public awareness is not enough to change consumption habits, and governments' interventions through demand side initiatives are inevitable to complement public awareness.

Though most of the Arab countries have had a long history of subsidizing energy, water, and food prices for different reasons, experience shows that subsidies only

promote wasteful consumption behavior, and do not help to ease the burden on the poor, as over 90 percent of the general subsidies go to the rich. An interesting response of the AFED survey, worth to consider while planning to reform energy and water pricing in the region, shows that 77 percent of the respondents agree to pay more for water and energy if compensated with better social benefits, such as education, health insurance and adequate pensions. Thus, governments' fears of price reforms need to be revisited if enhanced social benefits are considered.

Increased welfare is a major driver of food demand and changes in food consumption habits in the region. The Arab population is experiencing a nutrition transition characterized by a shift away from a traditional, more seasonal, and more diverse diet, rich in whole grains, fruits, and vegetables, towards a diet that is high in refined cereals, animal protein, fats, sugar, and salt. Although the rate of under-nutrition and underweight among under-five years children has been on the decline in some Arab countries, there has been a parallel dramatic increase in the prevalence of overweight, obesity and diet-related diseases such as diabetes, cardiovascular disease, and cancers. Changing dietary habits is a crucial issue involving intricate social and cultural values and traditions. The survey results indicated that 84 percent of the respondents are ready to change their dietary habits to protect the environment and 99 percent are ready to do so for better public health.

The Arab region is known to be energy rich, water scarce, food deficient, and one of the world's most economically and environmentally vulnerable regions to climate change. The current weak or lack of policy coordination for water, agriculture land, energy, and climate change calls for the adoption of the nexus approach when addressing the management of these vital resources in a changing climate.

In order for the Arab countries to gradually shift to sustainable consumption and production, every country, based on its respective socio-economic circumstance, needs to identify priority actions and enabling conditions necessary to facilitate that transition. These enabling conditions include: good governance, integrated policy planning, sound regulatory regime, use of market-based instruments, capacity development, access to finance and investments, research and development, public awareness, and green procurement.

REFERENCES

AFED (2010). Arab Environment: Water - Sustainable Management of a Scarce Resource. Annual Report of the Arab Forum for Environment and Development (AFED), El-Ashry, M., Saab, N. and Zeitoon, B. (Eds.). Beirut, Lebanon. Technical Publications.

AFED (2013). Arab Environment: Sustainable Energy. Annual Report of the Arab Forum for Environment and Development (AFED), Abdel Gelil, I., El-Ashry, M. and Saab, N. (Eds.); Beirut, Lebanon. Technical Publications.

AFED (2014). Arab Environment: Food Security. Annual Report of the Arab Forum for Environment and Development, 2014; Sadik, A., El-Solh, M. and Saab, N. (Eds.); Beirut, Lebanon. Technical Publications.

Afshari, A., Nikolopoulou, C. and Martin, M. (2014). Life-Cycle Analysis of Building Retrofits at the Urban Scale—A Case Study in United Arab Emirates, Sustainability (2014)6, 453-473. Available at: www.mdpi.com/journal/sustainability.

Afshin, A., Micha, R., Khatibzadeh, S., Fahimi, S., Shi, P., Powles, J. and Mozaffarian, D.(2015). "The impact of dietary habits and metabolic risk factors on cardiovascular and diabetes mortality in countries of the Middle East and North Africa in 2010: a comparative risk assessment analysis." British Medical Journal Open, 5:e006385.doi:10.1136/bmjopen-2014-006385.

Ahmed, G., Hamrick, D., Guinn, A., Abdulsamad, A. and Gereffi, G. (2013). Wheat

value chains and food security in the Middle East and North Africa region. Duke University Center on Globalization, Governance, and Competitiveness, Durham, NC.

Bernstein, M.A., Tucker, K.L., Ryan, N.D., O'Neill, E.F., Clements, K.M., Nelson, M.E., Evans, W.J. and Fiatarone Singh, M.A. (2002). "Higher dietary variety is associated with better nutritional status in frail elderly people." Journal of the American Dietetic Association, 102: 1096–1104.

Breisinger, C., van Rheenen, T., Ringler, C., Pratt, A.N., Minot, N., Aragon, C., Yu, B., Ecker, O. and Zhu, T. (2010). "Food security and economic development in the Middle East and North Africa: Current state and future perspectives." IFPRI Discussion Paper 00985. International Food Policy Research Institute, Washington, D.C.

El-Katiri, L. and Fatouh, B. (2015), A brief political economy of energy subsidies in the Middle East and North Africa, OIES paper.

ESCWA (2001), Energy options for desalination in selected ESCWA member countries., ESCWA.

FAO (2008). Climate Change and Food Security: A Framework Document. Rome: FAO.

FAO (2011). Energy-Smart Food at FAO: An Overview. Environment and natural resources management working paper. Rome: FAO.

FAO (2014) FAO Statistical Yearbook 2014: Near East and North Africa Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome.

GTZ (2010). Fossil Fuel Prices in the Arab World and the Fear of Reform: Challenges facing reform attempts and the way forward.

Habitat, Habitat, Urbanization and Urban Risks in the Arab Region, 2013. 1st Arab Region Conference for Disaster Risk Reduction, 19 – 21 March 2013 at Aqaba - Jordan Katja Schäfer – UN-Habitat Regional Office for Arab States (ROAS).

Hollis, J.H. and Henry, J.K. (2007). "Dietary variety and its effect on food intake of elderly adults."Journal of Human Nutrition and Dietetics, 20: 345–351.

Horwath, C., Kouris-Blazos, A., Savige, G. and Wahlqvist, M.L. (1999). "Eating your way to a successful old age, with special reference to older women." Asia Pacific Journal of Clinical Nutrition, 8: 216–225.

Johnston, J., Fanzo, J. and Cogill, B. (2014). "Understanding sustainable diets: A descriptive analysis of the determinants and processes that influence diets and their impact on health, food security, and environmental sustainability." Advances in Nutrition, 5: 418-429.

LAS (2009). Arab Regional Strategy on Sustainable consumption and Production.

Meerman, J., Garrett, J. and Wüstefeld, M.(2013). "Development partners and country programming in nutrition and agriculture." SCN News, 40: 10-18.

Micronutrient Initiative. (2009). Investing in the future: A united call to action on vitamin and mineral deficiencies, global report 2009. Micro-Nutrient Initiative, Ottawa.http://www.unitedcalltoaction.org/documents/Investing_in_the_future.pdf.

Popkin, B. (2000). "Urbanization and the nutrition transition." IFPRI Brief, 7. International Food Policy Research Institute, Washington, D.C.

Sachs J. et al. (2010).Monitoring the world's agriculture, Nature, 466, 558-560.

SEI (2011). Understanding the Nexus, Background paper for the Bonn2011 Nexus Conference. Bonn2011 Conference, The Water, Energy and Food Security Nexus: Solutions for the Green Economy, 16 – 18 November 2011, Bonn, Germany.

Siddiqi, A. and Anadon, L., The water–energy nexus in Middle East and North Africa, Energy Policy 39 (2011) 4529-4540.

UNCED (1992). Agenda 21. Available at: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf.

UNDESA (United Nations Department of Economic and Social Affairs) (2012) World Population Prospects, the 2012 Revision. New York. [http://esa.un.org/unpd/wpp/Excel-Data/population.htm].

UNDP (2013). Water Governance in the Arab Region: Managing Scarcity and Securing the Future. UNDP Regional Bureau of Arab States (RBAS). [Available at:http://www.arabstates.undp.org/content/rbas/en/home/library/huma_development/water-governance-in-the-arab-region.html.

UNEP (2010). ABC of SCP: Clarifying concepts on SCP., available at: http://www.uneptie.org/scp/marrakech/pdf/ABC%20of%20SCP%20-%20Clarifying%20Concepts%20on%20SCP.pdf.

World Bank (2012). Adaptation to a Changing Climate in the Arab Countries, available at: http://elibrary.worldbank.org/doi/book/10.1596/978-0-8213-9459-5.

World Bank (2014). HARNESSING THE GLOBAL RECOVERY: A TOUGH ROAD AHEAD, available at: http://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-0395-6.

World Bank (2015). WDI, available at: http://data.worldbank.org/data-catalog/world-development-indicators.

World Bank, FAO, IFAD (2009). Improving food security in Arab countries.

World Health Organization (WHO) (2011). Regional strategy on nutrition 2010–2019 and plan of action. WHO Regional Office for the Eastern Mediterranean: Cairo.

World Health Organization (WHO) (n.d.). "Global and Regional Food Consumption Patterns and Trends." http://www.who.int/nutrition/topics/3_foodconsumption/en/ [accessed March 13, 2015].

WSSD (2002).Johannesburg Plan of Implementation, Chapter III., available at: http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf.

WW (2007). The World's Water 2006–2007 Data, report of the Pacific Institute. Available: /http://www.worldwater.org/data.html.

NOTES

1. FAO defines the Near East and North Africa region as including Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

2. According to the World Health Organization (2015), overweight is defined as a body mass index (BMI) greater than or equal to 25 and less than 30; obesity is defined as a BMI greater than or equal to 30.

3. Food supply is used as a rough proxy for food consumption. Total food supply may overstate consumption, as food may be wasted or otherwise not consumed.

ANNEX

ENABLING CONDITIONS FOR SUSTAINABLE CONSUMPTION AND PRODUCTION IN THE ARAB REGION

Hussein Abaza

In order for the Arab countries to gradually shift to SCP, every country, based on its respective socio-economic circumstances, needs to identify priority actions and enabling conditions necessary to facilitate that transition. The following is shopping lists from which governments can use to tailor make their interventions. However, it is worth noting that government actions and policy interventions though essential, they will not be sufficient to bring about sustainable consumption and production in Arab countries without the engagement and active role of different actors and stakeholders in the Arab world. Civil society and the private sector as well as the general public have an important role to play in bringing about a change in consumption and production patterns that uses scarce natural resources in a more efficient and sustainable manner.

1. Good governance

A strong governance system that promotes transparency, accountability, and stakeholder participation is essential in promoting more sustainable consumption and production patterns and promoting a transition to a green economy. Moreover, fighting corruption is also a necessary prerequisite for a strong and efficient governance structure. Apart from promoting an all-inclusive approach to policy and decision-making, good governance should ensure an equitable distribution of incomes and wealth and the involvement of women and youth. This has been one of main reasons that have resulted in the series of unrests and revolutions in several Arab countries. Engaging different segments of the population in the decision-making process, promoting social justice and equity are all factors that contribute

to the acceptability of proposed policy measures and their successful implementation. They promote a sense of ownership andbelonging to the country, which consequently increases workers' productivity and positive attitude towards the government and its decisions. Adopting a participatory approach in the design and implementation of measures and policies that contribute towards sustainable consumption and production will ensure that the different interests of community stakeholders are taken into account. Officials, civil servants and decision makers should be provided with information, capacity training, and the ability to analyze challenges, assess opportunities and ensure coordination between different entities in order to avoid redundant, inefficient, and conflicting policies.

Overall managerial restructuring and reform of certain public bodies and the establishment of new ones with specialized mandates related to sustainable consumption and production could significantly facilitate the introduction of necessary policy tools and measures to green the economy and achieve sustainable development. Strategic environmental assessments, project level impact assessment, identifying sustainable development indicators, life cycle analysis, integrated environmental and economic accounting, and public environmental expenditure reviews are tools that could be used.

2. *Integrated policymaking*

Integrating environmental and social considerations with macroeconomic and sectoral policies are essential in achieving sustainable development. Integrated policy making should include the mainstreaming of sustainable consumption and production and greening the economy as a tool to achieve sustainable development. Such integration is necessary in designing overall government strategies and in formulating, plans, programs, and projects. A strong and good governance system will facilitate the realization of this integration. It will also facilitate the implementation of the proposed strategy, plans, programs, and projects. Integrated policymaking for sustainable consumption and production and green transformation should be conducted in a manner that contributes to achieving a number of key objectives. This includes promoting a more sustainable production and consumption practices, resource efficiency, waste reduction and eventually avoidance, the introduction and use of innovative technologies, enhanced competitiveness of final products, and job creation.

Social cohesion and equity considerations are essential elements that should be taken into account in introducing policy packages that promote sustainable consumption and production and the transitioning into a green economy. Special consideration should also be given to under privileged and marginalized communities. Subsidy reform for water, energy and food should be accompanied by the introduction of compensatory measures such as employment opportunities, and affordable housing and public transport systems, as well as social services, including access to health, educational, cultural and recreational services. Monitoring and evaluation should be introduced to continuously monitor and assess the adequacy of policies, the impact they have on different segments of the population, the extent of their inclusiveness, and in bringing about a transition to more sustainable and green economies.

Investments in much needed social and physical infrastructure and services especially in rural areas in the form of health, sanitation, and education can raise the standard of living of the rural population, their productivity, and sense of belonging.

3. Regulatory framework

Regulations can provide a strong and effective means for supporting and encouraging a transition towards more sustainable patterns of consumption and production in the Arab world. Certification for sustainably grown agricultural products, eco labeling and energy efficiency labels are possible tools that can be introduced through regulations. More than half of the Arab countries have adopted minimum energy efficiency standards for household appliances. However, the problem lies in monitoring and enforcing these codes standards. In addition, regulatory measures may also include the introduction of green building codes and equipment that promote water and energy efficiency. Mandatory building codes and the introduction or strengthening of standards for air conditioners are becoming more common in the region. Many Arab countries have adopted either mandatory or voluntary forms of energy efficiency building regulations, these include for examples UAE, Qatar, Kuwait, and Lebanon.

Regulations could also be designed to direct food production that leads towards food products that has more nutritious value, affordable to consumers and reduces the environmental footprint of the food products.

Weak compliance and monitoring mechanisms are among the main challenges facing the effectiveness of regulations in the Arab region. Financial resources and capacities needed in designing and managing a national regulatory framework represent a major constraint in many Arab countries.

4. Market based incentives

Economic incentives should be designed to support regulatory command and control mechanisms. They should be carefully selected to influence behavior towards more sustainable patterns of production and consumption. An incentive system should also be designed to encourage private sector engagement and investments in social and green infrastructure projects.

There is a need to reform the entire fiscal and tax system to achieve this goal. It is essential for example to shift the tax system from taxing jobs and incomes to taxing unsustainable practices. It should be designed to apply the polluter-pays principle, attempt to reflect full cost pricing of natural resources, and internalize environmental and social externalities. Full consideration should be given to ensuring that the proposed tax system does not represent an extra burden on citizens, particularly low-income and poor families. Moreover, it should attempt to achieve revenue neutrality, which does not result in reduced governments' revenues.

Economic instruments include taxes, pollution charges, credits and rebates, R&D grants, subsidy reform, and green subsidies. Other tools include feed-in-tariffs to promote the business competitiveness of renewable energy sources and encourage the building of its related infrastructure. Payment for providing ecosystem service schemes (PES) to promote ecosystem and biodiversity conservation is another economic tool that contributes to the sustainable management of natural resources.

More specifically government should reform the subsidies system to encourage the efficient allocation and use of resources and discourage consumption and production patterns. This is particularly important since subsidies in several Arab countries continue to represent a burden on government budgets and in many instances fail to reach the targeted segments of the population they are designed to support. Such a reform will reduce pressure on government budgets and release financial resources to provide the much needed social services, fund environmental activities, and investments in human resources and R&D. Subsidized water, electricity, fuel, food, and waste collection schemes are all examples of the extent of current local market distortions contributing to unsustainable production and consumption patterns that need to be corrected.

5. Human resource development

Investing in human resource development is key in making a qualitative shift towards sustainable consumption and production patterns and supporting government efforts to achieve sustainable development. Investing in human capital through an improved education system that integrates sustainability consideration across all disciplines is a necessary prerequisite to provide the needed calibers at all levels, whether managerial, technical, or skilled labor to support a transition to a green and sustainable economy. A well-educated and informed public will go a long way in supporting a transition to more sustainable and green economy that uses resources in a prudent and more efficient manner.

6. Access to finance and facilitating Investments

It is crucial to gradually redirect existing financial resources

towards sustainable development plans, programs, and activities. Innovative financial mechanisms include the introduction of soft loan programs, credit schemes, hedge funds, social venture capital, carbon credits, and micro finance. It is also important to emphasize that access to finance tools endorsed by governments should target small and medium size enterprises as they represent a large percentage of operating companies in the Arab world.

Financial tools should be used to stimulate local market demand; investments and practices along more sustainable consumption and production by supporting consumer-based schemes to purchase locally produced green and energy efficient goods such as renewable energy, organic products environment-friendly consumer goods and vehicles.

7. Research and development

Innovative technologies and practices are essential in supporting a transition to sustainable economy. Arab capacity on R&D has been very low due to many factors including lack of investments in R&D activities. Arab countries generally allocate small percentage of their GDP to R&D. Egypt for example has allocated in 2011, 0.43 percent of GDP to R&D (World Development Indicators, July 2015), while the Republic of South Korea currently allocated about 4.4 percent of GDP to R&D in 2014 (CEIC, Morgan Stanley, June 2014) and Israel allocated 3.9 percent of its GDP in 2012 (World Development Indicators, July 2015). This has to change if the Arab world is to achieve a real qualitative shift towards more sustainable patterns of consumption and production. Efforts should also be made to encourage private sector engagement in R&D. This can be achieved by providing incentives for private sector investment in R&D through tax cuts and rebates and other incentive measures.

It is also important to shift emphasize from relying on imported technologies, products and know-how to developing local technologies and products that suit local conditions and can eventually be exported to generate foreign exchange earnings.

Research and development in water, food and energy should focus on Arab priorities such as solar water desalination and wastewater treatment technologies, water saving irrigation equipment, and green building components.

8. Green public procurement

Government spending can be an effective tool in stimulating sustainable consumption and production patterns in the Arab world by directing government spending purchases and spending towards green products and services. Apart from setting the example for the general public and the private sector, green public procurement will also create markets and demand for green products.

Green public products include public offices, schools, hospitals, and other public buildings, transport systems, public infrastructure, building material, office equipment and supplies, etc. Promoting green public procurement and practices in the Arab world will go a long way in contributing towards a more sustainable and efficient use of resources across sectors. It can also influence the market for cleaner production and efficient consumption by purchasing locally made resource efficient products.

9. Public awareness and information dissemination

Public awareness and information dissemination can be effective tools in supporting government efforts in defining, informing and communicating the benefits and significance of sustainable consumption patterns for health, environment and the economy. As revealed by the AFED survey, unsustainable consumption patterns were in many instances attributed to lack of awareness to the negative implications of excessive and wasteful patterns of consumption on health, the environment and resource use.

These tools can take the form of Internet, social media, advertising and printed campaigns. They can also be in the form of educational materials, reports, and flyers and brochures that can be distributed in schools, and through commercial and public facilities. Seminars, expert consultations and lectures are also possible venues for outreach and awareness. It should be emphasized though that these communication packages should be designed to address different target groups in simple language and in a manner that caters for their specific interests, priorities and concerns.

Hussein Abaza, Former Chief, UNEP's Economics and Trade Branch, Geneva.

ANNEX

INTERNATIONAL LAW AND THE PYRAMID OF ASSUMPTIONS: DO WE NEED MORE FOOD TO TACKLE HUNGER IN THE FACE OF CLIMATE CHANGE?

Anne Saab

INTRODUCTION

Climatic conditions such as droughts, higher average temperatures, and higher levels of soil salinity are expected to cause a significant decline in crop yields in some parts of the world. Lower crop yields means less food production, which arguably leads to more food insecurity and exacerbates global hunger. A common response to issues of food insecurity and hunger – whether in the context of climate change or not – is to aim for an increase in production. Although increasing food production may indeed be necessary, particularly in certain regions, this is not the only way to address the issues. Changing consumption patterns may be a cheaper and more environmentally-friendly alternative to focusing so much attention on increasing production. In this piece, I will discuss some of the main conclusions from my doctoral research and argue that there are assumptions underlying popular discourse on climate change and hunger that strongly suggest that increasing food production is the main way to deal with climate-induced hunger. As a legal scholar, my focus is on the role that international law plays in upholding these assumptions.

In my doctoral research,[1] I explored one specific adaptation strategy that proposes to stabilize or even increase crop yields in the face of climate change, namely so-called 'climate-ready seeds'. Climate-ready seeds are genetically engineered to resist climatic stresses such as drought. Some actors contend that they are an adaptation strategy that will increase crop yields and tackle climate-induced hunger. A handful of large private seed corporations dominate the development of climate-ready seeds. These corporations are increasingly applying for patent rights on the seeds.[2] Others – notably critical NGOs – contend that climate-ready seeds benefit seed corporations but do nothing to alleviate hunger of the poorest and most vulnerable. They hold that seed corporations abuse the climate and food crises to monopolize the seed market.[3]

Contradictory accounts of climate-ready seeds present different views on whether this proposed adaptation strategy can contribute to combating food insecurity and hunger caused by the impacts of climate change. These accounts form the basis of my investigation and analysis. I am not in the position in my research to address the science behind climate change. I am also not in the position to address the science behind adaptation strategies, such as climate-ready seeds. Rather, my exploration focuses on studying discourses. In other words, what are different actors saying about the impacts of climate change on food security and hunger, and how we should go about addressing these problems? More specifically, as an international legal scholar, I focus on the role that international law plays in shaping these discourses. Which areas of international law are relevant to discussions about climate-ready seeds, and how do different actors in these debates employ international law in their discourse?

Several fields of international law are relevant to discussions on climate-ready seeds, and contradictory accounts of climate-ready seeds draw on these areas of international law. I examine in my research consecutively: climate change adaptation law, patent law (particularly seed patents), and human rights law (especially the right to food). An initial observation on the role of international law[4] is that law is most often presented as a means through which to 'solve' these problems, for instance in contributing to devising adaptation strategies. The main conclusion that I draw from my research, however, is that there are assumptions about the problem of climate change and hunger that are present in all narratives of climate-ready seeds, and that international law – in the way it is framed and how it is invoked – contributes to upholding these assumptions. These assumptions support a certain way of thinking about the problem of climate change and hunger, and consequently determine the types of adaptation strategies / solutions to the problem. I argue that upholding these assumptions limits other, and perhaps more effective, solutions.

The main analysis of my research therefore focuses on the cumulative role of different areas of international law in contributing to our understanding of the problem of food insecurity and hunger in the context of climate change. My analysis is based on five fundamental assumptions about climate change-induced hunger, which I will explain in the next section.

THE PYRAMID OF ASSUMPTIONS

While examining different stories about climate-ready seeds

and how they employ international law in their arguments, it became evident to me that most of the debate revolves around the question of patent rights on these seeds. The biggest issue appears to be that a handful of seed corporations are increasingly filing patent applications on those seeds. One influential and highly critical NGO, the ETC Group, has called these corporations 'Gene Giants'.[5] My initial focus in studying the role of international law was therefore on patent law, and how it has increasingly allowed the application of patent rights on living things, such as (genetically engineered) plants and seeds.

I soon realized, however, that to focus so much critical attention on the fact that seed corporations are increasingly applying for seed patents on climate-ready seeds, means that there are other questions relating to climate change and hunger that are not as explicitly addressed. The five assumptions that I identify are examples of questions that are left in the background of the debate, while corporate seed patents are in the foreground. I view these assumptions as a pyramid. The debate about patent rights and Gene Giants is situated in the tip of the pyramid, where most of the attention is concentrated. I argue that placing so much attention on this question in the tip of the pyramid serves to uphold the five assumptions that I identify lower in the pyramid.

The five assumptions are as follows: 1) climate change causes hunger; 2) increased food production is necessary to address hunger; 3) agricultural biotechnologies are needed to increase food production to address hunger; 4) private sector investments are necessary to develop agricultural biotechnologies to alleviate hunger; and 5) patent rights are necessary incentives for the development of agricultural biotechnologies. The first assumption forms the base of the pyramid and is the most fundamental. Each assumption higher in the pyramid depends on the acceptance of the foregoing assumption.

Each of these assumptions is highly contentious; this is the exact reason why I chose them. Despite serious and valid challenges to each of the assumptions, the way in which the discourse is framed and how international law is framed in the discourse in a subtle manner foregoes explicit questioning of each assumption.

First assumption: climate change causes hunger

If we are to have any discussions about food security and hunger in the face of climate change, then we must assume that there is some kind of causal relationship between climate (change) and hunger. The nature of this relationship is by no means uncontested. I draw on Mike Davis's study on famines in British colonies in the 19th century.[6] Davis argues that it was already known by some at that time that it was not only 'bad weather' that caused famines, but also 'bad systems' that leave some more vulnerable to the effects of the climate than others. Despite this recognition, Davis argues that British colonial rulers often attributed famines to 'bad weather', as a way to extenuate the adverse influence of the colonial system on the incidence of famines.[7]

In contemporary discussions about climate change, there is also recognition that it is not climate change itself, but rather vulnerability to its impacts that cause food insecurity and hunger. Notwithstanding these nuances, the way that the discourse is framed gives the strong impression that climate change causes hunger. The term 'anthropogenic' is often used to refer to climate change: climate change is caused by man. The same term is not used, at least not explicitly, for hunger. The suggestion seems to be that climate change is anthropogenic, and climate change exacerbates hunger, but hunger is not anthropogenic.

International law, notably climate change adaptation law and human rights law, also contribute to upholding this assumption. This is evident in reports published by the Intergovernmental Panel on Climate Change (IPCC)[8] and the UN Framework Convention on Climate Change (FCCC),[9] as well as in media reports[10] that draw on information from these authoritative climate change institutions. These reports, which can be viewed as part of the broader climate change adaptation legal discourse, place a great deal of emphasis on the relationship between climate change impacts, food insecurity, and hunger.

The way in which international human rights law is framed and invoked in discourse on climate change in general, and climate-ready seeds in particular, also contributes to this impression. Climate change is presented as a threat to human rights, and particularly to the right to food.[11] By presenting climate change impacts as potentially violating the right to food, the suggestion is raised that there is a causal link between climate change and food insecurity/hunger.

Second assumption: increased food production is necessary to tackle hunger

Assuming that climate change causes hunger, what needs to be done to alleviate climate-induced hunger?

The second assumption that is left in place is that food production needs to increase in order to tackle hunger. This is also a much-debated issue. There are many reports that suggest that there is enough food produced globally to feed more than the world population; the real problem is distribution of, and access to, food. Indian economist Amartya Sen has famously said that starvation is not a problem of there not being enough food, it is a problem of some people not having access to enough food.[12] In climate change discourse, there are also recognition that it is not so much the overall global food production we should be concerned with, as much as the continued lack of access to food for those regions and peoples already most food insecure and vulnerable.

Despite these nuances, the different narratives of climate-ready seeds do not expressly pose the question of whether we really need to increase food production to tackle climate-induced hunger. Seed corporations evidently promote the idea that more food needs to be produced to address hunger, as they develop climate-ready seeds with the public intention of increasing crop yields. Critics of climate-ready seeds, however, do not question this assumption expressly. The way in which international law is framed and employed in the debates contributes to this.

Climate change adaptation law emphasizes crop failures and decreasing food production as the problem of climate change for agriculture and food security. Texts of the UNFCCC, the Kyoto Protocol, and the IPCC reports do not say explicitly that food production needs to increase. Nevertheless, there is a lot of emphasis in these reports on the predicted crop losses and on adaptation strategies aimed at increasing food production.[13]

Human rights discourse in relation to climate change also focuses much attention on crop losses and the devastating impacts for food insecurity and hunger. The right to food approach is used mainly as a way to regulate seed policies and to balance the corporate patent rights; not primarily to discuss questions of production of food versus access to food as means to combat hunger.

Third assumption: agricultural biotechnologies are necessary to increase food production

implicitly accepted the assumptions that climate change causes hunger and that food production needs to increase to address climate-induced hunger, the next question is: how do we increase food production? The third assumption is that agricultural biotechnologies – in the case of this research, particularly genetically engineered seeds – are needed to increase food production. Again, like the previous assumptions, this is a much debated issue. There is a lot of critical discussion about genetically engineered seeds. Reports state that GM seeds do not produce more;14 even Monsanto in its own report admits that a drought-resistant corn the company has developed for the US market does not give higher yields than conventional non-GM crops.[15]

Despite these contentions, in the way in which international law is used in discourses on climate-ready seeds there is a strong emphasis on the value of agricultural biotechnology and genetic engineering. International climate change adaptation law encourages the use of biotechnologies for adaptation. Special reports and technical papers written under the auspices of the UNFCCC and the IPCC endorse the use of biotechnologies and genetically engineered seeds to adapt to the effects of climate change and to increase food production.[16] Drought-resistant seeds are named expressly in these reports.

The patents rights debate, as drawn on in narratives of climate-ready seeds, centres on the question of who should have rights over seeds and crops. It largely ignores questions about the practical value of climate-ready seeds. Arguing about the property rights gives the impression that these seeds are worth fighting for, and that agricultural biotechnologies are valuable.

In a similar fashion, human rights law and how it is used recognizes the value of biotechnologies. The intention of those invoking human rights law is not to dispute the value of genetically engineered seeds per se. Rather, it is to ensure that the right to food is achieved and that those most vulnerable and food insecure will benefit from those seeds. There is little space in the accounts of climate-ready seeds for discussing the contentions about agricultural biotechnologies and food production.

Fourth assumption: private sector investments are needed to develop agricultural biotechnologies, thereby increasing food production and alleviating hunger

If agricultural biotechnologies, including genetically engineered climate-resistant seeds, are considered necessary to increase food production, the next question

is: who will invest in the development of climate-ready seeds? There is a lot of criticism of the private sector's role in 'solving hunger'. The private sector may indeed invest a lot of money into the development of genetically engineered that could produce more food in the face of climate change; but the question remains whether these seeds will benefit the world's hungry.[17] International law relevant to discourses on climate-ready seeds, however, is welcoming of private sector involvement without questioning these nuances.

Climate change adaptation law creates an enabling and welcoming environment for private sector engagement in adaptation. Even though international law – including climate change law – strictly creates obligations only for States Parties, the private sector is mentioned often in legal texts related to adaptation. Adaptation initiatives developed under the UNFCCC include private sector initiatives that provide corporations with a platform in which to suggest adaptation strategies.[18] Many of the large seed corporations have filed climate-resilient seeds as examples of adaptation strategies.[19] There is no discussion at all in narratives of climate-ready seeds about the role of adaptation law in setting a conducive context for private sector involvement.

Critics of climate-ready seeds are, as already mentioned, particularly critical of the large number of patent rights that a handful of corporations are applying for and obtaining on these seeds. In this critical discourse, however, there is no explicitly questioning of the necessity of private sector investments to combat hunger. The main gist seems to be a call for better regulation of private sector actions, rather than rejecting the value of private sector engagement. This is evident in how human rights law is framed and used. Human rights texts emphasize the need to regulate private sector action,[20] without expressly questioning the value and necessity of these investments. By invoking human rights law and by not addressing the role of adaptation law, critics of climate-ready seeds implicitly leave this assumption in place.

Fifth assumption: intellectual property rights are necessary incentives for the development of agricultural biotechnologies

The fifth and final assumption that is left in place is that intellectual property rights – mainly patent rights – are necessary incentives for investments in biotechnologies to eradicate hunger. This assumption contains the premises that applying intellectual property rights to living things is acceptable, and that intellectual property rights are necessary to incentivize innovation. Both parts of this assumption are highly debated. They are also – again – not challenged explicitly in discourses on climate-ready seeds, and international law contributes to that.

There is a great deal of debate about patenting living things, with groups calling for 'no patents on life' and 'no patents on seeds'.[21] Discussions about climate-ready seeds are set within a context of larger debates about genetically engineered organisms. The main legal response that critics provide to corporate patents on climate-ready seeds, is not to deny the application of intellectual property rights in living things altogether. It is, rather, to call for recognition of farmers' rights and developing countries' sovereign rights over natural resources.[22] Arguing for sovereign rights over natural resources and farmers' rights does not deny forms of proprietary rights on seeds and crops; it primarily argues that parties other than private corporations should also be granted property rights.

There is also a huge amount of debate over whether intellectual property rights do in fact incentivize innovation, and whether this innovation benefits larger society. There are many who argue that patent rights are not necessary to ensure innovation in agriculture, and that patents only direct rather than increase innovation.[23] In discourse on climate-ready seeds, this question of whether patent rights are necessary incentives to develop agricultural biotechnologies for adaptation is not expressly posed. One example is the way in which the right to food is employed. The right to food is used primarily as a way to direct (corporately patented) climate-ready seeds towards contributing to the realization of the right to food. Human rights are promoted as tools to regulate patent rights, not to dismiss or even question the latter.

Conclusion

The starting point of this research was the problem of hunger and food insecurity in the context of climate change. At the surface, the most obvious role of international law – of different fields of international law – is to contribute to finding ways to alleviate food insecurity and hunger in the context of climate change. This is so, for instance, in climate change adaptation law seeking to devise ways to adapt to climate change impacts; in intellectual property law seeking to incentivize

technological innovations to deal with climate change impacts; and human rights law seeking to put human suffering at the centre of climate change policies.

The argument that I make in this research is that international law – how it is framed and invoked in different narratives of climate-ready seeds – not only contributes to 'solving' hunger, but also, and importantly, has a hand in shaping our understanding of the problems of climate change and hunger. There are certain assumptions about climate change and hunger that are left largely in the background. Questions about these contentious assumptions are not posed explicitly in the discourse, and how international law is employed contributes to upholding these assumptions.

Debates about climate-ready seeds as proposed 'solutions' to climate-induced hunger take place within a framework of assumptions that set a certain way of thinking about climate change and hunger. This determines the range of solutions we can devise. It was not my intention to formulate answers to these contentions, but rather to show that international law as it is framed and invoked has a hand in obscuring important debates and determining the contours of the 'problem', thereby also limiting possible solutions.

This pyramid of assumptions places a lot of emphasis on increased food production as the main response to climate-induced food insecurity and hunger. Changing patterns of consumption, towards more sustainable food consumption, could well be a cheaper, more effective, and more environmentally-friendly way to address the problem. Recognizing the underlying assumptions is one step towards challenging the way we frame the problem of climate change and hunger, and opening the way for alternative solutions such as changing food consumption patterns.

Dr. Anne Saab is assistant professor of international law at the Graduate Institute of International and Development Studies in Geneva, Switzerland. She teaches courses on climate law, patent law, and global food systems.

Notes

1. 'A Legal Inquiry into Climate Change and Hunger: Climate-Ready Seeds in the Neoliberal Food Regime', was the title of my doctoral thesis at the Law Department of the London School of Economics and Political Science in June 2015.

2. See, for an overview of the patents on climate-ready seeds, two reports from civil society organization ETC Group: ETC Group, 'Patenting the "Climate Genes" … and Capturing the Climate Agenda' (ETC Group, 2008); ETC Group, 'Capturing "Climate Genes": Gene Giants Stockpile Patents on "Climate-Ready" Crops in Bid to Become "Biomassters"' (ETC Group, 2010).

3. Ibid.

4. I adopt a broad understanding of 'international law', including not only legal texts, but also legal discourse.

5. See the title of the 2010 ETC Group report, at note 2 above.

6. Mike Davis, Late Victorian Holocausts: El Niño Famines and the Making of the Third World (New York: Verso, 2001).

7. Ibid., at page 280.

8. The latest IPCC assessment report from 2014 contains a chapter dedicated to agriculture. The chapter emphasizes crop losses. John R. Porter et al, 'Food Security and Food Production System' Chapter 7 in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 485-533, Cambridge, United Kingdom; New York, NY, USA: Cambridge University Press, 2013.

9. A technical paper published under the auspices of the UNFCCC in 2006 focuses on technologies for adaptation, and includes information on genetically engineered crops to increase food production. Richard J.T. Klein et al., 'Application of Environmentally Sound Technologies for Adaptation to Climate Change, FCCC/TP/2006/2' FCCC Technical Papers (UNFCCC, 10 May 2006).

10. For example: Ben Block, 'Climate Change Will Worsen Hunger, Study Says' World Watch Institute, http://www.worldwatch.org/node/6271; Action Against Hunger, 'Climate Change Could Become a Leading Cause of Hunger', http://www.actionagainsthunger.org/blog/climate-change-could-become-leading-cause-hunger; John Vidal, 'Poor Face More

Hunger as Climate Change Leads to Crop Failure, Says Oxfam' The Guardian, 5 July 2009, http://www.theguardian.com/environment/2009/jul/05/crops-farmers-climate-change-oxfam. Last accessed on 27 September 2015.

11. See, for instance: Caesens, Elisabeth and Maritere Padilla Rodriguez, 'Climate Change and the Right to Food: A Comprehensive Study' in Heinrich Boll Stiftung Publication Series on Ecology, edited by Heinrich Boll Foundation, Volume 8, Berlin: Columbia Law School – Human Rights Institute, 2009, https://www.boell.de/sites/default/files/Series_Ecology_Volume_8_Climate_Change_and_the_Right_to_Food_0.pdf.

12. Amartya Kumar Sen, Poverty and Famines: An Essay on Entitlement and Deprivation (Oxford, New York: Clarendon Press; Oxford University Press, 1981), at page 1.

13. See, for instance, the reports mentioned in notes 8 and 9 above.

14. See, for instance, reports from the Union of Concerned Scientists: Doug Gurian-Sherman, 'Failure to Yield: Evaluating the Performance of Genetically Engineered Crops' (Cambridge, MA: Union of Concerned Scientists, 2009); Doug Gurian-Sherman, 'High and Dry: Why Genetic Engineering Is Not Solving Agriculture's Drought Problem in a Thirsty World' (Cambridge, MA: Union of Concerned Scientists, June 2012).

15. Monsanto and the US Department of Agriculture acknowledge that that 'equally drought resistant corn varieties produced through conventional breeding techniques are readily available and may be cultivated in lieu of MON87460'. USDA/APHIS, 'Monsanto Company Petition (07-CR-191U) for Determination of Non-regulated Status of Event MON 87460' (November 2011), at page 33, www.aphis.usda.gov/brs/aphisdocs/09_05501p_fea.pdf, last accessed on 27 September 2015.

16. Intergovernmental Panel on Climate Change, 'Methodological and Technological Issues in Technology Transfer – Special Report of Working Group III of the Intergovernmental Panel on Climate Change' in IPCC Reports, ed. Bert Metz et al. (Cambridge, UK: IPCC, 2000). For the UNFCCC technical paper, see Klein et al at note 9 above.

17. As philosopher Henry Shue has stated: 'If there were lots of profit to be made in solving the world's hunger problem, market forces would presumably have sent people rushing in to solve it long ago'. Henry Shue, 'Solidarity among Strangers and the Right to Food' in World Hunger and Morality, ed. William Aiken and Hugh LaFollette (Upper Saddle River, New Jersey: Prentice Hall, 1996), at page 128.

18. UNFCCC, 'Private Sector Initiative - Database of Actions on Adaptation', http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/6547.php, last accessed on 27 September 2015.

19. Adaptation proposal involving climate-resilient crops by companies such as Monsanto, Syngenta, and BASF can be found in the list is initiatives.

20. General Comment 12 of the Committee on Economic, Social, and Cultural Rights, which elaborates on the right to food, specifies that States Parties are under the obligation to 'take appropriate steps to ensure that activities of the private business sector and civil society are in conformity with the right to food'. United Nations Economic and Social Council, CESR General Comment 12: The Right to Adequate Food (Article 11) E/C.12/2000/4 (12 May 1999).

21. See, for example: Rebecca Charnas, '"No Patents on Life" Working Group Update', http://www.councilforresponsiblegenetics.org/ViewPage.aspx?pageId=169; SWISSAID, 'No Patents on Life!', http://www.swissaid.ch/en/no_patents_on_life,; The International Coalition of 'No Patents on Seeds', 'Stop Patents on Plants and Animals!', http://no-patents-on-seeds.org/, last accessed on 27 September 2015.

22. As recognized in the International Treaty on Plant Genetic Resources for Food and Agriculture. International Treaty on Plant Genetic Resources for Food and Agriculture, Food and Agriculture Organization. Entry into force 29 June 2004, http://www.planttreaty.org/, last accessed on 27 September 2015.

23. See for instance: Arnold Plant, 'The Economic Theory Concerning Patents for Inventions' Economica 1 (1934), 39.

OPINION

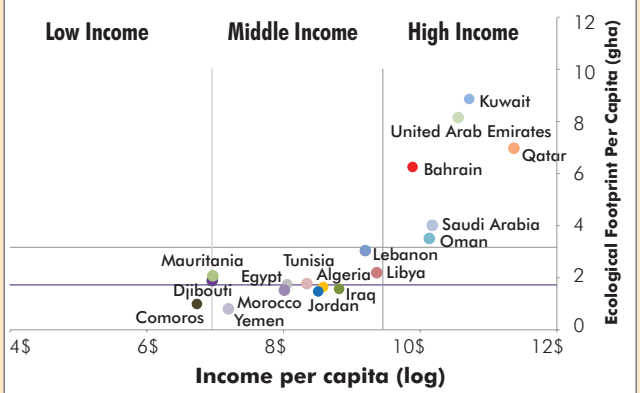
SCP WITHIN THE SUSTAINABLE DEVELOPMENT GOALS

Roula Majdalani and Fidele Byiringiro

The Millennium Development Goals (MDGs), which came to an end in 2015, are credited with notable improvements at the global level and in selected regions in areas such as poverty reduction, access to education or health improvement despite their shortcomings such as working in silos or being UN-led (UN, 2014a). The Rio+20 Summit had called for a new set of goals to guide development in the post-2015 era and following extensive consultations, the Sustainable Development Goals were recently agreed upon as a continuation of the MDGs while being more balanced as well as consultative, integrated, universal and the recognition of key development challenges. Thus, in addition to goals such as poverty and hunger, education, gender, health, environmental sustainability and global partnership, new goals have been included such as access to energy for all, sustainable industrialization and human settlements, inequalities within and among nations, climate change or sustainable consumption and production (UN, 2014b; UNEP, 2015a; UN, 2015).

With regards to sustainable consumption and production (SCP) – Goal 12 in the SDGs – it is crucial as the current level of carbon dioxide is the highest in over 800,000 years, mostly due to the consumption of fossil fuels which make up 81 percent of the energy consumed. Further, the "recent food and energy crises, and high prices for many commodities point to a world where increasing resource scarcity is the norm" (UN, 2013) while the Global Footprint Network (2015) estimates that there is a world bio-capacity deficit of 0.9 global hectares per person, meaning that we need about 1.5 earths in order not to overuse available renewable resources. Our current consumption and production patterns are unsustainable and might lead to catastrophic economic, social and environmental disasters (Akenji & Bengtsson, 2014; UNEP, 2015a).

PER CAPITA INCOME AND ECOLOGICAL FOOTPRINT IN THE ARAB REGION, 2011



Source: Adapted from the Global Footprint Network (2015)
Ecological Footprint values are 2011 values from the 2015 National Footprint Accounts, Global Footprint Network. Income values are GNI Atlas Method as provided by the World Bank (2013)

Unsustainable consumption and production patterns also affect the Arab region, as at least 10 countries have an ecological footprint that is beyond the world's average bio-capacity (Global Footprint Network, 2015). In the Arab region, the consumption of resources, particularly water and energy, is growing at an unsustainable rate with little to no evident attempt to "decouple" economic growth from environmental degradation. The high consumption of resources is driven in part by generous subsidies that in some cases amount up to 5 percent of the gross domestic product (ESCWA et al, 2015). If these unsustainable consumption and production patterns are not addressed, they could lead to decreased ecological goods and services (e.g., less food, clean air and fresh water, slower decomposition of wastes, lower greenhouse gas mitigation, less pleasing landscapes, etc.) and could potentially turn into a vicious cycle of degradation, low productivity, poverty and instability.

To make the shift towards sustainable consumption and production a reality, SCP principles have been embedded in several of the proposed 17 sustainable development goals (SDG). These include food security (Goal 2), healthy lives (Goal 3), water and sanitation (Goal 6), energy for all (Goal 7), economic growth and employment (Goal 8), infrastructure, industrialization and innovation (Goal 9), cities and human settlements (Goal 11), oceans, seas and marine resources (Goal 14), sustainable use of terrestrial ecosystems (Goal 15) and means of implementation (Goal 17). However, SCP also has its own dedicated goal, Goal 12, which specifically calls to "Ensure Sustainable Consumption and Production Patterns" (UN, 2014b). As adopted, the SCP goal has 8 targets and 3 means of implementation (UN, 2015; UN, 2014b):

The achievement of the SCP goal will largely depend on the ways the global, regional, national and local economy and society function. SCP and sustainable development will only be achieved if our ecosystem is able to provide the necessary natural resources to sustain us while also

SCP GOAL 12 – TARGETS

1. Implement the 10-Year Framework of Programme on SCP Patterns
2. By 2030, achieve the sustainable management and efficient use of natural resources
3. By 2030, halve global food waste at the retail and consumer levels and reduce food losses along production and supply chains
4. By 2020, achieve environmentally sound management of chemicals and wastes
5. By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse
6. Adopt sustainable practices and integrate sustainability information into reporting cycle
7. Promote sustainable public procurement practices
8. By 2030, ensure the availability of relevant information and awareness for sustainable development and lifestyles

SCP GOAL 12 – MEANS OF IMPLEMENTATION

a. Support developing countries to strengthen their related scientific and technological capacities
b. Develop and implement tools to monitor sustainable development impacts
c. Rationalize inefficient fossil fuel subsidies that encourage wasteful consumption

Source: Adapted from UN (2015, 2014b)

absorbing our wastes and emissions (UN, 2012; Schoon et al, 2013). Agreeing upon a dedicated goal and specific targets is a step in the right direction, but there is also a need to agree upon specific indicators to monitor implementation (SDSN, 2015, UNEP, 2015b).

A recent review of the experience of selected Arab countries with monitoring the MDGs was found to be modest at best due to a lack of capacity, resources, appropriate conceptual framework and a transparent mechanism for monitoring and follow-up. This might be a challenge for improving the science-policy interface which is increasingly seen as a critical aspect not only of governance but also of sustainable development. Some of the common challenges facing countries of the region include the lack of a fully integrated process for compiling and reporting indicators and the necessary capability at the institutional level to interpret and design appropriate strategies and programmes in support of sustainable consumption and production and sustainable development (ESCWA et al, 2015).

To support regional efforts, the Economic and Social Commission for Western Asia (ESCWA) together with its regional stakeholders – notably the League of Arab States (LAS) and the United Nations Environmental Programme (UNEP) – organized several major regional consultations, which culminated in the establishment of the Arab Forum on Sustainable Development (AFSD). The AFSD endeavors to improve access to information, enhance the science-policy interface, assess progress, trends, gaps and opportunities and determine national and regional priorities. Its upcoming Arab Sustainable Development Report provides key ingredients of a roadmap for the Arab region to enhance sustainable consumption and production and to achieve sustainable development that include (i) Enhancing knowledge; (ii) Improving the institutional framework; (iii) Enhancing data capacity and collection; and (iv) Aligning financial resources with requirements (ESCWA et al, 2015).

References

Akenji, L. and M. Bengtsson (2014). Making Sustainable Consumption and Production the Core of the Sustainable Development Goals. Discussion Paper, Institute for Global Environmental Strategies (IGES), Kanagawa, Japan.

Global Footprint Network (2015). Ecological Footprint and Biocapacity in 2011: Results from the National Footprints Account 2015 Edition.

ESCWA, UNEP and LAS (2015). Arab Sustainable Development Report: Prototype Edition – Technical Summary. ESCWA, Beirut, Lebanon.

Schoon, N., F. Seath and L. Jackson (2013). One Planet Living – The case for Sustainable Consumption and Production in the Post-2015 development agenda. BioRegional (www.bioregional.com).

SDSN (2015). Indicators and a Monitoring Framework for the Sustainable Development Goals: Launching a data revolution for the SDGs. A report to the Secretary-General of the United Nations by the Leadership Council of the Sustainable Development Solutions Network.

UN (2012). Outcome of the Conference: The Future We Want. Rio+20 Conference, United Nations Conference on Sustainable Development, Rio de Janeiro.

UN (2013). A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development. Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations, NY

UN (2014a). The Millennium Development Report 2014. United Nations.

UN (2014b). Open Working Group proposal for Sustainable Development Goals. United Nations, A/68/970 (http://undocs.org/A/68/970).

UN (2015). Draft outcome document of the United Nations summit for the adoption of the post-2015 development agenda. Follow-up to the outcome of the Millennium Summit, United Nations General Assembly (A/69/L.85)

UNEP (2015a). Sustainable Consumption and Production and the SDGs. UNEP Post 2015 #2 (http://www.unep.org/post2015).

UNEP (2015b). Sustainable Consumption and Production Indicators for the Future SDGs. UNEP Discussion Paper, UNEP.

World Bank (2013). Gross National Income Per Capita 2013, Atlas Method and PPP. (http://databank.worldbank.org/data/download/GNIPC.xls).

Roula Majdalani, Director of the Sustainable Development and Policies Division (SDPD) at the Economic and Social Commission for Western Asia (ESCWA); Fidele Byiringiro, Economic Affairs Officer, SDPD, ESCWA.

OPINION

SOLAR DEVELOPMENT AND SUSTAINABILITY IN DUBAI

Ahmed Buti Al Muhairbi

The Emirate of Dubai has charted its name on the global map as the new growing regional hub for logistics, tourism, finance, innovation, among other sectors. It comes at no surprise that, over the past 10 years, Dubai has registered one of the fastest growing electricity demand rates with a compound annual growth rate (CAGR) of peak power demand of about 8 percent. As the city continues to grow, it is expected to maintain a relatively high electricity demand growth rate between 5-6 percent over the next decade [DEWA Sustainability Report 2013].

Currently, Dubai's installed capacity of about 9.6GW is powered mainly by imported natural gas. With limited local gas reserves, Dubai is therefore a net energy importer. To fuel its booming infrastructure development and sustain its economic growth, the Emirate is compelled to pursue a sustainable development path, particularly given the recent global commodity market dynamics and sustainable technology advances.

In particular, the fast and continued decline in solar PV module cost witnessed a drop of over 75 percent in the past five years [Renewable Power Generation Costs 2014, IRENA]. In a country endowed with high solar irradiation along the year and in the absence of other energy sources such as hydropower or significant wind resources, solar technologies are deemed an attractive alternative energy option.

THE SOLAR TIPPING POINT OF DUBAI

Today, within a short span of about two years, Dubai delivered on its commitment towards sustainability and establishing the tenets of a green economy. Before October 2013, the city's total installed solar PV capacity was about 4.5 MW scattered across residential and commercial applications. This figure tripled with the commissioning of a 13 MW solar PV power plant in October 2013, as the first phase of the Mohammed Bin Rashid Solar Park. Less than two years later, Dubai's efforts to open the energy market to independent power producers reaped a new global benchmark of the cheapest unsubsidized levelized cost of energy generated by solar PV in the world. An additional 200 MW was then awarded, almost 15 times the previous phase. This record-breaking public-private partnership (PPP) deal placed solar at par with conventional sources such as natural gas, and transformed how utilities, project

FIGURE 1 **TIMELINE OF MAJOR MILESTONES IN DUBAI'S PATH TOWARDS DEPLOYMENT OF SOLAR ENERGY**

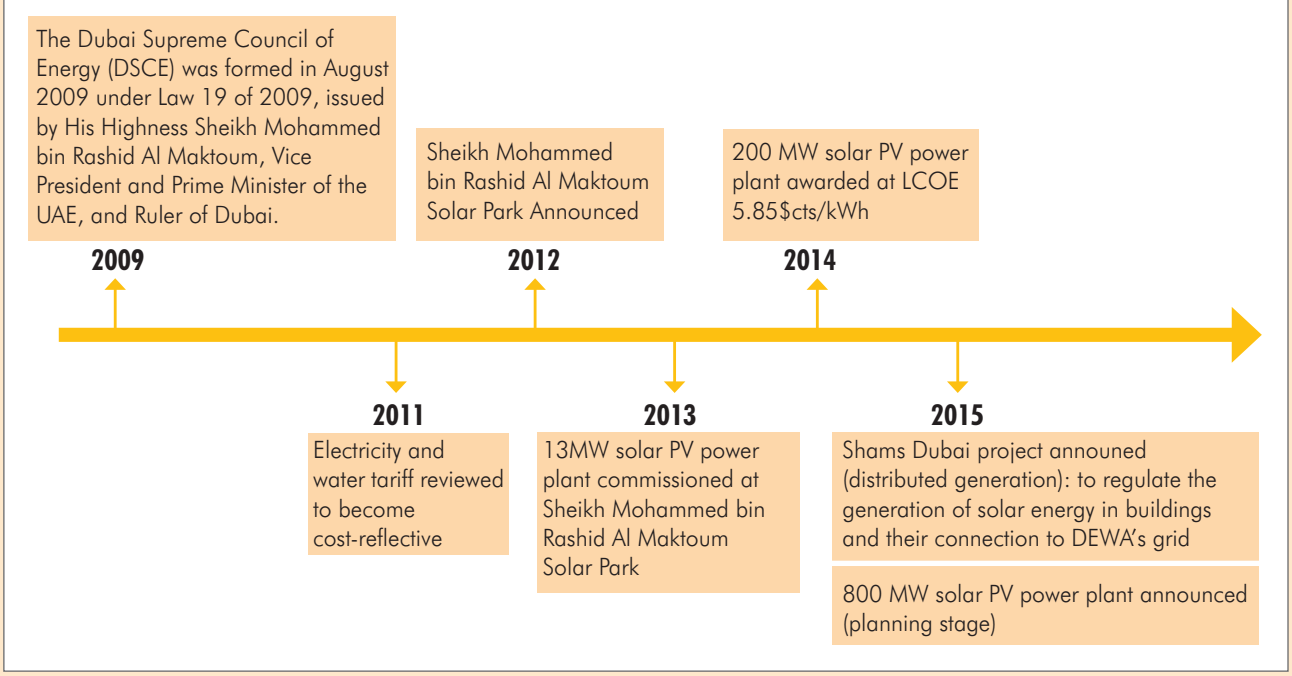
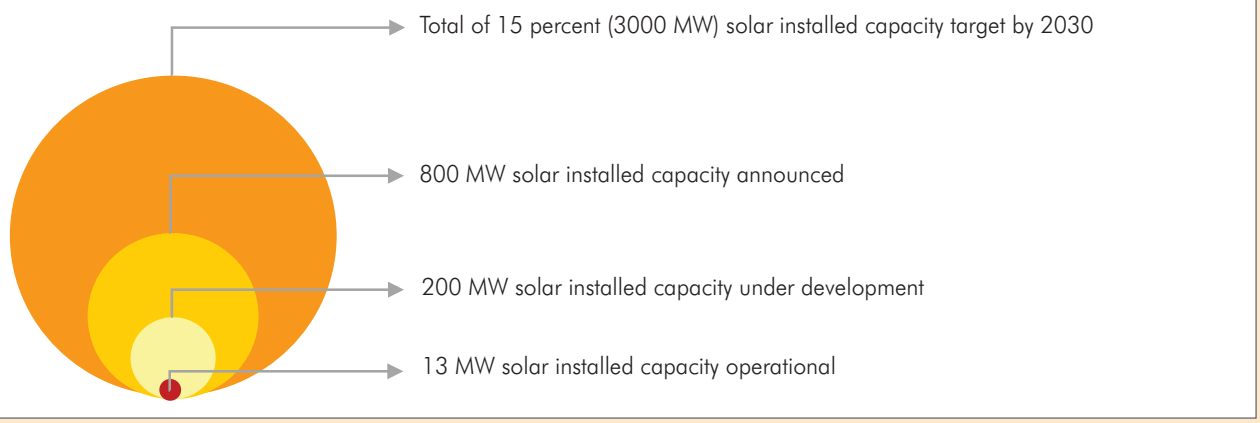


FIGURE 2 **UTILITY SCALE SOLAR PV PROJECT DEVELOPMENT IS PROGRESSING SIGNIFICANTLY IN DUBAI**



developers, policy makers and consumers perceive solar energy in Dubai and the region. Shortly after the initiation of the 200 MW solar PPP deal, Dubai's Electricity and Water Authority (DEWA), the utility that owns and operates Dubai grid, – announced its plan for the third phase of 800MW solar project.

The transformation of the energy sector in Dubai is also taking place at the customer side. Dubai residents can now generate their own electricity using solar panels that can also feed extra energy to Dubai power grid. This will gradually transform consumers to prosumers, meaning consumers that also generate part of their own energy consumption.

These developments collectively mark a tipping point for solar energy in Dubai. Today, solar energy is considered economically feasible compared to conventional fuels at market price. The strong backing of the Dubai Government for solar projects and the announcement of a solar target of 15 percent of installed capacity by 2030 send positive signals to private investors and financiers. In addition, the gradual introduction of solar projects has also helped establish a learning curve and build local capacities that would be needed to resolve possible technical challenges during implementation. The looming question is how did Dubai succeed - in a relatively short time – in building the enabling environment to transform its energy sector towards higher shares of renewables?

THE TRANSFORMATION

The achievements of Dubai are a natural result to the effective and efficient governance model of its energy sector. A model that is referred to as one of the few comprehensive demonstrations of streamlined energy sector management. The efforts started back in 2009 when the Dubai Supreme Council of Energy (DSCE) was established under Law 19, issued by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE, and Ruler of Dubai. The Council is therefore responsible to oversee the whole energy sector in Dubai and provide the governance platform and strategic direction through a defined roadmap. Dubai Sustainability Model is a manifestation of DSCE structural approach to drive the energy transformation of the Emirate. It comprises ten pillars: policy and regulatory framework, capacity building, diversification of energy sources, demand side management and energy efficiency, energy pricing and consumer behavior, investment in clean and smart technology, stakeholder engagement, public-private partnership, energy services contracting, and carbon abatement.

Under the DSCE, Dubai pioneered the first-of-its-kind integrated energy strategy, a comprehensive strategy to drive the energy sector and align visions and targets of various stakeholders. The strategy encompasses both the supply and the demand side of the energy ecosystem, making it the launching pad towards a common vision of Dubai 2030. In order to catalyze this transformation, Dubai needed first to review its electricity tariff structure. As a result, a slab system was introduced in 2011 to incentivize lower consumption and more efficiency in the use of water and electricity. In fact, in 2011, Dubai Electricity and Water Authority succeeded in reducing power demand growth to only 3 percent of net consumption growth, despite a simultaneous 5 percent growth in combined registered electricity and water accounts [Dubai Status of Energy Report 2014].

FIGURE 3 **THE 13 MW GRID-CONNECTED SOLAR PV PLANT, THE FIRST PHASE OF THE MOHAMMED BIN RASHID AL MAKTOUM SOLAR PARK**

CREDIT: RECHARGE NEWS, CHARLES VERGHESE

The review of the tariff also sent positive signals to clean energy investors, as the market becomes economically attractive for renewable energy technologies with cost-reflective electricity tariffs. This has paved the road for the announcement of Sheikh Mohammed bin Rashid Al Maktoum Solar Park in January 2012. This 48 km2 park is solely marked for the development of large scale utility solar projects, through phases to reach the final goal of 15 percent (equivalent to 3000 MW) of solar power installed capacity by 2030.

To respond to fast growing demand of infrastructure development, a market-based approach using Public Private Partnerships promises to meet Dubai's needs. Such an approach leverages funding sources and helps balance the risk between the government and private investors. By fostering partnerships with leading international firms in clean energy, Dubai also aims to develop its local capacities through transfer of knowledge and skills. Therefore, since its inception, the DSCE has rolled out a series of step by step regulatory reforms and policies to open the electricity market for independent power and water producers (IPWPs). This involves establishing the Regulatory and Supervisory Bureau (RSB) for the electricity and water sector in 2010. Part of RSB responsibilities include licensing of new generators in the power sector. The robust regulatory framework resembles the fundamental block for sound policy design to attract investment, namely transparency, longevity and certainty. In other words, Dubai's excellent solar resources around the year combined with the stable political environment, credit worthy off-taker (DEWA) and transparent procurement processes facilitated access to low-cost finance through local commercial banks resulting in a global benchmark for the market-driven levelized cost of energy (LCOE) for solar PV: less than 6 US$ cents/kWh.

SUSTAINABILITY AS A COMPREHENSIVE ECOSYSTEM

The bold strides that Dubai is making in clean energy are not limited to power generation. The Emirate through its Dubai Plan 2021 aims to integrate clean energy development as part of a paradigm shift of its socioeconomic outlook and economic diversification. This includes fostering the local clean energy market and expanding its activities to cover wide segments of the supply chain. Today, there is a noticeable increase in solar companies that are based in Dubai benefiting from excellent logistics infrastructure and easy access to emerging economies in Asia, MENA region and Africa. In fact, a survey of Emirates Solar Industry Association (ESIA) in 2009 found that 50 percent of the then 70 solar companies in the Middle East were based in Dubai [Dubai State of Energy Report 2014].

In addition to developing the downstream marketing and sales arm of the clean energy industry, Dubai is keen to advance the research and development (R&D) component. As part of the Mohammed bin Rashid Al Maktoum Solar Park, DEWA is developing a state of the art R&D center coupled with an innovation center. The center aims to spur development of creative solutions pertaining to solar energy, water treatment, smart grid and energy efficiency among others. Such an institution will contribute to building local capacities to drive innovation in the clean energy sector, owing to its vital attribute to link government, industry and academia, resulting in relevant and sustained capacity building programs.

As Dubai embarks on developing its clean energy sector, it is expected that thousands of jobs will be created as the industry grows. In particular, both large scale utility solar projects and the distributed solar generation (sometimes referred to as Shams Dubai Project) will contribute to adding new jobs to the market during the manufacturing, engineering, procurement, financing and project development, construction, operation and maintenance, and decommissioning.

In a rapidly changing world, Dubai has seized the opportunity to follow a sustainable development pathway as it continues to grow. The clear and supportive vision of its leadership paved the way to develop a long term strategy and deliver stepwise but steady implementation progress towards higher share of solar in its energy mix. This galvanized the trust of the private sector, resulting in successful public private partnerships (PPP) that drove the cost of solar energy to unprecedented ranges, impacting the future of solar not only in Dubai but the entire region. Dubai's model is emerging as a benchmark for the transition to a sustainable energy future in a region historically perceived as a synonym to "oil". As we approach 2030, Dubai is expected to turn its sunny days into a sustainable fuel for generations to come.

FIGURE 4 **ILLUSTRATION OF THE FUTURE DEWA R&D CENTER**

Ahmed Buti Al Muhairbi is Secretary General of Dubai Supreme Council of Energy (DSCE) – the governing body tasked with policy development, planning and coordinating with concerned authorities and energy bodies to deliver new energy sources while employing a balanced approach to protecting the environment. Mr. Al Muhairbi is also the Vice Chairman of Dubai Regulatory & Supervisory Bureau for Electricity and Water and a member of the Board of Directors of Emirates National Oil Company (ENOC).

SwitchMed: PROMOTING SUSTAINABLE CONSUMPTION AND PRODUCTION IN THE MEDITERRANEAN

Anna Ibañez de Arolas

The Mediterranean Region has seen rapid economic development in recent decades. However, this has been accompanied by a serious depletion in natural resources and a widespread degradation of the natural environment. The adoption of "consumption intensive" lifestyles by the Mediterranean population and the current unsustainable patterns of production are increasing the pressure on the local and regional environment. This pressure is characterized and affected by water scarcity, population growth and rapid urbanization in coastal areas, growing waste generation, climate change and mass tourism. In the Mediterranean region, decoupling development from environmental degradation and resource depletion has become an urgent need, and making the shift to more sustainable consumption and production (SCP) patterns is becoming more necessary by the day. This shift can only be achieved through a holistic approach that tackles every aspect involved in the way we consume and produce.

The SCP approach responds to this need by proposing a combined implementation of tools and measures oriented to redesign the way in which goods and services are consumed and produced. This approach aims at addressing key economic and social challenges while decoupling economic development from environmental pressure by applying life cycle thinking. Life cycle thinking is at the core of the SCP approach since it involves considering all the environmental and social impacts that occur during the life cycle of the consumption-production chain. In short, the SCP approach can drive the revitalization of industrial and socio-economic development towards non-pollutant, no-waste, low-carbon, resource efficient, socially inclusive, green and circular economies.

The successful implementation of the SCP perspective needs the active participation and collaboration of all relevant stakeholders including: governments and policy makers, businesses and entrepreneurs and, civil society organisations and individual citizens. Governments and policy makers can stimulate both the supply and demand side for sustainable products at country levels; businesses and entrepreneurs can increase their efforts to produce products and services entailing the least environmental impact and the lowest energy and resource consumption; and a conscious and involved civil society adopting sustainable lifestyles can drive the demand side for more sustainable products and services in the market.

Over the last two decades SCP policies have gained a central role on the road towards sustainable development, as recognised by world leaders in the World Summits in Rio (1992), Johannesburg (2002), and Rio+20 (2012) where the 10-Year Framework of Programmes (10YFP) on Sustainable Consumption and Production patterns was adopted. In the Mediterranean Region, the Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention), adopted in 1976, constitutes a unique regional policy umbrella for environmental protection and sustainable development. Its 22 contracting parties recognise the importance of switching to more sustainable patterns, and since 2005 many actions have been developed to strengthen SCP in the region. In the Middle East and North Africa (MENA) region, Arab countries adopted in 2012 the Arab 10YFP on SCP with the aim "to promote the concept of sustainable consumption and production in the Arab region through encouraging the utilisation of products and services that ensure environmental protection, conserve water and energy as well as other natural resources, while contributing to poverty eradication and sustainable lifestyles".

In line with this approach, the European Union (EU) funded SwitchMed Programme has been designed as a multi-component programme to facilitate the shift towards SCP in the Southern Mediterranean Region including: Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine and Tunisia.

SwitchMed is an initiative that supports and connects stakeholders to scale-up SCP in the Southern Mediterranean Region through social and eco innovations. It aims at achieving productive, circular

and sharing economies in the Mediterranean by changing the way goods and services are consumed and produced so that human development is decoupled from environmental degradation. It supports industry, emerging green entrepreneurs, civil society and policy makers through policy development, demonstration activities and networking.

SwitchMed is implemented through collaborative efforts of the EU, the United Nations Industrial Development Organization (UNIDO), the United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP), UNEP/MAP Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC) and UNEP – Division of Technology, Industry and Economics (UNEP-DTIE) (www.switchmed.eu).

The programme, which works with a wide range of stakeholders, is committed to catalysing the market of sustainable products and services in the Mediterranean via:

1. Engagement with policy makers to establish a regulatory and policy framework to boost the market for sustainable products and services. At the national level, it supports targeted countries to develop and refine national SCP policy action plans while at the regional level it develops a Mediterranean SCP Action Plan and a roadmap for its implementation under the Barcelona Convention. The SCP Action Plan aims at achieving the shift to sustainable patterns in four priority areas of consumption and production, namely food, fisheries and agriculture; goods manufacturing; tourism; and housing and construction.

2. Demonstration activities through which the programme implements concrete actions tackling the barriers faced by key players responsible for the shift towards SCP patterns:

    - Through the MED TEST II Initiative (Transfer of Environmental Sound Technology in the Southern Mediterranean Region) it provides capacity building in industry service providers targeting small and medium sized enterprises for resource efficiency improvements;

    - It provides trainings for start-ups and entrepreneurs to build skills in ecodesign, business planning, marketing and financing of sustainable products and services;

    - It works for the empowerment of citizens and civil society organizations to lead socially innovative solutions addressing environmental changes;

    - It implements demonstration activities in each country drawn from the SCP National Action Plans developed with governments.

3. Networking activities, through which it supports the visibility, effectiveness, long-term sustainability and impact of the programme. The SwitchMed Action Network gathers relevant stakeholders, links with similar initiatives and networks, supports the exchange of information and the scaling-up of current activities while minding synergies with the sister programmes, namely SWITCH-Asia and SWITCH-Africa Green.

Through the implementation of all these SCP practices, SwitchMed aims to generate positive environmental, social and economic impacts to Mediterranean environment and societies, while it creates tangible benefits related to climate change and other cross-cutting issues such as water and energy efficiency, food security, land use, and pollution.

Anna Ibañez de Arolas, Information Officer at the Regional Activity Centre for Sustainable Consumption and Production, Mediterranean Action Plan - United Nations Environment Programme (SCP/RAC-UNEP/MAP), SwitchMed Programme Networking Facility.

Consumption Patterns in Arab Countries

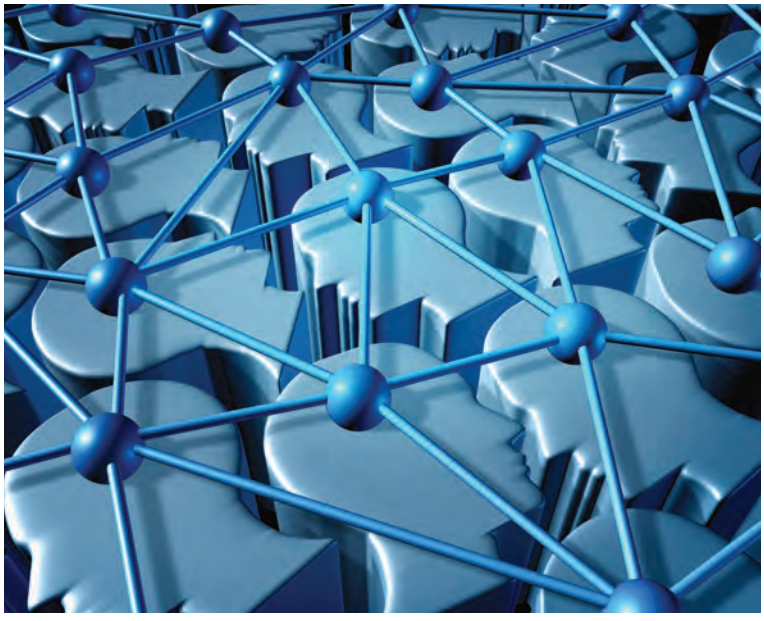
AFED Public Opinion Survey

Najib Saab

I. SUMMARY OF RESULTS

The Arab public is ready to pay more for energy and water and embrace changes in consumption patterns if this will help preserve resources and protect the environment, according to a survey carried out by Arab Forum for Environment and Development (AFED) in 22 countries. However, good intentions and wishes of the public, as demonstrated in the survey results, are not enough, as putting change into action requires the introduction of appropriate enabling conditions by governments. While public awareness and education are important tools to demonstrate the benefits of sustainable consumption on human health and the environment, regulations and incentives are indispensable to transform intentions into action. Implementing energy and water conservation measures on a large scale requires revising subsidies. Renewable energy will not be deployed extensively as long as conventional fuels are sold at fraction of their real market price. Equally, phasing out subsidies needs to be accompanied by direct economic and social benefits, mainly job creation, providing education and health coverage, alongside securing appropriate income levels and pension schemes.

When a vast 84% majority of the people accept to eat more fish than red meat, which is better for the environment as well as health, the fact remains that good intentions cannot be transformed into action until fish is made available in abundant quantities and at affordable prices.



As safeguarding the environment and ensuring sustainable management of natural resources are the main driving concerns for consumption patterns, the survey also examined public attitudes regarding some general environmental challenges, focusing on water, energy and food. This allowed comparison with previous surveys carried by AFED on public opinion attitudes towards environmental challenges in 2006 (AFED Survey, 2006), and on climate change in 2009 (AFED, 2009). Comparison was also made with a survey carried out by Al-BiaWal-Tanmia (Environment & Development) magazine in 2000 (EDM, 2000).

A. Environment Outlook

Among the 31,000 people surveyed in the 22 members of the League of Arab States, 72% indicated that the environmental situation in their countries worsened over the past 10 years. This constitutes a remarkable 20% increase over the negative classification in 2006, which then stood at 60%. It is interesting to note that the 2006 results showed a big improvement over 2000, when 85% said that the environmental situation worsened. This means that what the Arab public saw as a gain for the environment between 2000 and 2006 was wiped out between 2006 and 2015. The biggest drop in confidence was recorded in countries that witnessed wars and conflicts. Tunisia presents a salient example, as in 2006 it recorded the highest percentage of people who thought the environment became better (54%), while in 2015 this dropped to just 4%, with 84% saying it worsened and 12% saying it has not changed. Across the region, an average of 82% thought that governments were not doing enough to tackle environmental challenges. The majority of those dissatisfied were in Lebanon, Palestine and Sudan (over 90% in the three countries). The percentage of those who thought their governments were doing enough for the environment reached 29% in the Gulf Cooperation Council countries (GCC), representing the highest level in the region.

Solid waste management, traffic congestion and inefficiency of water and energy use scored as the top environmental challenges, followed

by industrial pollution, air quality, wastewater disposal and food safety. While top 10 priorities remain the same in 2015 as in 2006, it was remarkable to see that traffic congestion moved from position 11 to position 2, which reflects the mounting gravity of road overcrowding and inadequate public transport systems in the Arab region.

As to the impact of climate change, 88% indicated that this posed a real threat to their countries – a 5% increase over those who answered likewise in 2006. We believe that the extreme weather conditions witnessed in some parts of the region over the past years, including cyclone Gonu in Oman, recurrent untimely heavy rainstorms in Gulf countries and extended droughts in other parts of the region, were major contributors to this shift in responses. Stronger scientific evidence and better public awareness about climate change also should also have contributed to this result.

B. Consumption Patterns

The AFED Sustainable Consumption survey revealed acceptable levels of public awareness on environmental matters related to consumption patterns. While 72% of the respondents were aware that the Arab region was the world's poorest in water resources, 77% knew that the level of water and energy consumption in some Arab countries is among the highest. Asked to identify the main reason behind high water and energy consumption at the household level, a majority of 46% attributed the wasteful behavior to lack of awareness. A mere 6% put the blame on subsidies, with the highest scores as compared to the regional average coming from Oman, the United Arab Emirates and Kuwait (46, 19 and 18%). This can be explained by the fact that the three countries witnessed heated debates on the issue over the past two years, with officials endorsing phasing out of subsidies. The strongest statement against subsidies came from the Omani minister of oil and gas, who declared in 2013 that "what is really destroying us right now is subsidies…we simply need to raise the price of petrol and electricity" (Al-Yaum, 2013,http://www.alyaum.com/News/art/103930.html).

Another example showing that informed official positions help shape public opinion is that 85% of the respondents said they used energy-saving lamps, while only 45% used water-saving devices at home. This is a result of the intensive programs which made energy-saving lamps available and easily accessible in the markets, including the distribution of free energy-saving bulbs in Egypt, Morocco, Lebanon and the UAE. This was in contrast to meager marketing support for water-saving devices.

As a follow up, participants were asked whether they were ready to pay more for water, electricity and fuel if this contributed to more sustainable use of natural resources. The question made the proposition conditional on compensating higher prices (as a result of phasing out subsidies) by offering direct benefits including higher salaries, better job opportunities, education, health and pension. 77% agreed to pay more when it came as part of a package, compared to a mere 6% who attributed the waste in water and energy use to subsidies. This presents a clear indication that people accept change as a package supported by the right enabling conditions, including appropriate incentives.

Efficiency was the most important driving factor for most respondents (42%) when buying a car or electrical appliance, which reflects more concern about saving energy. Brand name and price consecutively followed. Fuel and electricity saving was of less concern in countries where prices are highly subsidized, reaching a low of 16% for cars in Qatar, compared to a high of 72% in Jordan. It is worth to note that Jordan was a regional pioneer in promoting hybrid and fuel-efficient cars, through offering a tax-break program. At sub-regional level, efficiency and price were lower factors in the GCC countries, while brand, model and size had a higher rank. Although Saudi Arabia was the first Arab country to introduce fuel economy labeling and standards for imported vehicles in 2014, the impact of this measure on consumers is still to be seen.

The survey revealed that an equal percentage of respondents used private cars and public transport as the main means of mobility (47% for each), with the remaining 6% using motorbikes and bicycles. The extensive use of private cars in the GCC countries – about 89% on average – is explained by higher income levels, very low fuel prices, and a lack of modern public transport

systems. Lebanon was an exception to the other Arab countries, with a staggering 72% using private cars – a reflection of inadequate public transport systems. While 82% of respondents at the regional level agreed to share a personal car with others to go to work, attaining such a scheme on a large scale can only be possible when supported by programs for car-pooling, allocating strategically-located public areas for drivers to meet and share cars.

A majority of the respondents (89%) said they were aware that Arab countries import half of the basic food products they consume, and 88% preferred locally produced food over imported food. Frequency of fast food consumption revealed uniform moderate patterns, with 61% buying fast food 1-5 times per month, and 21% not eating fast food at all. Those who buy fast food more than 6 times a month in the region amounted to 18%, compared to 24% in the GCC countries alone.

Cost of food constituted the largest portion of the family income, compared to water and energy. 62% of respondents spent over 10% of their income on food, while only 4% of respondents spent this same proportion of their income on water and electricity.

Changing dietary habits is a crucial issue, involving intricate social and cultural values and traditions. Dwindling water resources is likely to prevent countries from producing enough quantity of a certain traditional crop, like rice, for an ever growing population. The same applies to red meat, as raising cattle is a water-intensive activity. Moreover, cows produce a particularly high level of greenhouse gases, which intensifies climate change. Are people ready to shift to other products that are less water intensive and friendlier to the environment, such as alternative grains, fish and poultry? If the change in dietary habits would protect the environment, 84% of the respondents were ready to go for it. An astounding majority of 99% would change their habits if this would ensure their health, such as fighting obesity, diabetes and blood fats. Taking into consideration that what is better for the health is better for the environment, as most cases show, the results might indicate that a good approach to promote positive change in food consumption patterns is to put more emphasis on the health benefits, as these are more appreciated by the public.

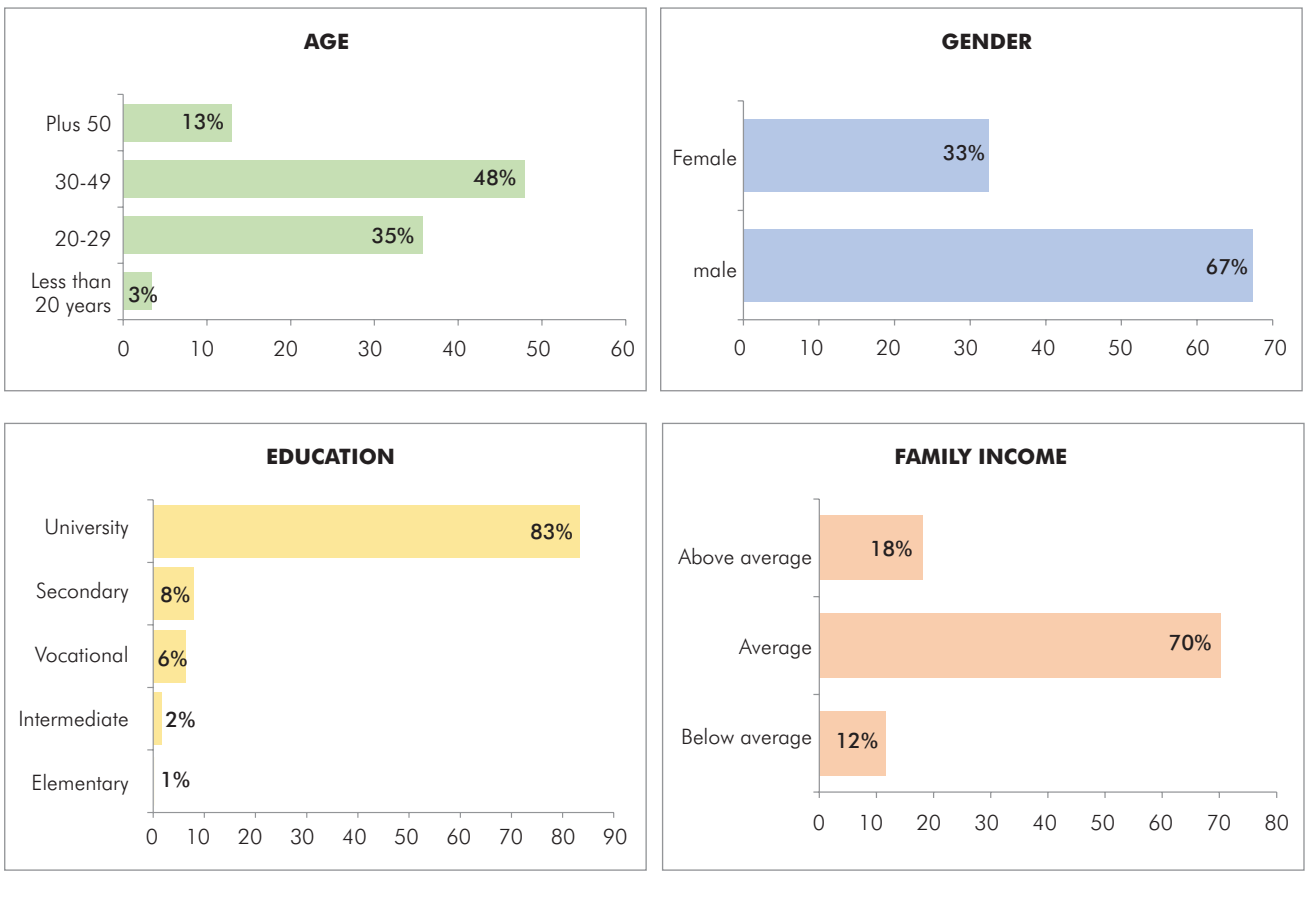
The main conclusion of AFED's public opinion survey on sustainable consumption patterns is that the Arab public is ready to endorse and implement profound changes in the way water, energy and food are consumed, provided that the shift is combined with appropriate enabling conditions and incentives. Alternative products and practices can only be popularized through measures that make them attainable and accessible at competitive prices.

II. DESCRIPTION AND BACKGROUND

As part of its 2015 annual report on Sustainable Consumption in Arab Countries, the Arab Forum for Environment and Development (AFED) carried out a public opinion survey to examine consumption patterns and the willingness of people to change. The survey, which covered the 22 member countries of the League of Arab States (LAS), comprised 27 questions and focused on water, energy and food. The survey was conducted online between January and May 2015, on a voluntary basis and without interviewers. In order to simplify participation, the questionnaire was made available through Google Forms, which could be opened on all types of computers, tablets and smart phones. The survey was conducted in cooperation with Al-BiaWal-Tanmia - Environment & Development magazine (EDM), and promoted by 10 regional newspapers. The promotion campaign to attract participants was also designed to help disseminate awareness on sustainable consumption. Social media, particularly Facebook, was widely used to attract participants.

Valid entries amounted to 31,010 from 22 countries. Only one entry was kept in cases of multiple responses coming from the same name or email address. In addition to total results for the whole region, the statistical report calculated sub-regional results, according to the following geographical classification: Levant (Iraq, Jordan, Lebanon, Palestine and Syria): Gulf (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen); North Africa (Algeria, Libya, Mauritania, Morocco, Tunisia); Nile Valley

FIGURE 1 SOCIO-ECONOMIC DISTRIBUTION OF THE SAMPLE



(Egypt and Sudan); African Horn (Comoros, Djibouti and Somalia). Results of individual countries were analyzed to detect cases of sharp differences, which might pinpoint a peculiar situation. Responses from Comoros and Djibouti were less than 100, and thus considered not a large enough sample to be analyzed separately.

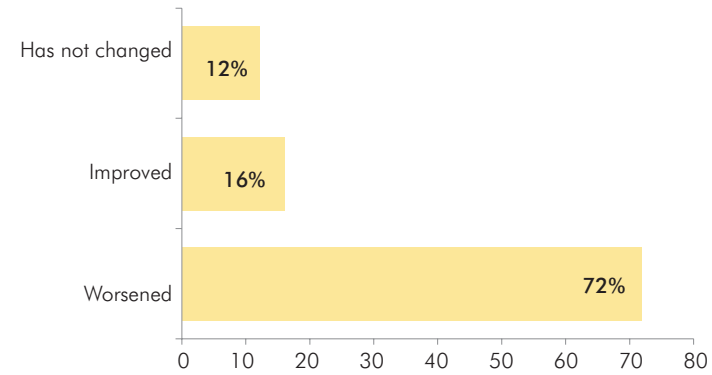
The questionnaire started with introductory questions to determine the position on general environmental issues. This helped to compare results with previous surveys carried by EDM and AFED in 2000, 2006 and 2009. The second set of questions was designed to determine the level of knowledge of respondents regarding the situation of energy, water and food in Arab countries. The third set focused on identifying specific patterns of consumption, and the fourth aimed at finding out to which extent respondents were ready to change their consumption habits in order to help protect the environment and conserve natural resources.

Promotion through newspapers and social media expanded the reach of the survey to a wide range of social, economic and educational backgrounds that reflected a broad spectrum of views. It is to be noted that, due to the voluntary nature of the survey, the regional sample included a high proportion of educated people, urban dwellers and males. While this might not proportionally reflect the actual social mix, it reflects more the views of those nearer to decision making.

The respondents have the following major characteristics: 39% are less than 30 years old, 48% between 30 and 50 years, and 13% above 50 years; 67% are males and 33% females; 83% are university graduates; 70% have an average income compared to the income level in their

country, while 18% are above average and 12% below average; 73% live in urban areas, 16% in villages and 11% in suburban. While 90% of the respondents use tablets or smart phones, only 63% said that social media influence their consumption patterns. As socio-economic factors were taken into account in analyzing the sample, it was possible to track differences in attitudes among various categories.

FIGURE 2 HOW DID THE ENVIRONMENT CHANGE IN 10 YEARS?



III. ANALYSIS OF RESULTS

A. General

1. How did the environment change in 10 years?

The majority of respondents, 72%, thought that the environmental situation in their country worsened over the past ten years. 12% said that it did not change, and 16% that it improved. This is a slight improvement over an EDM survey in 2000, which showed that 85.5% thought the environment became worse and 14.5% said it became better. However, it represents a setback compared to the results of AFED 2006 survey, when 60% said the environmental situation had worsened. In the current survey, some countries strikingly stood out of the regional average. In seven countries, the percentage of those who thought the environmental situation deteriorated was higher than the regional average: Syria (94%), Yemen (88%),

FIGURE 3 HOW DID THE ENVIRONMENT CHANGE IN 10 YEARS?

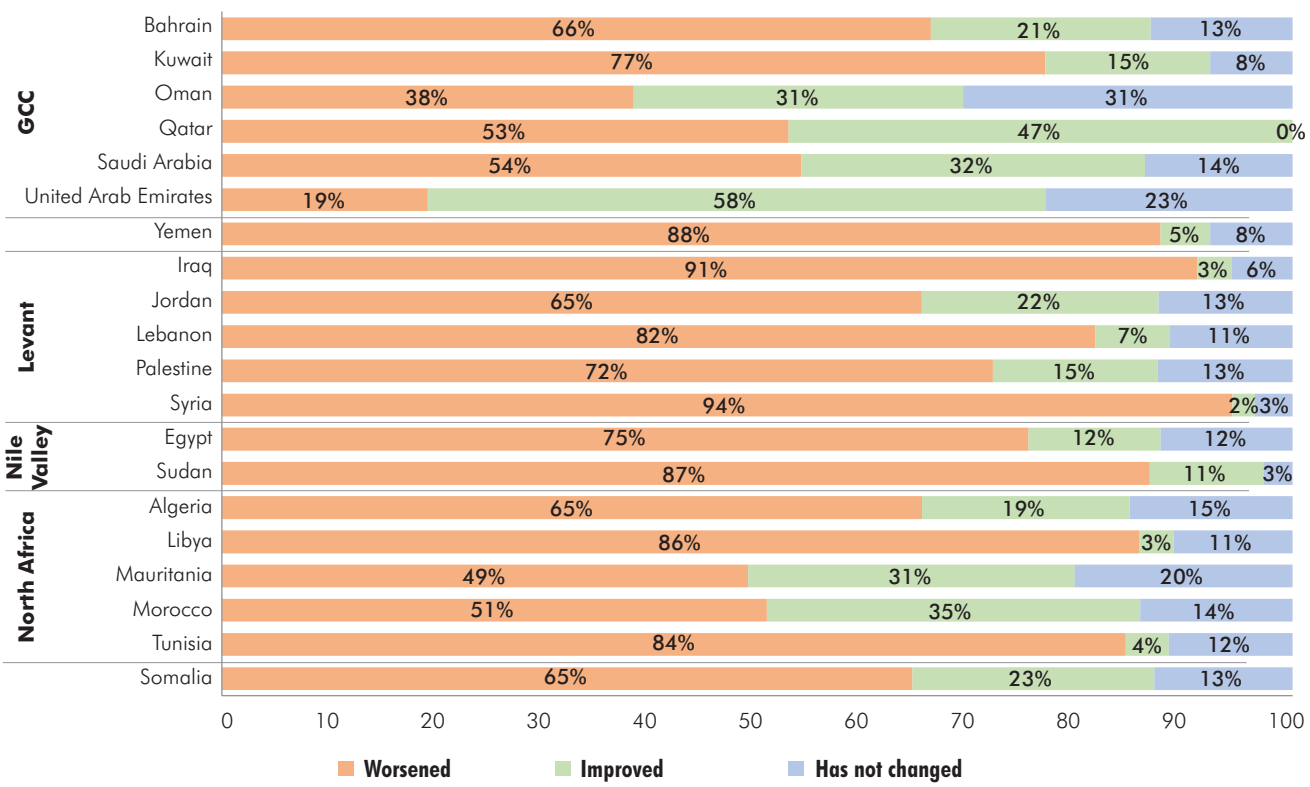
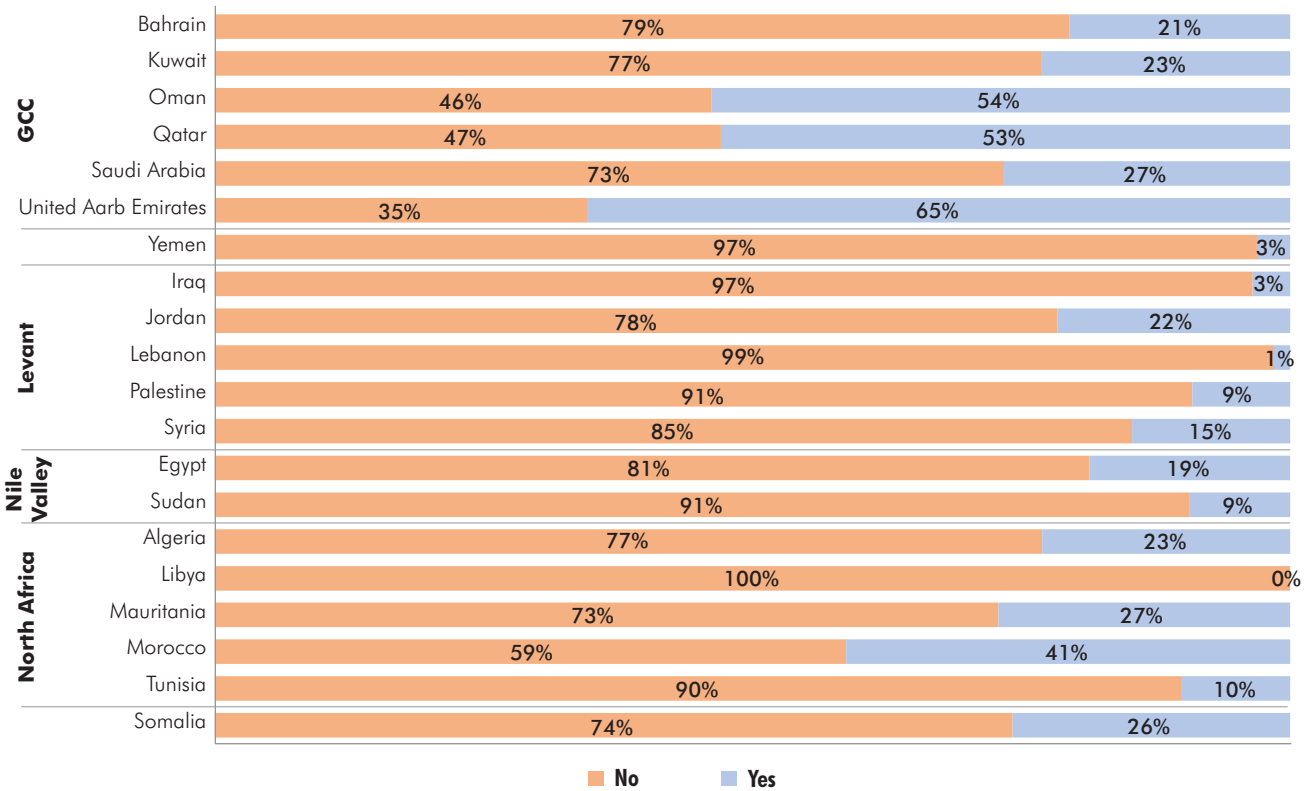
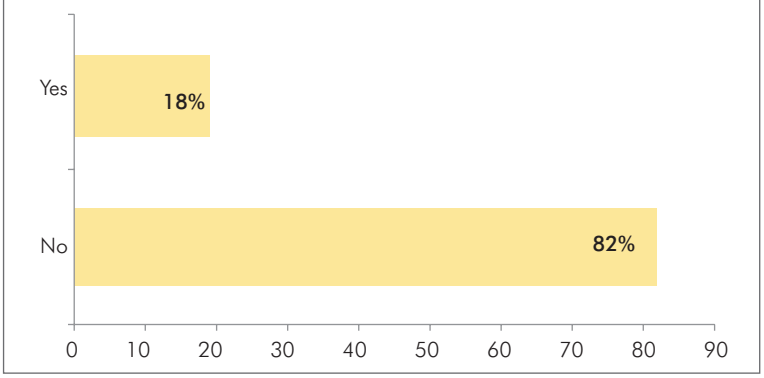


FIGURE 4 IS THE GOVERNMENT DOING ENOUGH TO SOLVE ENVIRONMENTAL PROBLEMS?



Sudan (87%), Libya (86%), Tunisia (84%), Lebanon (82%) and Kuwait (77%). It is interesting to note that these are all countries that have suffered wars and conflicts. On the other extreme, in three countries, the percentage of respondents who said that the situation became better was higher than regional average: UAE (58%), Qatar (47%) and Morocco (35%). While positive answers in some countries might reflect genuine belief that the environment improved, it might in other instances be a reflection of a lack of accurate information or the result of mixing between high standards of living and good health of the environment.

FIGURE 5 IS THE GOVERNMENT DOING ENOUGH TO SOLVE ENVIRONMENTAL PROBLEMS?



2. *Is the government doing enough to solve environmental problems?*

82% of the respondents said that their governments were not doing enough to solve environmental problems, while 18% thought that governments were doing a satisfactory job. Negative responses, which were much higher than the regional average, pointing to unsatisfactory work of governments, were recorded in Lebanon (99%), Palestine (91%) and Sudan (91%). The highest percentages of those who were satisfied with what their

governments were doing for the environment came from the UAE (65%), Oman (54%) and Morocco (41%).

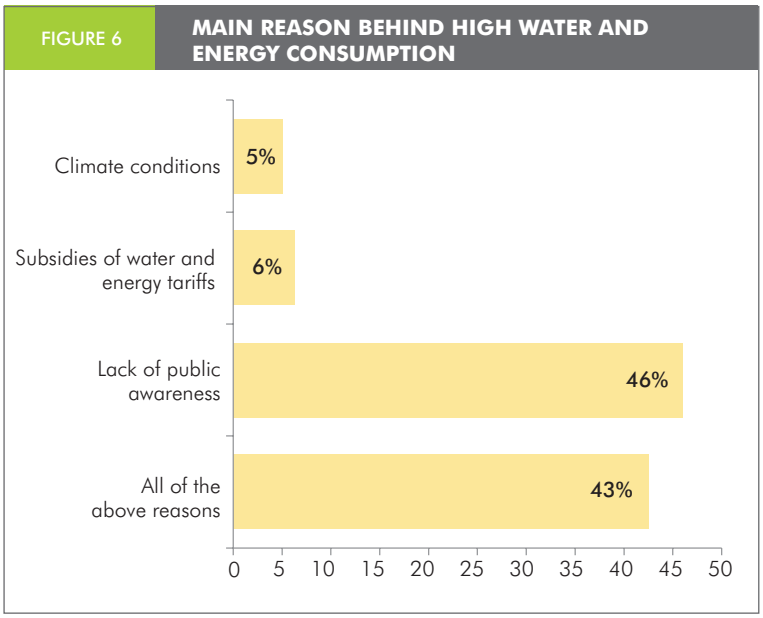
3. *Most important environmental problems*

At the regional level, three problems scored highest as environmental priorities: solid waste (16%), traffic congestion and transport systems (14%), and inefficiency in water and energy use (12%). Those were followed by industrial pollution (10%), quality of sanitary and wastewater disposal systems, air quality and food safety (9% each). The combined regional averages concealed differences at the country level: industrial pollution scored higher in Oman, Bahrain, Morocco, Qatar and Tunisia, while marine pollution ranked high in Bahrain, Oman and Somalia. At the sub-regional level, food safety featured among the top three priorities in the Nile Valley and African Horn, while it scored low in the GCC countries and North Africa.

4. *Threat of climate change*

In response to a question on whether or not climate change poses a real threat to the country of the respondent, 88% said yes and 12% said no. In comparison, a survey carried out by AFED in 2009 recorded 84% yes and 16% no. This represents 5% increase in six years in those who believe that climate change represents a real and direct threat to them. There were no sharp differences recorded among sub-regions. Oman stands alone with 100% of the respondents saying that climate change poses a threat to the country, which might be attributed to the Omanis' devastating experience with Cyclone Gonu in 2007.

FIGURE 6 **MAIN REASON BEHIND HIGH WATER AND ENERGY CONSUMPTION**



B. Water and Energy

5. *Do you know that the Arab region is the poorest in the world in natural water resources?*

72% said they were aware that the Arab region is the poorest in the world in renewable fresh water resources, while 28% were not. The highest percentage of those who said they didn't know was in Algeria (43%) and Iraq (42%), while all Gulf countries recorded a higher than average awareness level of freshwater scarcity. This reflects the situation in the Gulf countries, which are increasingly dependent on the desalination of seawater to meet their basic water needs.

6. *Do you know that individual consumption of water and energy in some Arab countries is among the highest in the world?*

A remarkable 77% of the respondents said they were aware that levels of per capita consumption of water and energy in some Arab countries rank among the highest in the world. The highest scores came from the UAE (92%) and Kuwait (90%).

7. *What is the main reason behind high water and energy consumption?*

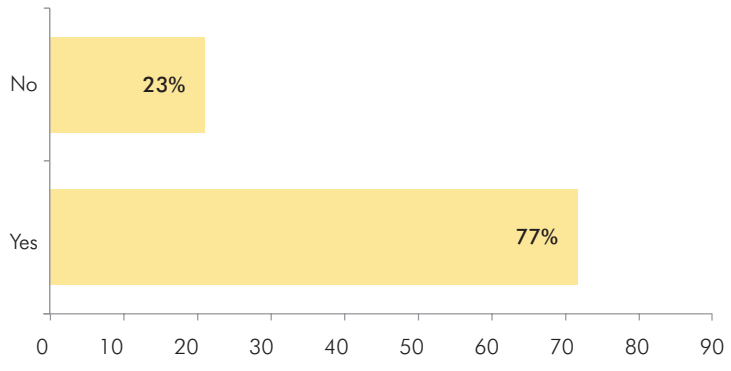
Participants were asked to choose one main reason for the high per capita consumption of water and energy in Arab countries from among: climate conditions, lack of public awareness, water and energy subsidies, or all of these factors together. Lack of public awareness scored highest, at 46%, while 6%

thought the main reason was high water and energy subsidies, and 5% attributed the high consumption to harsh weather conditions. 43% thought the cause was a combination of the three factors. The highest percentage of those who singled out subsidies as the main factor came from Oman (46%), the UAE (19%) and Kuwait (18%). This can be explained as a reaction to the strong position about the negative effects of subsidies on the national economy, publicly adopted by high officials in the three countries over the past two years.

8. *Do you use water-saving devices at home?*

The answers on whether respondents use water-saving devices at home do not necessarily reflect the willingness to use them, as much as their availability in certain markets. At the regional level, 45% said they used water-saving devices, and 55% did not. The highest scores came from countries undertaking programs to promote water-saving and where devices are available in the market, such as Oman

FIGURE 7 DO YOU ACCEPT TO PAY MORE FOR WATER, ELECTRICITY AND FUEL IF THE INCREASE IS COMPENSATED BY DIRECT SOCIAL BENEFITS?

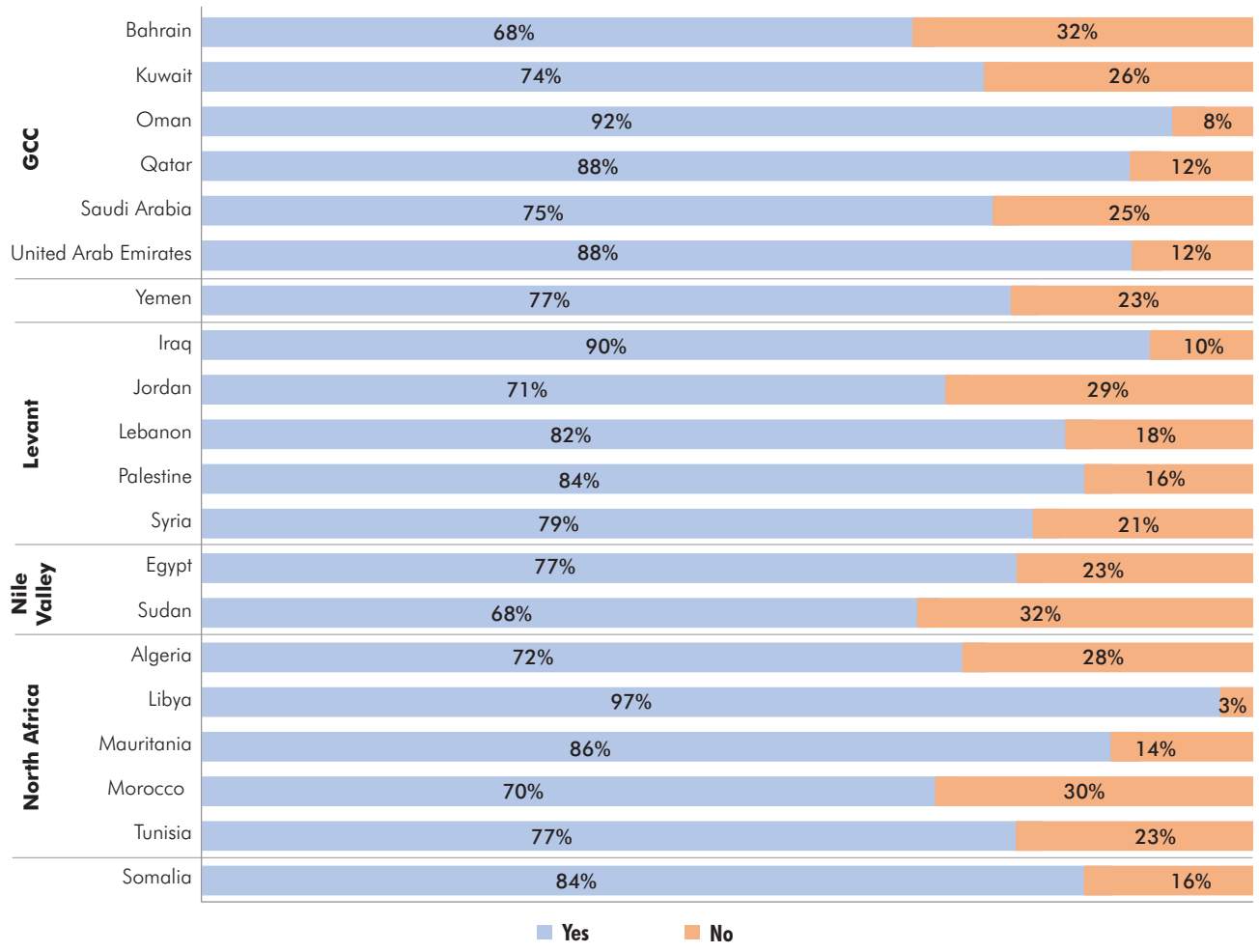


(69%), Jordan (63%), Bahrain (54%) and the UAE (50%).

9. *Would you accept to pay more for water, electricity and fuel if the increase is compensated by direct social benefits?*

The question was specifically structured to balance between phasing out of subsidies and compensating with additional social benefits such as education, health insurance and adequate pensions. In response, 77% accepted while 23% rejected. Results reflected uniformity of responses among sub-regions and countries. An interesting observation was that the highest percentage of those who

FIGURE 8 DO YOU ACCEPT TO PAY MORE FOR WATER, ELECTRICITY AND FUEL IF THE INCREASE IS COMPENSATED BY DIRECT SOCIAL BENEFITS?



rejected to pay more for energy and water was in the GCC countries (26%). Although this is only slightly higher than the regional average and other regions (25% in the Nile Valley and North Africa and 18% in the Levant), it shows that higher income does not necessarily mean that consumers are ready to pay more for environmental conservation.

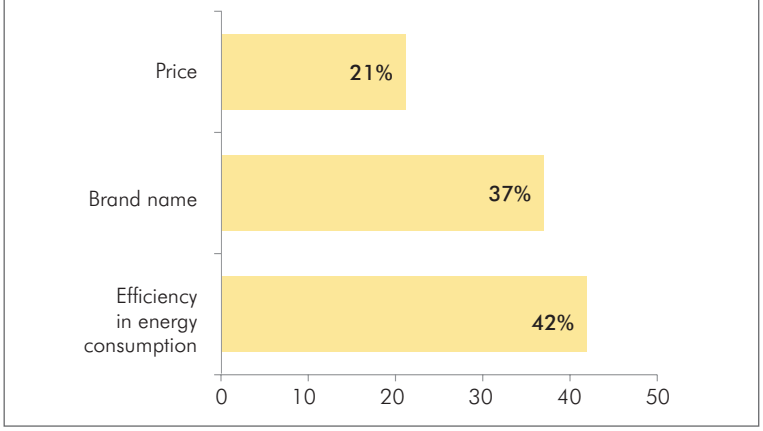
10. What is your main concern when you buy an electrical appliance?

Respondents were asked to choose their main concern when buying an electrical appliance, from among three factors: brand name, efficiency in energy consumption and price. Efficiency was chosen by 42%, which reflects growing concern in the region about saving electricity, and wider availability of efficient appliances. 37% chose brand name, and 21% chose price as main factors. The lowest percentage of those who buy electrical appliances based on efficiency was recorded in Qatar (9%) and the highest in Tunisia (57%) and Jordan (56%). This reflects the importance of adopting Minimum Energy Efficiency Standards (MEPS) for electrical appliance by governments. It is likely that Tunisians ranked high because of the rigorous energy efficiency policies adopted by the government.

11. Do you use energy-saving lamps?

Results showed that the use of energy-saving lamps (like CFL and LED) is increasing in Arab countries, as 85% of the respondents use them. This reflects the wider availability of energy-saving lamps in the market, with easy access to consumers. It also reflects the global trend, as major suppliers have cut off the production of conventional lamps. Saudi Arabia and Qatar recorded low levels of domestic use of energy-saving lamps (35%), which is likely due to heavily subsidized electricity prices. On the other hand, high levels came from Jordan and Syria (95%), Egypt (94%) and Lebanon (91%), countries which undertook energy-saving initiatives in the past years, including programs to promote energy-saving lamps and making them available to consumers.

FIGURE 9 MAIN CONCERN WHEN YOU BUY AN ELECTRICAL APPLIANCE



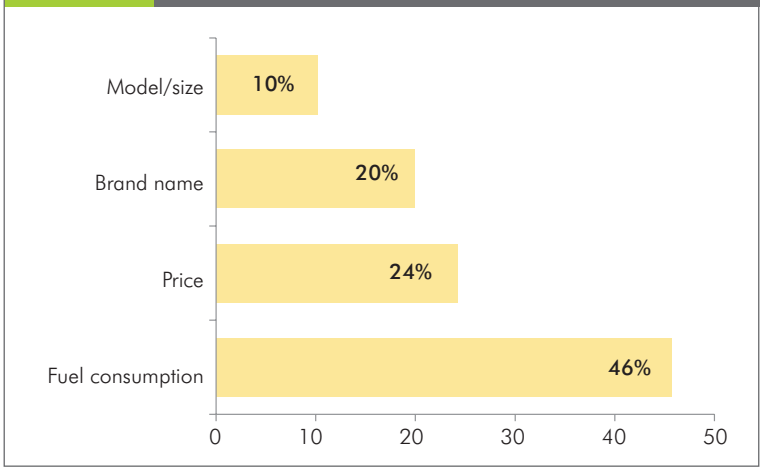
12. Percentage of water cost of the family income

At the regional level, water cost for 54% of the people was below 3% of the family income. It was 4-5% for 31%, between 6-10% for 11%, and above 10% for 4% of the respondents. No sharp differences were noticed between income categories, which clearly showed that people with higher income benefited most of subsidies.

13. Percentage of electricity bill of the family income

Results Results showed that 38% of the respondents spent 4-5% of the family income on electricity bills; 26% of the people paid

FIGURE 10 MAIN CONCERN WHEN YOU BUY A CAR

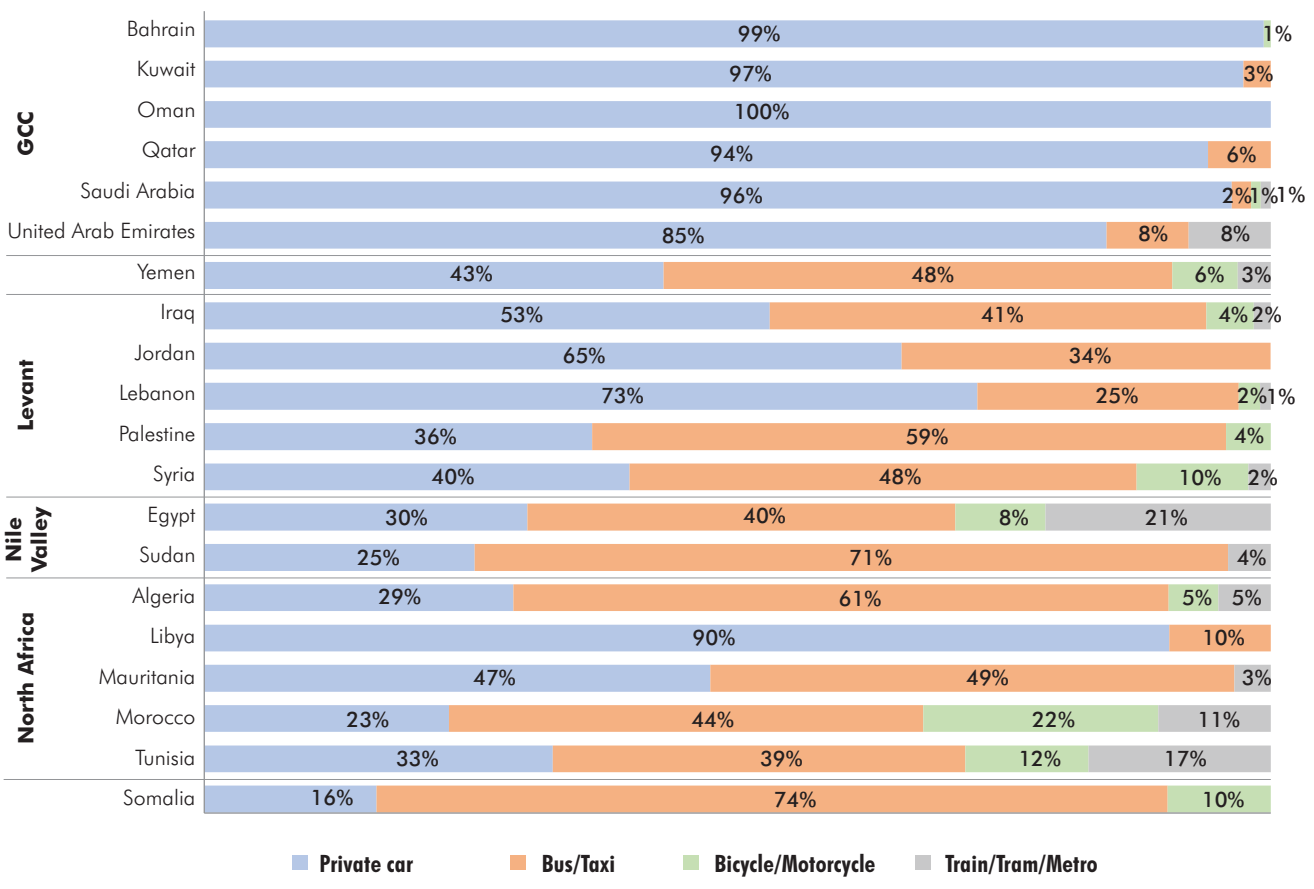


below 3% of family income for electricity, with another 26% paying between 6-10%. The remaining 4% of the respondents paid over 10% of the family income to cover the electricity bill. Those who paid the lowest percentages compared to family income were residents of Qatar, the UAE, Saudi Arabia, Bahrain and Kuwait (countries with high per capita income and heavy energy subsidies). Those who paid the highest percentages of their income for electricity were in Palestine, Lebanon, Tunisia and Algeria. Same as in water, results indicated that higher income categories within countries benefited most of subsidies.

14. What is your main concern when you buy a car?

Respondents were asked to identify their main concern when they buy a car, choosing from among four factors: brand name, fuel consumption, model/size, and price. Fuel efficiency was the motive for 42% of car buyers, brand name for 37%, while 21% chose price as the main determining factor to buy a car. It should be noted that while some of these factors overlap, some variations were noteworthy. Brand name and model were the main factors in Qatar, Saudi Arabia, Bahrain, Kuwait and the UAE – well above 50% of the total (countries with very cheap fuel prices). Fuel efficiency and price dominated as the main factors in Jordan, Egypt, Morocco, Lebanon, Iraq and Tunisia. The highest percentage of those who choose a car for its fuel efficiency was in Jordan (72%) and the lowest in Saudi Arabia (17%) and Qatar (16%). This shows a direct relationship with fuel prices, which are high in Jordan and very low in Saudi

FIGURE 11 WHICH MEANS OF TRANSPORTATION DO YOU USE MOST?



Arabia and Qatar, and GCC countries in general, in combination with differences in income levels.

15. Which means of transportation do you use most?

Although modes of transport most used by respondents varied according to country and place of residence, some broad results were common. As the regional average, 47% used a private car, 41% bus or taxi, 6% metro or tram, and 6% motorcycle or bicycle. The use of a private car was highest across the GCC countries, followed by Lebanon. Besides social habits, this reflects in many cases the lack of a reliable public transport system. It was remarkable to note that 8% of those who responded from the UAE use the metro, introduced to Dubai in 2009, with networks under construction in Abu Dhabi. The growing popularity of the metro in the UAE shows that people are ready to use public transport when offered in an appropriate manner.

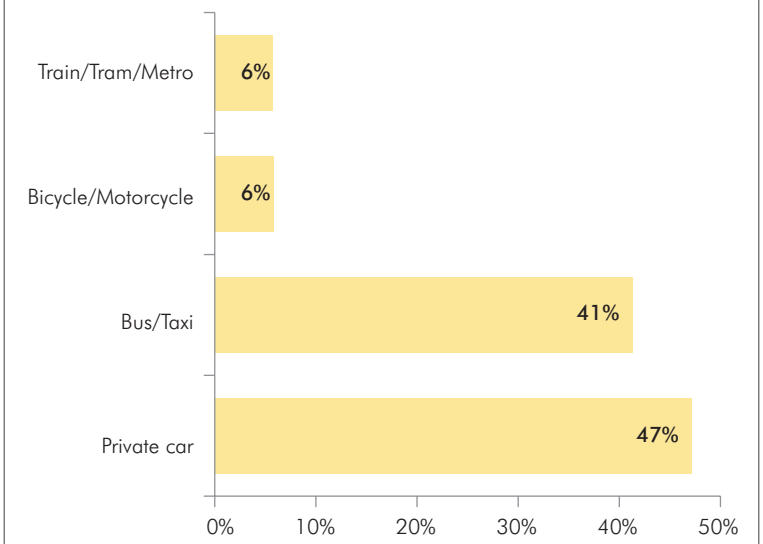
16. Sharing personal car with others

Asked whether people were ready to share a personal car with others to go to work, 84% said yes and 16% said no. The highest percentage of rejection came from GCC countries, topped by Saudi Arabia, likely due, at least in part, to social and cultural reasons. Still in those countries, acceptance of sharing a car with others to go to work was significant, attracting over 50% of respondents in every GCC country.

17. Do environmental labels influence your choice of a hotel?

Although the concept of environmental labels for hotels is new to the region (such as Green Stars in Egypt), some hotel chains promote their own environmental programs. The survey showed that clients might not be indifferent, as 79% of the respondents said that an environmental label will play a role when they choose a hotel.

FIGURE 12 WHICH MEANS OF TRANSPORTATION DO YOU USE MOST?



18. Does good environmental record play a role in your choice of an airline?

73% of the respondents said that good environmental record and program implemented by a certain airline would affect their choice when they travel. The lowest turnouts came from the UAE and Saudi Arabia (50% each) although the national carriers of both countries advertise environmental commitments, and in some cases environmental initiatives as in the case of Emirates Airlines.

FIGURE 13 DO YOU PREFER LOCALLY PRODUCED OR IMPORTED FOOD PRODUCTS?

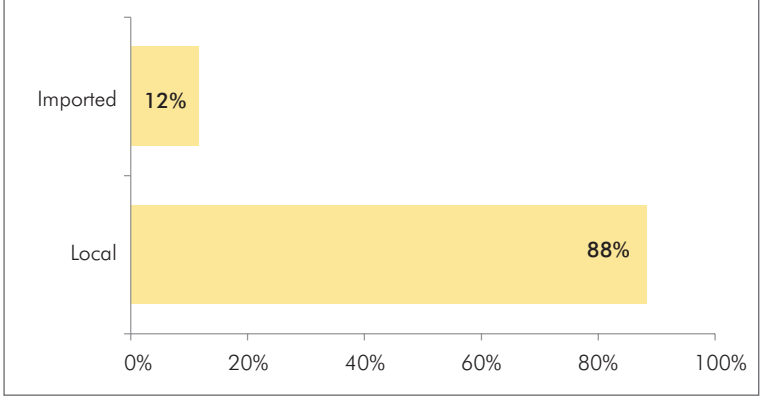
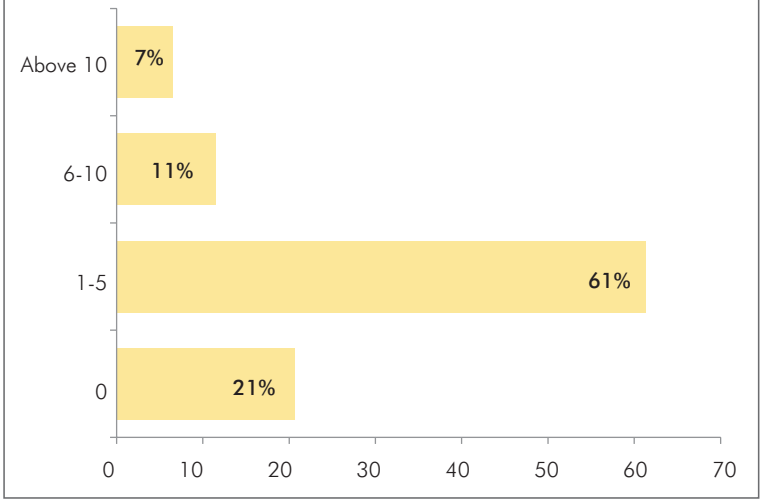


FIGURE 14 HOW MANY TIMES PER MONTH DO YOU BUY FAST FOOD?



C. Food

19. Do you know that Arab countries import half of the basic food they consume?

At the regional level, 89% of the respondents said they were aware that Arab countries import half of the food they consume. There was uniformity in answers among regions and countries.

20. Do you prefer locally produced or imported food products?

An overwhelming majority of 88% said they preferred locally-produced food products, with the score reaching 100% in some countries. It was remarkable that a portion of the respondents from some food-producing countries showed, in few cases, preference for imported food products, probably driven by food safety concerns.

21. How many times per month do you buy fast food?

The majority of respondents (61%) said they buy fast food 1-5 times per month, while 21% said they do not buy fast food at all. 11% buy fast food 6-10 times per month and 7% more than 10 times. Answers to this question revealed unexpected uniformity among countries, rich and poor.

22. What is the percentage of food cost to the total family income?

62% responded that food accounts for over 10% of the family income, with 23% saying it accounts for 6-10%. 14% said it accounts for less than 5% of income. Survey analysis showed that the lower the income,

the higher the percentage spent on food, and vice versa. However, the difference in ranges was not significant.

23. *Are you ready to change your dietary habits to save water and energy resources?*

People were asked whether they were ready to change their dietary habits, by eating less or dropping some types of food that require more energy and water to produce, and shifting to less water-intensive products with similar or higher nutritional value (such as fish and chicken instead of red meat), if this helps to conserve resources and safeguard the environment. 84% of the respondents accepted to shift to other foods, while 16% rejected this. The results were uniform among countries, with a significant higher than average percentage of those rejecting change coming from Saudi Arabia (29%).

24. *Are you ready to change your dietary habits to improve your health conditions?*

Considering that changing dietary habits helps fight many diseases, including diabetes and obesity, participants were asked whether they were ready to change their dietary habits if this leads to improvement in their health condition. A resounding majority of 99% answered yes. Positive responses reached 100% in most countries.

FIGURE 15 ARE YOU READY TO CHANGE YOUR DIETARY HABITS TO SAVE WATER AND ENERGY RESOURCES?

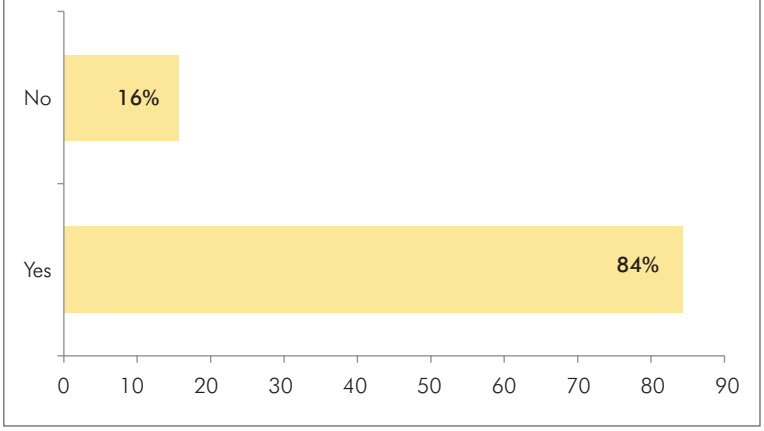
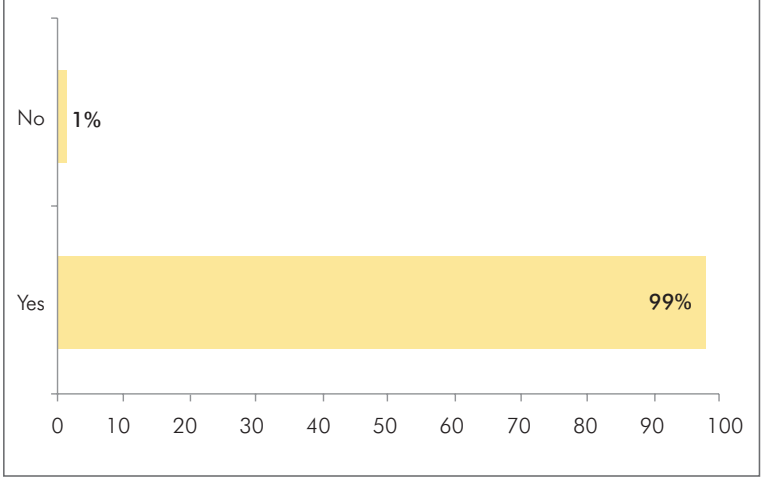


FIGURE 16 ARE YOU READY TO CHANGE YOUR DIETARY HABITS TO IMPROVE YOUR HEALTH CONDITIONS?



REFERENCES

AFED Arab Public Opinion and the Environment Survey, (2006) Tolba, M., and Saab, N., June 2006, Beirut.

AFED (2009) Arab Environment: Impact of Climate Change on Arab countries. Arab Forum for Environment and Development (AFED), Saab N., and Tolba M., (Eds.). Beirut.

Environment and Development Magazine EDM (Al-Bia Wal-Tanmia) (2000) "Results of the First Pan Arab Environmental Survey" Technical Publications, Volume 5, Number 25, April 2000.

Al-Yaum, (2013) Al Khattaf, D.,"Is There A Better Mechanism To Support Energy in Gulf States?"(Arabic). Retrieved from http://www.alyaum.com/article/3103930. (Accessed June 2015).

TABLE **REGIONAL AND SUBREGIONAL SURVEY RESULTS (%)**

		GCC	LEVANT	Nile Valley	North Africa	African Horn	Regional Average
1- How did the environment change in 10 years?	Has not changed	14	9	10	14	16	**12**
	Improved	28	9	12	19	29	**16**
	Worsened	59	82	78	66	55	**72**
2- Is the government doing enough to solve environmental problems?	No	71	91	83	77	71	**82**
	Yes	29	9	17	23	29	**18**
3- Most important environmental problems	Air Quality	9	10	10	7	7	**9**
	Food Safety	5	11	13	7	16	**9**
	Fresh Water Availability	9	8	3	3	5	**5**
	Fresh Water Quality	4	8	9	6	10	**7**
	Industrial Pollution	10	6	9	13	0	**10**
	Inefficiency in Water and Energy Use	10	13	11	11	11	**12**
	Marine Pollution	9	2	2	6	16	**5**
	Noise Pollution	4	4	7	5	1	**5**
	Quality of Sanitary and Wastewater Disposal System	8	9	10	10	11	**9**
	Solid Waste	13	15	12	18	16	**16**
	Traffic Congestion and Transport Systems	17	13	14	14	5	**14**
4- Threat of climate change	No	12	15	11	11	26	**12**
	Yes	88	85	89	89	74	**88**
5- Do you know that the Arab region is the poorest in the world in natural water resources?	No	19	23	26	35	45	**28**
	Yes	81	77	74	65	55	**72**
6- Do you know that individual consumption of water and energy in some Arab countries is among the highest in the world?	No	19	21	16	30	21	**23**
	Yes	81	79	84	70	79	**77**
7- What is the main reason behind high water and energy consumption?	Climate conditions	7	4	4	6	13	**5**
	Lack of public awareness	34	47	38	52	32	**46**
	Subsidies of water and energy tariffs	9	5	4	7	0	**6**
	All of the above reasons	51	44	54	36	55	**43**
8- Do you use water-saving devices at home?	No	52	49	60	57	61	**55**
	Yes	48	51	40	43	39	**45**
9- Would you accept to pay more for water, electricity and fuel if the increase is compensated by direct social benefits?	No	26	18	25	25	16	**23**
	Yes	74	82	75	75	84	**77**
10- What is your main concern when you buy an electrical appliance?	Brand name	46	28	47	41	11	**37**
	Efficiency in energy consumption	24	50	36	40	64	**42**
	Price	30	22	17	19	25	**21**

		GCC	LEVANT	Nile Valley	North Africa	African Horn	Regional Average
11- Do you use energy-saving lamps?	No	27	8	8	18	53	**15**
	Yes	73	92	92	82	47	**85**
12- Percentage of water cost of the family income	Less than 3%	66	55	55	50	29	**54**
	4-5%	26	30	28	34	29	**31**
	6-10%	8	11	14	11	29	**11**
	Above 10%	1	4	3	5	13	**4**
13- Percentage of electricity bill of the family income	Less than 3%	43	23	26	22	24	**26**
	4-5%	37	36	35	41	24	**38**
	6-10%	15	27	30	26	39	**26**
	Above 10%	5	14	9	11	13	**11**
14- What is your main concern when you buy a car?	Brand name	23	13	19	24	8	**20**
	Fuel consumption	17	60	51	39	49	**46**
	Model/size	24	7	6	9	11	**10**
	Price	19	20	24	28	32	**24**
15- Which means of transportation do you use most?	Bicycle/ Motorcycle	1	4	7	8	8	**6**
	Bus/ Taxi	2	40	47	52	63	**41**
	Private car	97	55	29	32	29	**47**
	Train/ Tram/ Metro	1	1	18	8	0	**6**
16- Sharing personal car with others	No	32	11	13	15	32	**16**
	Yes	68	89	87	85	68	**84**
17- Do environmental labels influence your choice of a hotel?	No	34	21	20	17	37	**21**
	Yes	66	79	80	83	63	**79**
18- Does good environmental record play a role in your choice of an airline?	No	42	26	25	24	24	**27**
	Yes	58	74	75	76	76	**73**
19- Do you know that Arab countries import half of the basic food they consume?	No	17	13	7	8	21	**11**
	Yes	83	87	93	92	79	**89**
20- Do you prefer locally produced or imported food products?	Imported	14	12	16	8	29	**12**
	Local	86	88	84	92	71	**88**
21- How many times per month do you buy fast food?	0%	14	19	28	21	18	**21**
	1-5	61	64	59	60	66	**61**
	6-10	15	11	8	12	13	**11**
	Above 10	9	5	5	8	3	**7**
22- What is the percentage of food cost to the total family income?	Less than 3%	4	2	3	5	5	**3**
	4-5%	17	10	6	12	13	**11**
	6-10%	32	21	15	24	39	**23**
	Above 10%	48	67	76	59	42	**62**
23- Are you ready to change your dietary habits to save water and energy resources?	No	19	16	15	15	26	**16**
	Yes	81	85	85	85	74	**84**
24- Are you ready to change your dietary habits to improve your health conditions?	No	1	1	1	2	0	**1**
	Yes	99	99	99	98	100	**99**

Background Papers

Energy Demand Profile in Arab Countries

Ibrahim Abdel Gelil

Access to affordable energy services is fundamental to human development and economic growth. The abundance of hydrocarbon resources in some parts of the Arab region has played a major role in the region's socioeconomic development. This unprecedented social and economic development along with dramatic changes in consumers' lifestyles has gradually turned the region into an evolving energy consuming market. The rise in energy demand in the Arab countries is driven by urbanization, increased economic activity, population growth, and energy pricing policies. The energy sector plays a major role in meeting the water and food needs in the region, and geographic factors such as water scarcity and harsh climate conditions have thus also contributed to the rise in energy demand. Though the Arab region shares some social and cultural factors, it is heterogeneous in terms of resource endowments, level of development, governance systems, and others. Despite rapidly growing energy demands and declining reserves of fossil fuels, the region continues to be one of the most energy-intensive economies in the world, and accordingly also has a high carbon footprint. This paper briefly presents the current pattern of energy consumption in the Arab region, the driving forces that shape these patterns, and how sustainable they are. The paper also discusses the different nexus between energy, water, and food in the Arab region, and finally concludes with a set of public policies that would facilitate the transition to a sustainable energy sector. These include promoting energy efficiency, making use of economic incentives to encourage private investments in the energy sector, and building the needed capacity to improve energy efficiency, among others.

I. INTRODUCTION

Access to affordable energy services is fundamental to human development and economic growth. The abundance of hydrocarbon resources in some parts of the Arab region has played a major role in the region's socioeconomic development. For decades, oil revenues in oil rich countries have been used to finance governments' spending, accumulate savings, or invest in infrastructure, social programs, and to improve human development indicators. This unprecedented social and economic development along with dramatic changes in consumers' lifestyle has gradually turned the region into an evolving energy consuming market. The rise in energy consumption and demand in the Arab countries is driven by urbanization, increased economic activity, population growth, and some geographic factors such as water scarcity and harsh climate conditions. This high level of consumption represents an unsustainable long-term pattern which poses energy security concerns, even for the world's top oil and gas producers such as Saudi Arabia (KSA) and the United Arab emirates (UAE). Those countries, as most of the other countries in the region, rely mostly on hydrocarbons for meeting their energy demands and all countries heavily subsidize their energy prices. Despite rapidly growing energy demands and declining reserves of fossil fuels, the region continues to be one of the most energy-intensive economies in the world. It is also worth noting that the energy sector plays a major role in meeting the water and food needs in the region.

This paper briefly presents the current pattern of energy consumption in the Arab region. It examines how efficient it is, and what the different nexus are between energy, water, and food in the Arab region. The paper will also discuss a set of public policies that would facilitate the transition to a sustainable energy sector.

II. DRIVERS OF ENERGY DEMAND IN THE ARAB REGION

The Arab countries are truly heterogeneous in terms of socio-economic contexts and levels of development. Per capita income and human development indicators vary dramatically between rich hydrocarbon endowed Gulf Cooperation Council (GCC) countries and those of the least developed countries such as Yemen, Mauritania, and Comoros. Thus, the determinants of energy demand as well as the pattern of energy consumption vary accordingly. One can generally summarize those drivers of energy demand as follows:

- **Economic structure and growth**
  Since 2005, the Arabs countries' GDP has increased from nearly US$1.2 trillion to about US$1.6 trillion with an annual growth of 4.7 percent (Table 1). However, economic performance in 2011 was affected by the historical political transition in a number of countries including Tunisia, Egypt, Libya, Syria, and Yemen. These political events have led to an unprecedented decline in total output, exports, tourism flows, foreign direct investment inflows and decline in workers' remittance. This in turn led to economic recession in most of the countries that witnessed political unrest in 2011. The economic structures of Arab countries also vary between energy intensive economies as in the GCC, and in more diversified economies as in Egypt, Tunisia and Iraq. On average, extraction and manufacturing represent more than 50 percent of the Arab economy (JAER, 2012). This is a major driver of both energy demand and energy intensity.

- **Population growth**
  Table 1 shows that the population of the Arab

countries grew by 2.2 percent annually between 2005 and 2012, which represents another major driving force for energy demand.

- **Rate of urbanization**
  The Arab region is one of the most urbanized regions in the world. In 2010, the Arab population reached 352 million residents, 56 percent of whom live in cities. By 2050, the population will reach 646 million residents, of whom 68 percent will live in urban areas. Disparities exist across sub-regions such as the GCC where urbanization levels reaches 80 percent, and the least developed Arab countries which are characterized by rapid urbanization based on conflict, environmental degradation, severe droughts, and rural poverty (Habitat, 2013).

- **Welfare**
  According to the World Bank, the average per capita income of the Arab countries has increased from US$3,796 in 2005 to US$4,649 in 2013, with an annual growth rate of 2.6 (World Bank, 2015)1. Increase in income would drive households to buy more electrical appliances or cars, and thus induce growth of energy demand.

- **Ownerships of home appliances and cars**
  As described above, increase of households' income would lead to an increase of ownership of home appliances and cars. Empirical data of car and appliances ownership in the region is scarce. Home surveys need to be done in different countries to collect this data, as a crucial pre-requisite to energy demand analysis at the end use. This is especially important in the Arab region as the residential sector consumes more than 40 percent of the total electricity (Figure 6).

- **Scarcity of water resources**
  Though the Arab region is energy rich, it is one of the most water scarce regions in the world. Most of the region's countries cannot meet current water demand, and the situation is likely to get worse due to changing precipitation patterns as a result of climate change. Furthermore, some 60 percent of the region's water flows across international borders, further complicating water resource management. Drinking water services will become more erratic than they are already and cities will come to rely more and more on energy intensive desalination, driving more energy demand. Water and energy are strongly interdependent in the whole value chain of both water and energy such as pumping and transferring underground water or use of water resources to produce hydropower, as is the case in Egypt and Iraq, and using fresh water for cooling of thermal power plants. Furthermore, agriculture uses more than 70 percent of the water consumption with a very low level of water productivity. The different nexus between energy, water, food, and climate change in the region is evident. Thus, there has been a growing recognition of the need for integrating the planning and design of energy and water systems.

- **Harsh climate conditions in the Arab region**
  Most of the region is characterized by harsh climate conditions of arid and semi-arid areas. This necessitates the use of air-conditioning during a prolonged time of the year. Some studies revealed that "air conditioning accounts for 70 percent of annual peak electricity consumption in the Gulf Cooperation Council (GCC) region of the Middle East and will require 1.5 million barrels of oil equivalent per day by 2030"(IDEA, 2015).

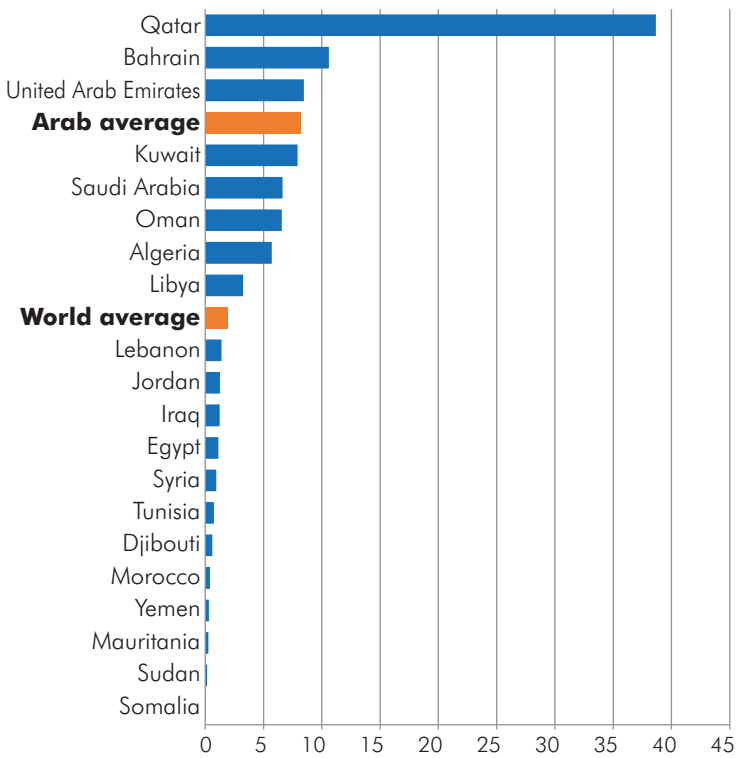
- **Land area, urban planning, and communication technology**
  Urban planning is an important determinant of demand on transport fuels. Proper urban planning would reduce travel needs by changing land-use patterns and improving communications. Land-use, transport, and fuel demand are closely related parts of the human activity system. Bringing schools, factories, offices, shops, and recreational and other facilities into, or near, urban centers will minimize the need to travel far or frequently for work and other activities. Some parts of the Arab region, like the GCC, have the unique advantage of their urban expansion with appropriate incentives for more efficient and environmentally sound patterns. Old Arab cities such as Cairo, Damascus, and Baghdad have limited opportunities for

TABLE 1 **GROWTH OF PRIMARY ENERGY, POPULATION, AND GDP IN THE ARAB REGION**

	2005	2006	2007	2008	2009	2010	2011	2012*	CAGR
Primary Energy (MTOE)	2,477	2,473	2,558	2,603	2,909	2,965	2,782.14	2,856.4	2.05
Population (million)	309	317	326	337	344	352	361	360	2.22
GDP (billion US$)**	1,161	1,245	1,315	1,363	1,386	1,456	1,508	1,602	4.70

*Figures of 2012 exclude South Sudan. UN Population Prospects Revision shows that the Arab population reached over 370 million in 2013. In 2015, the figure is about 392 million and is projected to reach about 659 million in 2050 (Medium Variant). **Source: GDP (constant 2005US$), World Bank, WDI

FIGURE 1 **ENERGY CONSUMPTION PER CAPITA (TOE)**



Source: OAPEC, 2015

proper urban expansions, leading to traffic congestion and deteriorated air quality. Recent advances in communication and information technology (ICT) offer a range of modern user services for increasing efficiency of travel and transportation of freight, leading to dramatic fuel savings. For instance, Dubai Transport Corporation (DTC) provides taxi services using an automatic vehicle location (AVL) and a tracking system based on Global Positioning System (GPS) technology.

- **Subsidy of energy prices**
  Most of the Arab countries have had a long history of subsidizing energy prices for different reasons, which has been a major cause of energy inefficiency. Subsidized energy prices encourage wasteful consumption behavior leading to an increased energy demand. Some Arab countries such as Jordan, UAE, Morocco and Egypt have already started to reform energy pricing schemes. Others are planning to follow.

III. ENERGY CONSUMPTION PATTERNS

Between 2005 and 2012, the Arab region's constant GDP rose at a Compound Annual Growth Rate (CAGR) of 4.7 percent, while primary energy consumption rose at a rate of 2.05 percent annually, and the population grew at 2.22 percent (Table 1).

Per capita energy consumption varies greatly between oil producing and non-oil producing countries. The per capita consumption in Qatar is 38.6 tons of oil equivalent (toe), which is the highest among Arab countries and twenty fold the world average (1.9 toe). Per capita energy consumption of the oil rich GCC, Libya and Algeria is higher than the world average, while the rest of the Arab countries have a per capita primary energy consumption lower than the world average (Figure 1).

The same disparity can be observed in the per capita electricity consumption of different Arab countries. Figure 2 shows that while the average Arab per capita electricity consumption is less than the world average, the per capita electricity consumption in the GCC countries and Libya exceeds the world average. The per capita electricity consumption in Kuwait, the highest in the Arab region, is about seven times the Arab

SAVING FUEL ON SAUDI ROADS

The transportation sector is responsible for almost 23 percent of total energy consumption in Saudi Arabia. The number of vehicles and the growth of consumption are expected to continue steadily if practical measures aren't taken to improve energy consumption efficiency and curb unjustifiable waste.

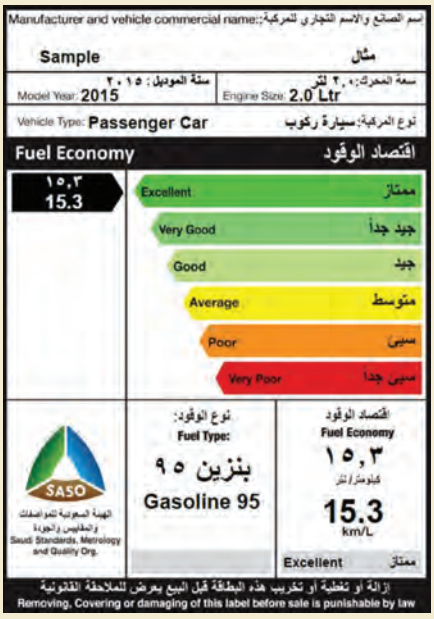
Hence, the Saudi Energy Efficiency Center (SEEC), in cooperation with involved parties, determined the reasons for low energy consumption efficiency in land transportation. It concluded that low saving in vehicle fuel is the main reason why consumption efficiency is low in this sector – it is close to 12 kilometers per liter of fuel, compared to 13 kilometers per liter in the United States, 15 kilometers per liter in China and 18 kilometers per liter in Europe.

The program's specialized team has worked with governmental and non-governmental advisory parties for two years on preparing secondary programs for improving fuel saving in current and imported light and heavy weight vehicles.

Secondary programs, executed to improve fuel saving in imported light vehicles, included issuing the Vehicle Fuel Saving Card in December 2013 and ensuring abidance by it in August 2014. The card's goal is to inform consumers about saving fuel in vehicles. A standard specification for tires – setting requirements for lessening sliding and increasing competence on damp surfaces – was issued in April 2014. The first stage will be applied in November 2015 and the second stage in November 2019. The specification's goal is to improve energy efficiency in light and heavy vehicles by improving the efficiency of their tires. The specification also requires preparing a card for energy efficiency for tires.

The Saudi Standards, Quality and Metrology Organization (SASO) issued the Saudi Standard for Energy Saving in Light Vehicles, which will be applied to all imported light vehicles starting January 2016. The standard's goal is to improve fuel saving in the kingdom's vehicles by four percent annually, hence, increasing fuel efficiency from the current 12 kilometers per liter to more than 19 kilometers per liter of fuel by 2025.

When preparations for the standard were launched in November 2013, the nature of vehicle supply and demand in Saudi Arabia was taken into consideration. Moreover, world car manufacturers were contacted to provide reports on their vehicles' fuel saving and to take their comments and suggestions in ongoing improvements to the standard's level. In the process, technical neutrality, just competition and the variety of vehicle choices for consumers were respected.



More than 80 manufacturers, representing more than 99 percent of vehicle sales in the kingdom, committed themselves to the Saudi Standard for Energy Saving in Light Vehicles.

A working network of four government authorities was formed to monitor the standard's application and the commitment of world car manufacturers to its requirements and to follow up on the improvement of the vehicle fuel saving rate. These authorities are the Ministry of Trade and Industry, SASO, General Customs and SSEC.

An awareness campaign was launched in February 2015 under the slogan "As You Like", and lasted for four weeks. It introduced consumers to the Vehicle Fuel Saving Card and encouraged them to change their vehicle driving habits.

Other secondary programs are being prepared to lower fuel consumption in vehicles on the roads and improve fuel saving in imported trucks and busses.

Once all land transport programs are fully applied, a noticeable increase in energy efficiency in this field is expected, and major savings in energy consumption will ensue.

Al-Bia Wal-Tanmia (Environment & Development) magzine, issue 208, July 2015.

average, and nearly five times the world average. Such a large disparity exists among different Arab countries to the extent that the average Kuwaiti consumes as much electricity as 13 Sudanese households of five persons each.

Although some Arab countries are rich in energy resources, almost 52 million Arabs have no access to electricity, especially in the least developed countries Yemen, Sudan, Mauritania, Comoros, Djibouti, and Somalia (World Bank, 2010). Without access to modern energy services, the opportunities for economic development and improved living standards are severely constrained. Furthermore, the wide disparities in access to affordable modern energy services between different countries and between urban and rural populations within the same country aggravate inequality, worsen poverty, and threaten social stability. The majority of Arabs with no access to electricity lives in least developed countries such as Yemen, Sudan and Mauritania. Renewable energy technologies could contribute to providing improved energy services for the rural poor, thereby alleviating poverty, while improving environmental quality and mitigating climate change. However, widespread diffusion of such systems faces strong institutional, technical, and financial barriers that need to be overcome for any effective contribution to poverty alleviation. One of the most challenging barriers has to do with the high initial cost of renewable technologies compared to conventional energy options (AFED, 2011).

One should thus be cautious when comparing amongst different Arab countries. Though the region shares many social, political and cultural aspects, it is completely heterogeneous in terms of economic conditions and level of human development.

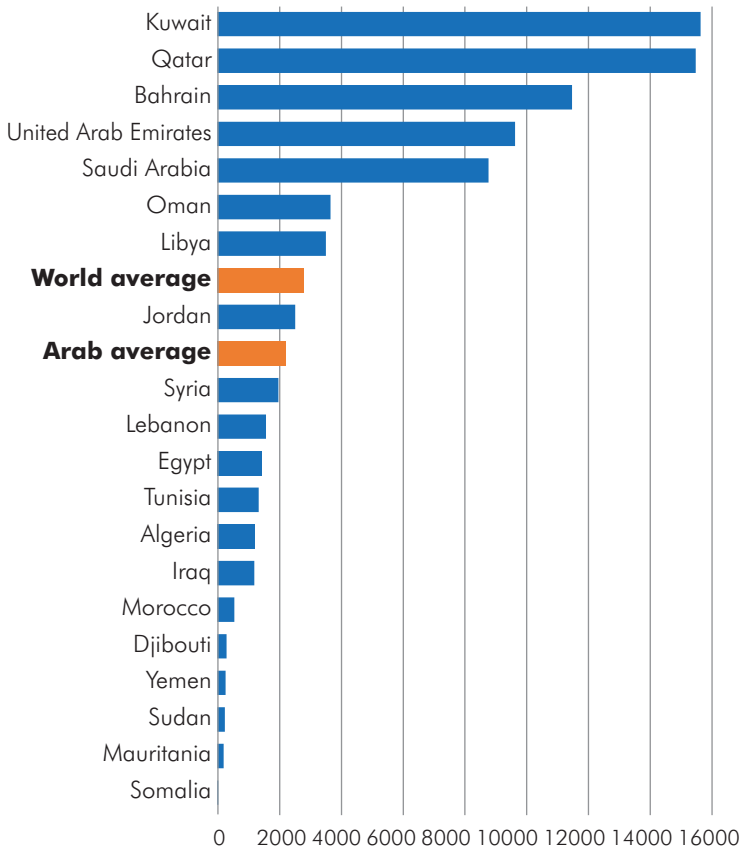
The high level of energy consumption in most Arab countries and the inefficiency of use can be attributed to, among others, the historically pervasive adoption of energy subsidies. In most countries of the region, fuel and electricity are subsidized at rates averaging more than 50 percent of the cost of supply. Table 2 displays energy subsidies as a proportion of the full cost of supply in selected Arab countries. Subsidies for electricity and petroleum products are intended to allow citizens to share in their countries' natural-resource wealth as in the case of GCC countries, or to make essential energy services available to the poor, particularly in resource scarce countries like Egypt. However, subsidies tend to promote inappropriate consumer behavior, send wrong signals to consumers and suppliers,

impair economic viability of sustainable energy options, aggravate environmental pollution and greenhouse gas (GHG) emissions, and they pose a rapidly increasing burden on governments' finances. Although in some cases fuel subsidies are designed so as not to deter development and energy access to the poor, they pose a fundamental barrier to promoting energy efficiency and shifting consumption patterns to more sustainable options.

The widespread regional unrest known as the "Arab Spring" has placed the issue of socio-economic justice at the top of the policy agenda. Energy subsidies, widely perceived as being a fundamental economic and social benefit, have placed huge pressure on the middle-income governments' finances, undermining their fiscal sustainability. For example, Egypt's expenditure on energy subsidies reached a staggering LE143.7 billion (close to US$21 billion) in the financial year 2013/14 – a figure representing 19.5 percent of total government spending. This strained public finance makes it difficult for those countries to invest in energy sector development and expansion plans. Recent recurring power outages have characterized electricity provision throughout wide parts of the region, exacerbated by a culture of non-payment of utility bills by some parts of the population, especially in the GCC.

A year on from the Arab Spring, domestic energy subsidy reform returned to the agenda of several Arab net oil importers such as Jordan, Morocco, and Egypt. In 2012, Jordan decided to gradually lift all petroleum product subsidies, later followed by the lifting of LPG and electricity subsidies. Morocco announced far-reaching domestic pricing reform for petroleum products between late-2013 and early 2014. Morocco's case is interesting as it is one of the few MENA countries that not only raised prices for domestic fuel products but actually leveled them on a permanent basis to international prices. In 2014, Egypt announced a steep price hike on most petroleum products (up to 70 percent price increases overnight). The process of phasing the subsidy out is thus likely to be lengthy, although the government has been ambiguous on the timing and nature of future price rises (El-Katiri, L., and Fatouh, B., 2015). Additionally, in 2014, a Prime Minister's decree outlined a five-year schedule to gradually raise electricity tariffs during the period 2014-2018[2].

FIGURE 2 **ELECTRICITY CONSUMPTION KWH PER CAPITA (2012)**



Source: OAPEC

TABLE 2 **ENERGY SUBSIDIES IN SELECTED ARAB COUNTRIES**

Countries	Subsidy as a percentage of fuel cost of supply (%)
Algeria	41.4
Egypt	56.3
Iraq	47.4
Kuwait	53.3
Libya	52.0
Qatar	63.2
Saudi Arabia	78.9
UAE	55.7

Source: AFED, 2011

The availability of fossil fuels at low production costs encouraged oil-producing countries to invest in energy-intensive industries such as desalination, petrochemicals, and aluminum smelting. This has led, in addition to harsh climate conditions and poor energy efficiency, to high-energy intensity. Primary energy intensity is

ACWA POWER DEVELOPS 200 MW SOLAR PV PLANT IN DUBAI: 5.84 CENTS PER KWH SETS NEW GLOBAL PRICING BENCHMARK

Paddy Padmanathan

In March 2015, the Dubai Electricity and Water Authority (DEWA) signed a 25-year power purchase agreement with a consortium of ACWA Power and TSK for a 200 MW net solar photo-voltaic (PV), under Phase II of the Mohammed bin Rashid Al Maktoum Solar Park, the Middle East's largest renewable energy park. The bid tariff set a new global pricing benchmark for renewable energy generated from utility scale PV panels at USD5.84 cents/kWh without subsidies. The second phase is based on the Independent Power Producer (IPP) model and is intended to be operational by April 2017. The project, which occupies 4.5 Km^2, will help to achieve a reduction of 400,000 tonnes of carbon emissions by 2020.

This nationally strategic project fulfils the directives of H.H. Sheikh Khalifa bin Zayed Al Nahyan, President of the United Arab Emirates and Ruler of Abu Dhabi, to produce renewable energy locally, and conforms with the Green Economy for Sustainable Development initiative, launched by Vice President and Prime Minister and Ruler of Dubai, H.H. Sheikh Mohammed bin Rashid Al Maktoum, to make the UAE one of the global leaders of sustainability and a hub for the export and re-export of green products and technologies. The project intends to strengthen the position of Dubai as a global hub for trade, finance, tourism, sustainability, and green economy, as well as an international role model for achieving the highest standards in energy efficiency.

The power purchase agreement (PPA) also supports the Dubai Integrated Energy Strategy 2030, developed by the Dubai Supreme Council of Energy to diversify Dubai's energy mix. Following the opening of the tariff bids in December 2014, it was reported in late January that Dubai planned to triple its target to increase the share of renewables to 15 per cent in its energy mix by 2030, along with increasing its 2020 target by seven times to 7 per cent. The entire Solar Park will produce 3,000 MW of electricity when completed in 2030 and will be one of the biggest IPP projects in the renewable energy market worldwide.

The ACWA Power led consortium was awarded preferred bidder status on 15 January 2015, based on a levelized tariff, which set a global benchmark for utility scale solar photovoltaic power plants. The signing of the PPA within 70 days of the award was a testament to the commitment shown towards the project by both DEWA and the winning consortium.

The Middle East's demand for power is growing across the board at 7-8 percent annually, which should make it a seller's market tailor-made for market pricing. However, ACWA Power's pricing model is centered on its long term sustainability perspective, driving its relentless focus on delivering the most optimal value-for-money solutions that are technically and commercially viable to meet the off-takers' need for quality and reliable service over the entire 20-25 year term of a PPA, while providing adequate returns to the private sector investors / developers.

Given that IPP projects are typically project financed to the tune of about 80 percent of the total project cost, the developer/investor has to factor in that the project cash flows in the initial first half of the PPA term mainly gotowards servicing the project's debt. These financial structures enable a developer/investor to only collect the return on equity in the latter half of the PPA Term. However, the developer/investor has to ensure that the bid tariff stays relevant and market competitive to the client throughout these years, especially since the client will still be procuring new capacity at lower tariffs.

ACWA Power's focus on creating shared value ultimately helped deliver the astounding tariff for the DEWA 200MW solar PV Independent Power Project (IPP). As with typical large power projects, the order of priority for cost reductions was CAPEX (Capital Expenditures), finance and then OPEX (Operational Expenditures). In broad terms, the breakdown of the ultra-low tariff was: 50 percent capital costs, a third for financing and the remainder for operating expenses. Under CAPEX, the PV panels accounted for slightly less than 40 percent of the cost, the inverters 12-13 percent, while the balance of plant and construction accounted for the remainder. One key success factor was the selection of the most efficient and cost competitively PV panels based on thin film technology from First Solar, the largest solar company in the world. Furthermore, the solid track record of both the Development team and its supply chain and the Off-Taker convinced the Financers to lend more

money than standard, so that the project was able to raise 86 percent debt which is significantly above the normal threshold of 80 percent. This, coupled with the prevailing status that debt is cheaper than equity, further helped check costs

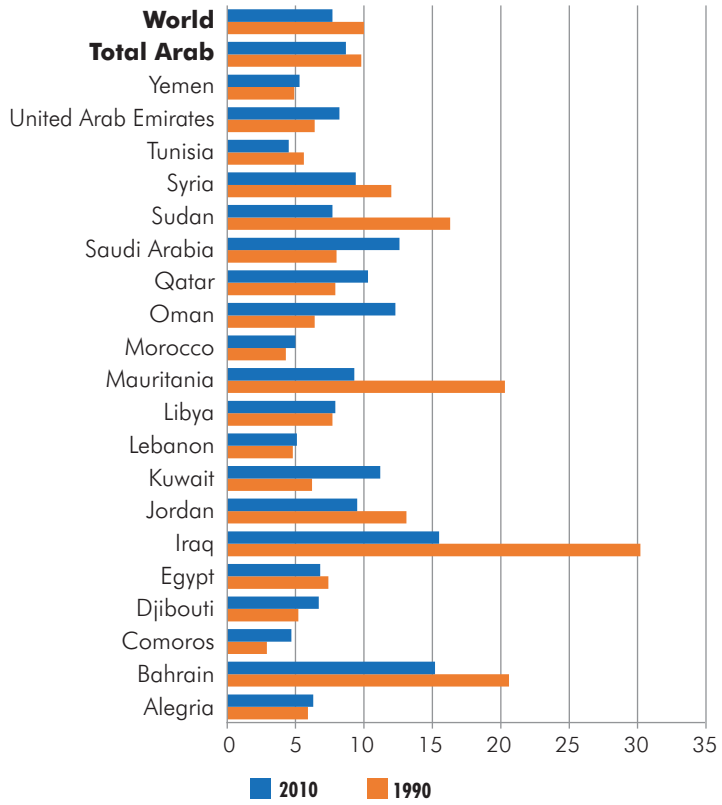
ACWA Power is a developer, investor, co-owner and operator of a portfolio of power generation and desalinated water production plants currently with operations in 10 countries in the Middle East and North Africa, Southern Africa and South East Asia regions. ACWA Power's portfolio, with an investment value in excess of USD26 billion, can generate 16.9 GW of power and produce 2.5 million m^3 /day of desalinated water to be delivered on a bulk basis to state utilities and industrial majors on long term off-take contracts under Public-Private-Partnership, Concession and Utility Services Outsourcing models.

ACWA Power, registered and head-quartered in the Kingdom of Saudi Arabia, is owned by eight Saudi conglomerates, together with Sanabil Direct Investment Company (owned by the Public Investment Fund of Saudi Arabia), the Saudi Public Pensions Agency and the International Finance Corporation (a member of the World Bank Group).

ACWA Power pursues a mission to reliably deliver electricity and desalinated water at the lowest possible cost while seeking to maximize local content and local employment creation, thereby contributing to the social and economic development of the communities and countries it invests in and serves.

Paddy Padmanathan, CEO and President, ACWA Power. ACWA Power is AFED corporate member.

FIGURE 3 **ENERGY INTENSITY (MJ/$2005 PPP)**



Source: SE4ALL

measured as the ratio between the total primary energy consumption and the country's GDP. It measures the amount of energy input required to generate one unit of GDP. In other words, it is a proxy to energy productivity in an economy. By expressing in Purchasing Power Parity (PPP), the GDP is adjusted to reflect the differences in the cost of living in different countries. Figure 3 indicates that in 2010, the average primary energy intensity in the region was nearly US$8.7 2005 (PPP) compared to a world average of US$7.7 2005 (PPP), and the energy intensities of all the GCC countries were higher than the world average. It is also clear that only seven countries improved their energy intensity between 1990 and 2010: Tunisia, Syria, Sudan, Mauritania, Iraq, Egypt, and Bahrain. Whether these improvements occurred due to improved efficiency or structural changes in the economy remains to be clarified by more analysis. Within the Arab group, results are widely divergent, from Iraq on the high end and Tunisia on the low end of energy intensity.

As the region relies almost entirely on fossil fuel for meeting its energy demands, and as most countries heavily subsidize energy prices, the region continues to be one of the most energy-intensive regional economies in the world. This has resulted in an increase of associated greenhouse gas (GHG) emissions. With rapid urbanization, population, and economic growth, the trend is heading towards an even greater rise in energy intensity.

Figure 4 indicates the high level of per capita carbon emissions of the GCC countries and Libya, with the level in Qatar exceeding eight times the world average.

Energy consumption in the region continues to be dominated by fossil fuels. In 2013, the primary energy consumption mix was dominated by oil products (47 percent) and natural gas (51 percent), with coal and hydro playing a minor role (1 percent). As can be observed from Figure 5, the situation has not changed significantly since 2005. The main trend is the increasing use of natural gas, with a relative reduction in share amongst all other sources. Between 2005 and 2012, the annual regional consumption grew from 2,477 million toe to 2,856 million toe, with a compound annual growth rate (CAGR) of nearly 2 percent. Consumption of all forms of energy increased over the same period.

Figure 6 illustrates final energy consumption by sector in 2009 in 13 selected Arab countries. As can be observed from this figure, the transport sector accounted for the largest share of total final energy consumption with 33 percent. By fuel type, final energy consumption was dominated by oil products (67 percent); followed by natural gas (15 percent); electricity (17 percent); and coal (1 percent). In terms of electricity consumption, the residential sector represents the largest consumer group (41 percent) followed by industry (26 percent) (AFED, 2013).

As noted before, the Arab region is mainly dependent on non-renewable resources (natural gas and oil). The region is also one of the world's most water stressed regions. Energy and water are inextricably linked. For instance, the GCC countries rely heavily on desalination plants to meet water demand for agriculture, household, and industrial activities with a high-energy

DEVELOPING A UAE VEHICLE FUEL ECONOMY POLICY

Simon Pearson

The transport sector was responsible for 23 percent of global CO_2 emissions in 2012, according to the International Energy Agency. Three quarters of these emissions were from the road sector, whose emissions have grown by 64 percent since 1990 and are projected to roughly double between 2000 and 2050. We see the same pattern in the UAE with road transport accounting for 22 percent of greenhouse gas emissions. The UAE transport sector's greenhouse gas emissions are predicted to grow by 3 percent per annum, from 19 million tonnes CO_2 equivalent per year ($mtCO_2e$) in 2005 to 40 $mtCO_2e$ by 2030. The sector's growth will also result in a substantial increase in the consumption of the country's oil reserves.

The UAE has started to tackle these emissions with projects such as Etihad Rail in Abu Dhabi and the Dubai Metro. The first phase of the Etihad Rail network for freight transport is now operational on a testing basis; a single freight train can carry the load of 250 trucks, and will result in a 60 percent reduction in carbon emissions once completed. The Dubai Metro carries over 500,000 passengers per day, leading to a significant reduction in car journeys. However, one area that still needs to be addressed is the vehicle fuel economy. The potential for emissions reduction resulting from the development and implementation of vehicle fuel economy policies is estimated to be 10 $mtCO_2e$ per year in the UAE market.

According to the Global Fuel Economy Initiative, strong fuel economy improvements to conventional vehicles could achieve a 50 percent reduction in fuel use per kilometre for new cars by 2030. This would in turn contribute to carbon emissions savings of almost 8 billion tones (Gt) over the same period. Most technologies for improving the fuel economy of vehicles are already commercially available and cost effective, and they would help to achieve a 50 percent reduction in fuel use/km for new cars globally. Drivers would also save an estimated $2 trillion by 2025 from reduced fuel costs, even when accounting for new expenditures on cars.

The Kingdom of Saudi Arabia has recently approved a vehicle-labelling programme to disclose fuel economy of different classes of light duty vehicles and a fuel economy standard that is based on the US Corporate Average Fuel Economy standards. If Saudi Arabia and the UAE were to set the same standards for vehicles, then it would be easier to develop a GCC- wide standard through the Gulf Standardization Organisation.

A UAE fuel economy label and standard for light duty vehicles is being developed under the coordination of the Ecological Footprint Initiative, overseen by the Ministry of Environment and Water. A study of the country's baseline and the standard's economic, technical and environmental potential is being undertaken by EWS-WWF to support the Emirates Authority for Standardisation and Metrology (ESMA) in developing a robust, science-based and locally-relevant standard. The process involves extensive data analysis and multi-stakeholder consultations with a wide set of local institutions including relevant ministries, transport authorities, oil and gas companies, environment and energy agencies, and vehicle manufacturers.

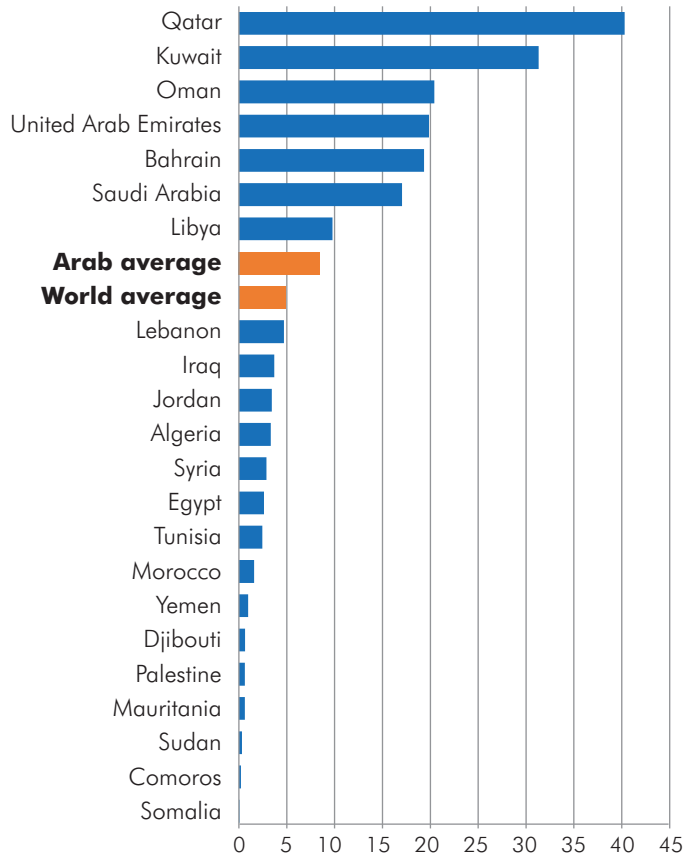
Initial estimates developed as part of the scoping study suggest that fuel economy and new engine technologies could reduce the UAE's fuel consumption resulting in a reduction of carbon emissions by 10 $mtCO_2e$ per year. According to an analysis done for the Green Growth Strategy, improving fuel economy for passenger vehicles provides the fourth highest return on investment at 780 AED/tCO_2e. In this way the standard is in line with the country's green growth agenda and the efforts to reduce the country's consumption and ecological footprint.

Dr. Simon Pearson, Senior Advisor, Environment Agency – Abu Dhabi.

footprint. With population rising and economic growth escalating, there will be increasing pressure on water resources and a subsequent increased demand for energy.

With more than half of the world's desalination capacity, the Arab region is the world leader in desalination. Although desalinated water contributes to only a very small share of Arab countries' total water supply (about 2 percent), it accounts for nearly all the water supply for many Arab countries, such as the GCC. The overall share

FIGURE 4 **PER CAPITA CO_2 EMISSIONS (2010)**



Source: World Bank, 2010

is expected to grow as a result of industrialization, accelerated urbanization, population growth and depletion of conventional water resources. Desalination plants in Arab countries have a cumulative capacity of more than 24 million cubic meters a day. The highest desalination capacity is in the Gulf countries (81 percent), Algeria (8.3 percent), Libya (4 percent) and Egypt (1.8 percent). Growth is expected to remain high for the next decade to meet escalating domestic water demand, concentrated mainly in the region's high-income, energy-exporting countries such as the Gulf countries, where it will be used to supply water to cities and industries. The two main types of desalination technology widely used in the region are the multi-stage flash (MSF) technology, a very energy-intensive process, and a few reverse osmosis plants (Bushnak, A.A. 2010).

Furthermore, global climate change would exacerbate water scarcity in the region, putting more pressure on both energy and water resources. While the region is predicted to get drier according to the forecasts of the models of the Intergovernmental Panel on Climate Change (IPCC), water demand for irrigation will also increase. Since water is a production factor for biocapacity through its potential to increase the area of productive land, these interconnections between water, energy, food, and climate become highly important and a source of concern in the

FIGURE 5 **CHANGE OF CONSUMPTION OF ENERGY RESOURCES IN THE ARAB REGION**

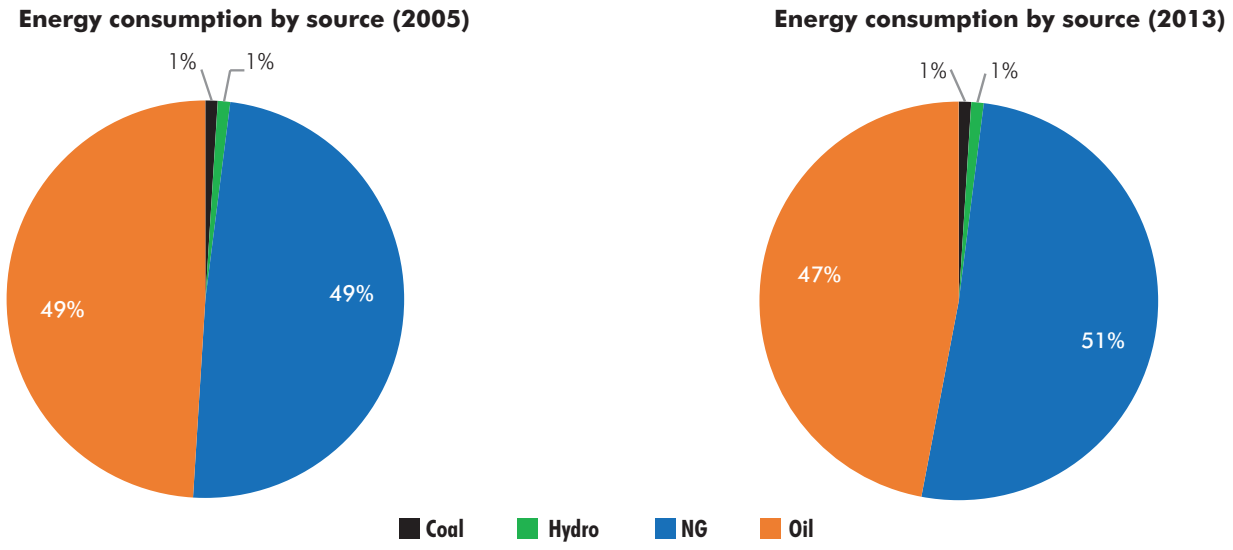
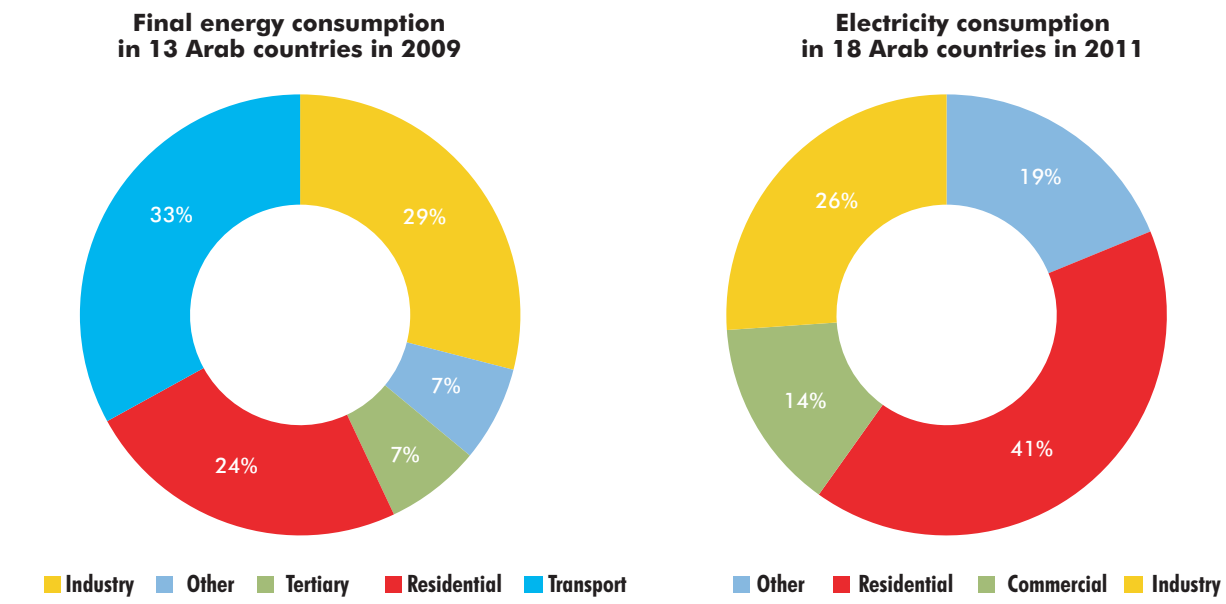


FIGURE 6 ENERGY CONSUMPTION BY SECTOR



Source: RECREEE & Plan Bleu study (2012); AUE (2011)

Arab region. There is a need to ensure that the future use of water and energy production is closely considered together with plans for climate change mitigation and adaptation (AFED, 2013).

The current level of energy intensity as described in Figure 3, and the large share of residential and commercial consumption of electricity (Figure 5) indicates a low level of energy efficiency. The efficiency of energy production and consumption patterns in the region reveals a huge potential of improvement. Energy efficiency is a development necessity for the Arab region, both for oil producing and exporting countries such as the GCC group and for oil importing countries such as Jordan and Morocco. The driving forces for improving energy efficiency includes alleviating the financial burden of oil imports in the oil importing countries, reducing demand on energy investment, making the best use of existing supply capacities to improve energy accessibility, improving economic competitiveness, reducing local pollution, and mitigating GHG emissions. In addition, for oil producers, energy efficiency would extend the lifetime of their hydrocarbon resources, availing more oil for exports, and reducing carbon footprint.

IV. POLICIES FOR IMPROVING ENERGY EFFICIENCY

Policy measures and market initiatives to stimulate the improvement of energy efficiency include:

1. Utilizing regulatory and policy instruments to move towards energy efficiency (e.g. prices and subsidies, tax incentives, import duties exemption, codes and standards).

   Energy demand is price sensitive. Most of the Arab countries have suffered from a long history of heavily subsidized energy prices. This has impaired the economics of energy efficiency and renewable energy projects, helped surge per capita energy consumption and GHG emissions, accelerated depleting natural resources, and worsened macroeconomic performance. Energy prices reform is crucial to improve energy efficiency and promote renewable energy technologies. Different Arab countries have different price reforms experiences – exchanging success and failure stories could be a good learning tool for Arab-Arab cooperation.

THE SAUDI ENERGY EFFICIENCY CENTER: STREAMLINING CONSUMPTION AND IMPROVING EFFICIENCY

Naïf Al-Abbadi

The Saudi Energy Efficiency Center (SEEC) was established in 2010 by a Cabinet decision, which transformed the National Program for Energy Management and Streamlining at King Abdel-Aziz City for Science and Technology into a permanent national center.

The center aims to help conserve national energy resources to boost development and enhance the national economy by streamlining energy consumption and improving energy efficiency. Its operations focus on five fields: preparing a national streamlining and efficiency improvement program; developing and applying policies, guidelines and rules to regulate energy consumption; supporting integration and coordination of efforts by involved parties; boosting social and official public awareness of streamlining energy consumption and improving its efficiency; and participating in the execution of some pilot projects.

The center's main task was to launch a national program for energy efficiency. A subcommittee was formed to prepare the program together with government authorities, major national companies and a large number of private sector companies. The goal was to improve energy consumption efficiency in three main sectors: manufacturing, land transportation and construction. These sectors are responsible for more than 90 percent of the kingdom's energy consumption. The goal was to limit consumption in these sectors by amending the specifications of electric home appliances, thermal insulation materials, lighting, and fuel consumption in vehicles and in the factories of iron, cement and petrochemical products.

AWARENESS OF STREAMLINING CONSUMPTION AND IMPROVING EFFICIENCY

The SEEC launched several initiatives to raise awareness about streamlining energy consumption and improving energy efficiency. These initiatives included awareness campaigns; exhibitions; workshops; lectures for university students; booklets and posters; cultural, sports and artistic activities in schools; and communication with governmental and non-governmental parties.

The awareness campaigns were held in commercial centers, targeting consumers in the housing sector and focusing on improving energy consumption efficiency in home appliances. Exhibitions included messages about energy; the steps needed to buy a new air conditioner; the optimal use of air conditioners, washing machines, refrigerators, iceboxes and lighting systems; thermal insulation in homes and its role in improving energy consumption efficiency; and explanations of the electric home appliances energy efficiency card.

Awareness campaigns targeting employees at governmental and non-governmental institutions were disseminated by email. The SEEC also conducted studies to time energy consumption in governmental, commercial and office facilities for streamlining and

SEEC'S ADMINISTRATIVE COMMISSION

King Abdel-Aziz City for Science and Technology heads the SEEC's administrative commission. Members include the Ministry of Petroleum and Mineral Resources; the Ministry of Water and Electricity; the Ministry of Municipal and Rural Affairs; the Ministry of Commerce and Industry; the Ministry of Transport; the Ministry of Finance; the Ministry of Culture and Information; the Ministry of Housing; the Ministry of Economy and Planning; Saudi Standards, Metrology and Quality; the Electricity Regulatory and Cogeneration Authority; the Royal Commis-sion for Jubail and Yanbu; the General Chairmanship of Meteorology and Environmental Protection; the General Establishment for Water Desalination; King Abdullah City for Atomic and Renewable Energy; the Customs Department; the National Committee for the Clean Development Mechanism; Saudi Aramco; the Saudi Basic Industries Corporation (SABIC); the Saudi Electric-ity Company; and representatives of the private sector.

efficiency improvement purposes. The studies specified and evaluated all possibilities to conserve energy, both technically and economically, by reviewing in detail data and patterns of energy consumption in each facility. The studies also carried out the necessary measurements of main energy consuming equipment, analyzed the results, and proposed recommendations and solutions to achieve energy savings with the least cost.

BUILDING NATIONAL CAPACITIES

The SEEC develops management and technical training programs in streamlining energy consumption and improving its efficiency. The programs include formal tests to help rehabilitate energy managers.

The programs, certified by the Saudi Council of Engineers, target various sectors such as construction to give engineers and technicians theoretical and practical information necessary to assess energy consumption conditions in buildings. The programs introduce techniques and tools for improving energy efficiency in buildings; train participants on energy management basics and economical principles; plan, manage and time energy consumption in practical approaches; and study possible streamlining chances in energy consuming systems in buildings.

In the manufacturing sector, training programs are prepared to introduce the benefits of streamlining energy consumption and improving its efficiency in manufacturing systems and assessing these systems technically and economically. The programs train participants on energy management and timing basics and introduce them to its economical principles, the benefits of energy streamlining in electric systems, engines and smelters, and introduce them to energy management systems according to the ISO50001 standard specification.

Dr. Naïf Al-Abbadi, Director General, Saudi Energy Efficiency Center (SEEC).

TABLE 3 **Status of EE Regulation for buildings**

		Type of building regulation
	Mandatory	
Bahrain	Thermal insulation implementation for buildings (1999)	Prescriptive
Egypt	EE code for commercial buildings (2006)	Mixed
	EE code for residential buildings (2003)	Mixed
Jordan	Thermal Insulation Code (1998)	Prescriptive
	Energy conservation building code (2010)	Prescriptive
	Solar energy building code (2012)	Prescriptive
Kuwait	Mandatory Energy Conservation Code of Practice for Buildings No R-6, (2014)	Prescriptive
Morocco	Thermal Regulation for Construction in Morocco (mandatory from November, 2015)	Mixed
Saudi Arabia	Saudi Energy Efficiency Building Code (2007)	Mixed
Syria	Building Thermal Insulation Code (2006), effective since 2009	Prescriptive
Tunisia	EE specifications for office buildings (2008)	Mixed
	EE specifications for residential buildings (2009)	Mixed
UAE - Dubai	Green Building Regulations and Specifications (2011)	
	Regulations on the Technical Specifications for Thermal Insulation Systems (2003)	
	Voluntary	
Algeria	Thermal Regulations for new Buildings (1997)	
Iraq	Reference EE specifications for Buildings (2012)	
Lebanon	EE building code	
Tunisia	Minimum EE performance specifications for hospitals and hotels	
	Under preparation	
Morocco	Technical specifications for active components of buildings	

Source: RECREEE, 2015

The need for minimum energy performance standards for appliances in the region is accentuated by the region's hot climate. Air conditioning contributes to 70 percent of the GCC's annual peak electricity consumption, with cooling demand expected to triple by 2030. Some Arab countries such as Saudi Arabia, Algeria, Egypt, Syria, and Tunisia have initiated programs for energy efficiency codes and standards of electrical appliances. More than half of the countries in the region have adopted Minimum Energy Efficiency Standards (MEPS) for household appliances, mostly for air-conditioners and refrigerators which is surely a positive development. However, the main problem remains in the lack of enforcement of these standards (RECREEE, 2015).

Another positive development for improved energy efficiency in the region has been the evolvement of energy efficiency building codes. Mandatory energy efficiency regulations for buildings, if enforced properly, would lead to remarkable reduction in energy demand. According to RECREEE, out of 13 existing mandatory regulations in the region, seven are prescriptive and the rest are mixed. Mixed energy efficiency building regulations include both minimum energy performance requirements for the whole building or certain parts of the building, and

UAE LIGHTING STANDARD

Deepti Mahajan Mittal

The UAE indoor lighting standard came into force in January 2014. The standard was developed under the aegis of the Ecological Footprint Initiative, which was established in 2007 to research and understand the UAE's high ecological footprint and to coordinate efforts to reduce this footprint.

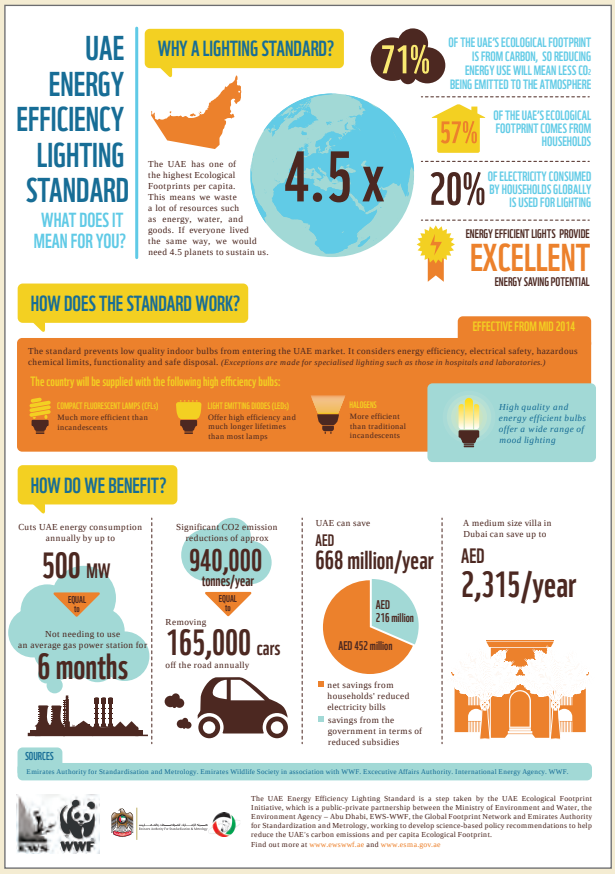
Research undertaken as part of the initiative's activities showed that within the UAE's residential sector, using energy efficient lighting would provide the second greatest energy savings potential after cooling. Cooling is already being addressed through other projects in Abu Dhabi and at the federal level , which is why the decision was made for the Ecological Footprint Initiative to focus on the lighting standard.

The implementation of this lighting standard provides a win-win for both the environment and the economy and brings the UAE in line with international best practice.

The replacement of inefficient light bulbs for indoor use will reduce the country's energy consumption by the equivalent of 340-500 megawatts per annum. Theoretically this is the equivalent of being able to turn off an average UAE gas fired power station for six months a year. This reduction in electricity consumption will result in reduced CO_2 emissions (which contribute to global climate change) and emissions of air pollutants such as particulate matter, sulphur oxides and nitrogen oxides (which are known to contribute to health issues such as respiratory diseases).

From an economic perspective, the initial cost of replacing inefficient light bulbs would be regained in just 1.1 years through reduced electricity consumption. The savings will be shared between households and the government depending on the ratio of billed and subsidized electricity. However, the benefits of establishing this lighting standard go well beyond the direct environmental and economic savings. Implementing this lighting standard demonstrates how effective collaboration and strong leadership can help to decouple economic and population growth from the trend of ever increasing emissions, resource consumption and waste production.

By 2030, the population of Abu Dhabi is projected to grow to around three times its current population. If no change is implemented, this means that greenhouse gas emissions, the emission of air pollutants, the consumption of resources such as water and our generation of waste will all increase three-fold. This scenario will have significant negative consequences for both the environment and human health, and ultimately will have negative repercussions on the economy.



The lighting standard sets a great example: it reflects the will of UAE stakeholders to take action; it demonstrates the merits of science-based, collaborative policymaking; and it provides inspiration for others to follow. This success illustrates how decoupling can be achieved, benefitting both the economy and the environment. On the back of this success we want to move forward with the implementation of the UAE Green Growth Strategy with increased impetus.

Dr. Deepti Mahajan Mittal, Project Manager, Ecological Footprint Initiative, Emirates Wildlife Society – WWF and Environment Agency – Abu Dhabi (EAD).

specific requirements for certain building elements. Qatar stands out in the region as having adopted the most advanced regulatory framework to promote energy efficiency in the building sector (Table 3). In 2012, the Global Sustainability Assessment System (GSAS) (formerly known as the Qatar Sustainability Assessment System (QSAS)) was introduced. GSAS is the first green building standard adopted to fit Middle Eastern conditions, with the aim to create a built environment where ecological impact is minimized (RECREEE, 2015).

Economic incentives to promote energy efficiency include measures such as subsidies for energy audits or investment. They aimed at encouraging investment in energy efficient equipment and technologies by reducing the investment cost. Some fiscal measures such as tax credits or reduction of custom duties are also used to decrease consumer upfront costs. A number of Arab countries such as Morocco, Tunisia, and Lebanon have had experiences in providing economic incentives, which can be beneficial for other Arab Countries.

2. Attracting private sector investments and resources in energy efficiency (e.g. public-private partnerships, private financing schemes). Generally, improving the investment climate at the national level promotes private investment in energy efficiency projects. Public-private partnerships (PPPs) for EE financing can serve as an effective means to realize energy efficiency investments. The application of a PPP structure for EE financing depends on a number of characteristics including the country context, the legislative and regulatory framework, the existing energy services delivery infrastructure, and the maturity of the commercial financial market (IEA, 2011). More needs to be done with the financial market in the Arab countries to devise financing schemes for energy efficiency.

3. Integrating energy efficiency into energy, economic, and environmental planning (e.g. least cost planning, Demand Side Management (DSM), renewable energy resources, etc.). Being mostly state-owned, most of the utilities in the Arab countries are still in the early stages of developing and implementing demand side management and energy efficiency programs. Major electricity consumers in the region such as residential and commercial sectors are good targets for utility delivered efficiency programs.

In addition, cross cutting activities that facilitate improving energy efficiency at the national levels include:

1. Increasing awareness of energy efficiency of all stakeholders. This includes raising awareness on the parts of the private sector, financial sector, and investors on the opportunities offered by energy efficiency.

2. Building capacity in key institutions (regulatory agencies, service providers, industry, financing institutions, research institutions, etc.). This includes:

   - Institutional capacity building for technology innovation and adaptation centers.
   - Capacity development for creating an enabling system for bridging the gap between scientific research and policymaking.
   - Develop adequate knowledge management systems to systematically disseminate the national experiences and lessons learned.
   - Building project-financing skills in government institutions as well as the financial sector.
   - Capacity building of local communities to raise public awareness.
   - Enhanced assistance to national education systems to consider energy efficiency at the primary, secondary and tertiary levels.

3. Developing an integrated energy efficiency knowledge management system to provide and facilitate the flow of energy efficiency information throughout the economy.

REFERENCES

AFED (2011). Arab Environment: Green Economy. Annual Report of the Arab Forum for Environment and Development, 2011; Abaza, H., Zeitoon, B. and Saab, N., (Eds.); Beirut, Lebanon. Technical Publications.

AFED (2013). Arab Environment: Sustainable Energy. Annual Report of the Arab Forum for Environment and Development (AFED), Abdel Gelil, I., El-Ashry, M. and Saab, N. (Eds.); Beirut, Lebanon. Technical Publications.

Arab Monetary Fund, Joint Arab Economic Report, 2012.

Bushnak, A. 2010. Chapter 8 in AFED (2010). Arab Environment: Water. Annual Report of the Arab Forum for Environment and Development, 2010; M. El-Ashry, B. Zeitoon and N. Saab (Eds.); Beirut, Lebanon. Technical Publications. [www.afedonline.org/en/inner.aspx?contentID=583].

El-Katiri, L., and Fattouh, B., A Brief Political Economy of Energy Subsidies in the Middle East and North Africa, The Oxford Institute for Energy Studies, 2015.

Habitat, Urbanization and Urban Risks in the Arab Region, 2013.

IEA, Joint Public-Private Approaches for Energy Efficiency Finance, 2011.

International District Cooling Association (IDCA), Conventional cooling not sustainable in GCC nations: Booz & Co., http://www.districtenergy.org/blog/2012/08/01/conventional-cooling-not-sustainable-in-gcc-nations-booz-and-co/, accessed 19 April 2015.

RECREEE, Arab Future Energy Index: Energy Efficiency, 2015.

World Bank, World Development Indicators, http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators, accessed 10 April, 2015.

World Bank, SE4ALL, http://databank.worldbank.org/data/views/variableselection/selectvariables.aspx?source=sustainable-energy-for-all, accessed 4 March 2015.

World Bank, World Development Indicators, 2010.

NOTES

1. GDP in 2005 US$ PPP.
2. Prime Minster Decree No. 1257 dated 17 July, 2014.

ANNEX

ENERGY SUBSIDIES IN THE ARAB REGION

Laura El-Katiri and Bassam Fattouh

Low domestic energy prices have played a major role in the historical surge in regional energy consumption, even beyond such factors as economic and population growth. With regional energy demand having more than quadrupled in less than 30 years, the Middle East and North Africa region now counts as one of the world's fastest growing energy markets; the IEA forecasts that the region will become the second most important driving force of global energy demand growth after Asia in the period to 2040.

Low energy prices have also contributed to the very high and (countering trends virtually everywhere else in the world) rising energy intensity of Arab economies. This means that more energy per unit of economic output is needed in these economies than anywhere else in the world. This has happened partly because the concentration of economic activity around energy-intensive industries in most Arab oil producers has diverted much investment from alternative economic sectors. However, high energy intensity in Arab economies is also due to inefficiencies in energy use across the region, fuelled to a large extent by a lack of price incentives for energy users. A recent ABB study comparing energy efficiency rates in power generation across a range of countries globally shows that Arab energy producers, such as UAE, Libya and Saudi Arabia, are among the least energy-efficient countries in terms of domestic power generation. Perhaps surprisingly at first sight, many Arab net importers of energy, including Jordan, Lebanon and Morocco, fare little better than oil and gas producers in terms of energy efficiency – the result of decades of domestic pricing policies that have largely followed those in neighbouring oil and gas producers.

Low energy prices have also affected the composition of domestic energy mix in Arab economies. Historically, these countries have not faced the same challenges as consumer countries in Europe and North America to diversify their domestic energy mix away from fossil fuels (for domestic energy security reasons). However, they may well have overlooked the economic potential of energy alternatives, such as renewable sources and nuclear power, in the presence of some of the world's lowest domestic fossil fuel prices. As a result, the Arab economies remain dependent on oil and natural gas for a staggering 95 per cent of their domestic energy needs, more than any other region in the world. This lack of diversity in domestic energy sources has left many Arab energy importers exposed to commodity price cycles and to surging world market prices of oil and natural gas.

Energy subsidies constitute a significant fiscal burden in Arab countries. With rising world market prices of oil and natural gas since the early 2000s, the region's parallel surge in domestic demand has translated into a rapid growth of fiscal expenditure on energy subsidies in importing countries such as Morocco, Egypt, Jordan, Syria and Lebanon. The recent fall in oil prices provides a welcome relief for these oil importers, but such relief could prove temporary, given that the trajectory of oil prices remains highly uncertain. Most Arab oil and gas producers do not tax their citizens, but finance to an overwhelming extent on export revenues from their valuable oil and natural gas resources. The level of this dependence ranges from around 60 per cent of total government revenues in Qatar to over 90 per cent in countries such as Libya, Iraq, Kuwait and Saudi Arabia. This modus operandi works as long as sufficient volumes of hydrocarbon exports are available. However, some studies have warned that under the business-as-usual scenario (where domestic demand keeps increasing at a robust pace and GCC governments fail to diversify their economies), export capability could be eroded, leading to a collapse of the revenue base of these countries. If the recent fall in oil price persists, it will increase the sense of urgency to adjust spending and reform energy subsidies.

The widespread use of energy subsidies in Arab countries continues to be widely defended on the basis of social safety and ensuring energy access. However, energy subsidies are largely inequitable, as they naturally accrue most to the heavy users – energy-intensive industries, and medium- to high-income households. Eliminating energy subsidies would free resources to fund improvements in public health, education and infrastructure, or alternatively allow tax reductions for small- and medium-sized businesses. Such measures would benefit all members of society and provide substantially higher social and economic returns than perceived citizens benefits bound to energy

consumption. The size of energy subsidies in some Arab countries, relative to other forms of expenditure, is staggering. In Egypt, the total government expenditure on energy subsidies in 2008 equalled its combined expenditure on health and education, as did fuel subsidies in Jordan prior to its 2008 reform of fuel prices. In Yemen, budgeted expenditure on fuel subsidies in 2008 amounted to more than 34 per cent of total government expenditure – more than one and a half times its expenditure on education and health combined.

ENERGY PRICING REFORM IN ARAB OIL AND GAS IMPORTERS

Although energy subsidies represent an inefficient and regressive distribution method, their reduction or elimination is a delicate economic and political task that requires considerable skill and political will. This is because, in the absence of appropriate compensatory programmes, energy price increases following reform will impact real incomes and lead to a decline in household welfare. The effect of removing energy

subsidies on households can be felt both directly, through higher prices of consumed energy (electricity and household fuels), and indirectly, through higher prices of other consumer goods that use energy as an intermediate input (transportation, food, etc). This is not only problematic for low-income groups, as unmitigated price rises often imply increased poverty, but also for the aspiring and increasingly politically mobile middle class in the Arab region. Energy pricing reform can also affect the competitiveness of domestic industries and firms – a particular concern for the large oil and gas producers, whose domestic industries, mainly petrochemicals, have historically been built around the competitive advantage of low-cost energy.

The fear of provoking a popular backlash has also kept those Arab countries that were largely unaffected by Arab Spring-style unrest cautious of energy pricing reform. In 2011, Morocco and Jordan (both IMF debtors who, in the late 2000s, initiated tentative reforms to reduce domestic energy subsidies) decisively rolled back further reforms, following the ousting of the Tunisian and Egyptian former presidents and the outbreak of political protest across many other parts of the region. A year on from the Arab Spring, however, domestic energy subsidy reform returned to the agenda of many regional governments, particularly net importers of oil and natural gas. Jordan has made several attempts to reform domestic prices of food and energy, the last in 2008 prior to the Arab Spring, but more recently in November 2012.

The rapid rise in Jordan's fuel import bill – in part, as a result of declining gas imports from Egypt which is struggling to supply its domestic market – subsequently contributed to a sky rocketing energy subsidy bill that reached 40 per cent of total government spending. Eventually, facing limited space for manoeuvre, the Jordanian government was forced to significantly curb public spending – including fuel subsidies – as part of a USD2.05 billion standby arrangement with IMF; one aim of this arrangement was to help the kingdom recover from the economic strains associated with the mass inflow of Syrian refugees due to the political crisis in neighbouring Syria. Jordan's November 2012 decision to gradually remove all petroleum product subsidies – later followed by the removal of LPG and electricity subsidies – was painful and faced considerable opposition both in parliament and in the streets. But the government's response – calmly continuing to roll out the reform, compensating poor Jordanian households with direct cash handouts, along with a series of television and newspaper interviews underlining the need to reduce the burden of subsidies or otherwise 'face catastrophe and insolvency' – proved effective in containing initial protests.

Morocco announced far-reaching domestic pricing reform for petroleum products between late 2013 and early 2014, as the country had been facing a ballooning energy subsidy bill which, by mid-2012, was out of proportion to any other form of expenditure. Morocco's case is interesting, as it is one of the few Arab countries that not only raised prices of domestic fuel products, but actually linked them on a permanent basis to international prices. A small, pre-determined subsidy remains in place for oil products, above and below which market prices determine the price for final customers. Price adjustments are made twice monthly by the Ministry of General Affairs and Governance, outside the reach of the Ministries of Energy and of Electricity.

In order to avoid any political backlash from the reform effort (having faced mass popular protests during the 1980s when the government attempted to raise prices for basic foods), Morocco implemented a comprehensive and well-orchestrated communication strategy to accompany the reform. This included public TV and radio discussions, newspaper articles, advertisements and debates, explaining in remarkable and easily understood detail the economic reasons for price reform, the different reform steps, the reason for linking prices to a regularly reviewed international price index, and the multiple benefits of reform for the society as a whole (including the availability of more money for investment elsewhere). The government also assured the population of kept benefits: electricity prices, already amongst the highest regionally, initially remained unchanged and non-flexible, and were only increased in July 2014 (nearly a year after the price indexation system started) as part of restructuring the Office National de l'Électricité (ONE). LPG, used primarily as a cooking and heating fuel in Moroccan households, remains heavily subsidized. Morocco's total bill for subsidies – including food – that had peaked in 2012 at 6.6 per cent of GDP, subsequently fell to around 3.9 per cent of GDP in 2013.

In Egypt, recent efforts to reform energy prices are bold by any standard, especially in light of political instability still engulfing the country – revealing the

extent of fiscal pressures and the limited choices faced by the Egyptian government. Defying many analysts' predictions, these price hikes, though very steep, have not resulted in mass protests and civil unrest. Part of the reason relates to timing. The reform measures were announced following a wave of nationalist fervour that saw President El-Sisi assume power, with strong support from his power base for the onslaught on the Muslim Brotherhood. The government's communication strategy, while considerably less systematic than strategies associated with reform efforts in other countries, has also been fairly effective. The government called for shared sacrifice, and highlighted the inequities associated with energy subsidies, together with the importance of freeing financial resources for essential services such as health and education. The government also introduced some measures to mitigate the impact of higher energy prices on the most vulnerable groups in society – for instance by freezing the prices of publicly distributed bread, rice, sugar, tea, flour and oil, and by expanding the food subsidy system, discounting the price of additional products such as meat and chicken. The government also avoided increasing the price of LPG, widely used by low-income households.

ENERGY PRICING REFORM IN ARAB OIL AND GAS EXPORTERS

Like the importers, Arab producers and net exporters of oil and gas have begun to align their domestic energy prices more closely with actual economic costs. The past few years have seen a proliferation of initiatives and public statements that suggest oil and gas producers may eventually undertake more comprehensive pricing reforms; the past year's evidence in particular suggests the relative low-price environment for fuel has actually worked in favour of those Arab oil and gas producers who have begun to adjust prices..

Oman's oil and gas minister Mohammed al-Rumhy stated in November 2013 that subsidized petroleum products and electricity caused a huge waste of resources in the GCC and called for an increase in consumer prices. There were indications that Oman's expenditure on fuel and electricity subsidies would reach OMR1.7 billion (USD4.4 billion) in 2014 (roughly 13 per cent of the total budget), the equivalent of the country's expected budgetary deficit for the fiscal year and more than allocated spending on health, social security, and welfare combined. In January 2014, UAE energy minister Suhail al-Mazrouei similarly announced that household consumption in the UAE needed to be curbed and that subsidies would hence need to be reduced.

Bahrain raised industrial tariffs for natural gas by 50 per cent in January 2012, followed by a separate price increase in utility prices in October 2013. The UAE and Qatar raised gasoline and diesel prices in 2010/2011. In July 2015, the UAE went a step further by deregulating fuel prices entirely, linking prices instead to an average international cost price to be adjusted on a monthly basis by the Ministry of Energy. The reform step has been largely met by a positive media echo emphasising the long-term benefits for the country's economy including greater incentives for fuel economy savings and a reduction in traffic congestion. The UAE, like other recent price reform cases, have thereby benefited from recent price movements for fuel products on international markets; prices for diesel actually fell slightly compared to pre-reform tariffs.

The UAE also raised electricity tariffs: Abu Dhabi being the most recent of the emirates to do so, in January 2015, following Dubai's lead in already having fairly high utility prices compared with the rest of the GCC region. Saudi Arabia last revised its utility prices in 2010 and is planning for tighter vehicle emission standards and larger public transportation networks over the medium term. Although smaller in scale than the kind of price increases seen in some Arab energy importers such as Jordan and Morocco, the recent price initiatives in many Gulf countries suggest that addressing the unintended consequences of energy under-pricing is no longer off the public agenda. The coming years will demonstrate whether further pricing reforms, combined with increasing efficiency along the energy value chain in these countries, can help mitigate their energy consumption growth over the medium and long terms; hence also helping them to save their valuable energy resources for future generations.

Laura El-Katiri, Research Fellow, and Dr. Bassam Fattouh, Director of Oxford Institute for Energy Studies

This excerpt is based on a recent study by the authors on the subject: El-Katiri, L. and Fattouh, B. 'A Brief Political Economy of Energy Subsidies in the Middle East and North Africa', OIES Research Paper, MEP 11, Oxford Institute for Energy Studies, February 2015 [afed.me/1U9fM4L].

Sustainable Water Consumption in Arab Countries

Waleed Al-Zubari

While the Arab countries have spent billions of dollars on water supply infrastructure (i.e., desalination plants, treatment facilities, dams, and drilling of wells) in the provision of water supply, inadequate attention has been given to how efficiently the existing water is being used, being supplied, recycled, or reused. In fact, the emphasis on "securing supplies" approach has not only reached its physical and financial limits for many countries, but has also led to the emergence of many unsustainable consumption and production patterns. In many Arab countries, water efficiency in both the supply-side and the demand-side is generally very low.

On the supply side the physical leakage in the municipal networks could reach more than 40 percent. Moreover, recycling in the Arab countries is negligible, while the reuse rates of treated wastewater are at their minimal. On the demand side, the per capita water consumption in the domestic sector in many countries ranks amongst the highest in the world. In the agricultural sector which consumes on average about 85 percent of the total water used in the region, the predominance of inefficient irrigation practices (flood irrigation is practiced on 80 percent of irrigated areas) leads to the loss of more than half of the amounts of irrigation water.

Similarly, in the industrial sector wasteful water practices are common with negligible recycling efforts. To enhance the sustainability of the water management system, there is an urgent need to improve water efficiency by reducing wasteful use in all the water consuming sectors. It is becoming crucially imperative for the Arab countries to focus on improving water efficiency to sustain water supplies with the least costs and minimum risks, and to achieve maximum productivity per cubic meter consumed. The achievement of sustainable water consumption and production patterns in the Arab countries will require the use of economic, legislative, and social change instruments.

I. INTRODUCTION

Although there are many definitions[1] for sustainable consumption and production (SCP), they all agree that the use of services and related products should satisfy basic needs and bring a better quality of life, and that the use of natural resources, toxic materials, emissions of waste and pollutants have to be minimized so as not to jeopardize the needs of future generations. Moreover, such minimization needs to be made over the life cycle of the service or product, to be implemented at both the supply side for sustainable production and the demand side for sustainable consumption. In the end, all stakeholders are responsible for achieving sustainable consumption and production.

Such concepts, when applied to water, mean that water should be produced without damaging the water source, either surface or groundwater. In the case of desalination, water should be produced with the minimum use of energy resources and environmental impacts of desalination plants; water should be supplied to the various users with the highest efficiency with minimum losses; water should be used in the most efficient manner without wastage and should be recycled as much as possible before it leaves the user as a waste. Moreover, to apply the life cycle thinking, this also implies that maximum amounts of wastewater are collected, properly treated, and reused to minimize pollution to the surrounding environment.

In other words, the main goal of water SCP is to decouple economic growth and environmental degradation by increasing water efficiency (i.e. production and supply, use, recycling, and reuse), aiming to keep the energy, material and pollution intensity of all production and consumption functions within the carrying capacities of natural ecosystems. Such decoupling through the transition towards more water sustainable consumption and production patterns is a prerequisite to achieving sustainable development.

Water is vital for human welfare, socio-economic development as well as for supporting the ecosystem. Clean water and sanitation are essential for basic human health, while access to adequate water resources is needed to support agriculture, industry and other economic activities. In the Arab countries, the importance and value of water is even more pronounced, for most of these countries are located in an area considered to be one of the world's most water-stressed regions. Rainfall scarcity and variability coupled with high evaporation rates have characterized this part of the world with a limited availability of renewable freshwater. Although the Arab region covers about 10 percent of the total area of the world and its population accounts for more than 5 percent of the world's population, it receives only 2.1 percent of the world's average annual precipitation and contains as little as 0.3 percent of the world's annual renewable water resources (ACSAD, 1997).

However, the increasing scarcity of renewable water resources is not the only distinctive characteristic of the region. Inadequate levels of water management, irrational water consumption and production patterns, increasing water deficits and the continuous deterioration of the quality of the region's natural water resources have become equally distinguishing features as well over the past decades. Currently, the Arab countries are risking an alarming future of increasing water scarcity and increasing water demands and supply costs, which might not only threaten their future development and hamper human and socio-economic development efforts,

BOX 1: SUSTAINABLE CONSUMPTION AND PRODUCTION IN THE ARAB REGION

The vital importance of natural resources for sustainable development was raised at the United Nations Conference on Environment and Development in 1992 and, as a result, Chapter 4 of Agenda 21 entitled, Changing Consumption Patterns called for the need to change unsustainable patterns of production and consumption and to develop national policies and strategies to encourage alternatives. Subsequently, the 2002 World Summit on Sustainable Development (Rio+10/WSSD) called for the development of a 10 Year Framework of Programmes on Sustainable Consumption and Production (10YFP) to encourage such a shift. In order to support the preparation of 10YFP, the Marrakech Process was launched in 2003, involving different stakeholder groups. The third draft of 10YFP was reviewed by countries at the eighteenth session of the United Nations Commission on Sustainable Development (CSD) in 2010 and is negotiated at CSD during its nineteenth session in 2011.

The Arab region recognized the urgent need for transition towards SCP during regional preparations for WSSD. This is articulated in the Sustainable Development Initiative for the Arab Region, which was adopted by the Council of Arab Ministers Responsible for the Environment (CAMRE) of the League of Arab States in 2001, and calls for the "promotion of the concept of sustainable production and consumption in the Arab region and encouraging the use of products that contribute to the protection of the natural resources". Following WSSD and subsequent launching of the Marrakech Process, Arab Governments and regional organizations that serve on the Joint Committee on Environment and Development in the Arab Region (JCEDAR), which advises CAMRE, initiated the formulation of the Arab Regional Strategy for Sustainable Consumption and Production. The strategy identifies the following SCP priorities for the Arab region:

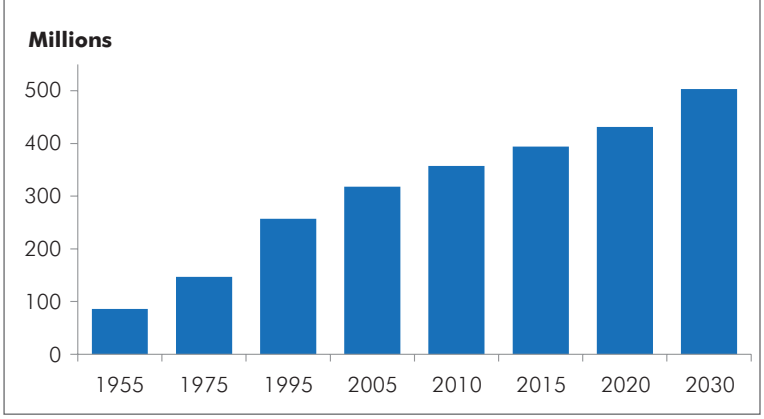
a. Energy for Sustainable Development;
b. Water Resources Management;
c. Waste Management;
d. Rural Development and Eradication of Poverty; and
e. Education and Sustainable Lifestyles.

Source: ESCWA, 2011

but also the preservation and sustainability of their past economic and social achievements.

In the last three decades, the Arab region has experienced rapid population growth and accelerated socio-economic development. The region's population has doubled from about 170 million inhabitants in 1980 to more than 350 million in 2010 (UNDESA, 2012; Figure 1). This growth was associated with a substantial increase in water demands, which have been driven mainly by rapid urbanization, the implementation of agricultural policies aimed at achieving national food security in many Arab countries, and by industrialization policies. To meet escalating demands, most Arab countries have focused their efforts mainly on supply management and augmentation – governments have invested heavily in major infrastructures to secure supplies and to provide water supply and irrigation services. Demands are being satisfied by increasing the storage capacity for surface water, development of groundwater, extensive installation of desalination plants, and expansion in wastewater treatment and reuse. However, the emphasis on the "securing supplies" approach to meet increasing demands has not only reached its physical and financial limits for many countries, but has also lead to the over-exploitation and quality deterioration of their natural water resources.

FIGURE 1 **ARAB REGION TOTAL POPULATION, 1955-2010 ACTUAL, 2015-2030 PROJECTED MEDIUM VARIANT (UNDESA, 2012)**



In fact, implementing a water management system that is based on securing supplies without adequate attention to improving and maximizing the efficiency of water allocation and water use, has created "excess demand", and has lead to the emergence of a number of unsustainable water uses in the region. Examples include low water supply and use efficiency, an increase in both water demands and per capita water use, increasing cost of water production and distribution, deterioration of water quality and land productivity, and increasing volumes of effluent discharge polluting the limited surface and groundwater resources in the region. The latter factor, in addition to its impact on human and ecological systems' health, has also contributed to increasing the water scarcity in the region. This situation is likely to worsen in the face of anticipated population growth, the impacts of climate change, and the continued challenges associated with the management and use of shared water resources originating from outside the region and military occupation (Box 2).

Ensuring sustainable consumption and production of water resources is thus a fundamental component of sustainable development. Furthermore, it is important to examine SCP of water, energy, and food in relation to one another since the production and consumption of these three are closely linked.

BOX 2: EXTERNAL CONSTRAINTS OF WATER SUSTAINABILITY IN ARAB REGION

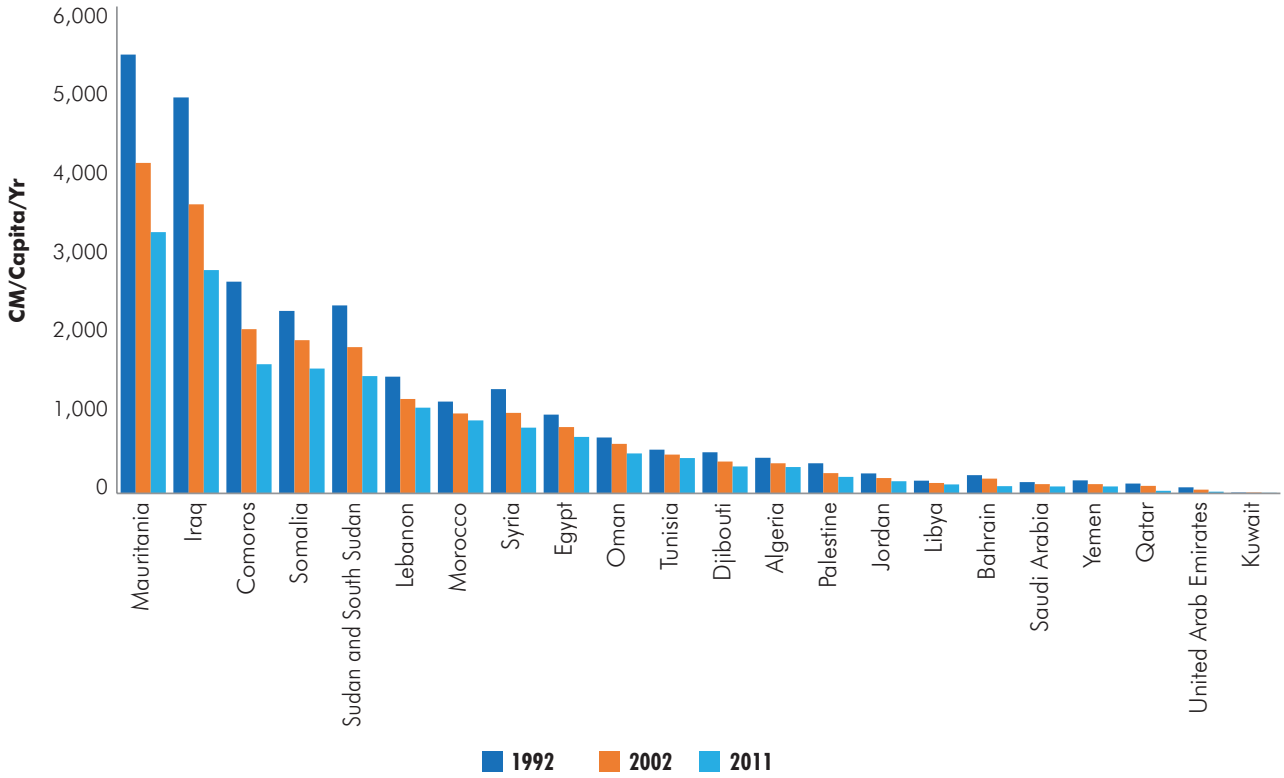
One of the major challenges facing the Arab region is the high overall dependency ratio of the region on shared water resources. As more than 60 percent of surface water resources originate from outside the Arab region, this issue remains a major concern threatening the region's stability and food security, and complicates national water resources management and planning. Riparian countries have not signed conventions and agreements on equitable sharing and management of water resources. Furthermore, some Arab countries are deprived of their water resources by occupying powers, which is another major issue in the region and is constraining the development of the population of these countries. The critical nature of the current water situation in the Arab region is expected to be further aggravated by the impacts of climate change, where it is anticipated that water scarcity and quality deterioration in the region will increase due to precipitation reduction, increase in domestic and agricultural water demands due to temperature increase, and seawater invasion of groundwater resources due to sea level rise.

II. WATER CONSUMPTION PATTERNS AND TRENDS IN THE ARAB REGION

The Arab region is considered to be one of the world's most water-stressed regions. Rainfall scarcity and variability coupled with high evaporation rates have characterized this part of the world as one with a limited availability of renewable freshwater. Under theses climatic conditions and poor endowment of water resources, and as a consequence of the rapid population growth experienced by the region since the mid 1970s, per capita freshwater availability decreased dramatically in all the Arab countries (Figure 2). The majority of these countries are currently below the borderline for water poverty of 1,000 m^3/capita/year. In contrast, the world average for per capita water availability is about 7,240 m^3/capita/yr. The current (2011) overall per capita freshwater availability in the Arab region is at about 800 m^3/capita/yr (AFED 2014). Based on projected population increase, it is expected that this indicator will continue to decrease to reach about 500 m^3/yr by the year 2030 when the Arab region's population will reach more than 500 million. This would mean that the whole region will experience absolute water poverty, where water will become a major constraint for development impacting the standard of living, health and the environment (Falkenmark, 1989). Furthermore, by then, climate change is expected to have led to a 20 percent reduction in renewable water resources and more droughts in the region (Doumani, 2008), which would further exacerbate the current water scarcity situation.

During the past three decades, water demands in all the Arab countries have increased dramatically as a result of increasing population and urbanization, improvements in the standard of living, industrial development and efforts to increase food self-sufficiency. The total water use for all sectors in the Arab region increased dramatically from about 190 billion cubic meters (BCM) in the mid 1990s (ACSAD, 1997) to about 255 BCM in 2010 (UNDP, 2013), while during the same period the

FIGURE 2 **TRENDS IN TOTAL RENEWABLE FRESHWATER RESOURCES PER CAPITA IN THE ARAB COUNTRIES, 1992, 2002, AND 2011**



(Graph source: UNDP, 2013, Data source: FAO AQUASTAT, 2013)

population increased from about 260 million to about 360 million (UNDESA, 2012).

To meet these escalating demands, the Arab countries rely on both traditional water resources (including surface water and groundwater resources) and non-traditional water resources (including desalinated water, treated wastewater, and irrigation drainage water), but with varying degrees (Figure 3a). Most of the Mashreq, Nile Valley, and Maghreb countries rely mainly on surface water resources, while the Arabian Peninsula countries rely mainly on renewable and non-renewable groundwater resources. All Arab countries are increasingly using treated wastewater, while desalinated water progressively represents a major component in the water budget of the Gulf Cooperation Council (GCC) countries. Reuse of agricultural drainage water is practiced mainly in Egypt and Syria. The majority of water resources in the region are being used for agriculture (85 percent), while the municipal and the industrial sectors consume about 8 percent and 7 percent of the total water use, respectively (Figure 3b)

III. MUNICIPAL[2] WATER CONSUMPTION

In almost all Arab countries, rapid urbanization challenges efforts to meet rising domestic water demand, especially in countries with tight budget constraints. During the period 2005-2015, urbanization increased from 67 percent of the Arab population to about 70 percent[3], and and it is expected to continue to increase by the same rate in the next 10 years to reach 73 percent by the year 2025 (UN Urbanization Prospects, 2014). Along with this relatively rapid urbanization rate, domestic water consumption has increased from about 14 BCM in the early 2000s to about 20.4 BCM in 2011 (UNDP 2013), and is expected to increase to about 30 BCM in 2025 (Hamoda, 2004). This would constitute an anticipated increase of more than 50 percent in the next 10 years.

GREEN AGRICULTURE IN EGYPTIAN DESERT: COMBINING SOLAR POWER WITH IRRIGATION EFFICIENCY

Ayman Abou Hadid

Climate change has negatively affected wheat and maize yields both regionally and globally.Since the IPCC Fourth Assessment Report, several periods of rapid food and cereal price increases following climate extremes in key producing regions indicate a sensitivity of current markets to climate extremes, among other factors. Food insecurity and the breakdown of food systems linked to warmingresult in the loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity.

Without adaptation, any local temperature increase in excess of about 1°C above preindustrial is projected to have negative effects on yields for the major crops (wheat, rice, and maize) in both tropical and temperate regions. These impacts will occur in the context of a crop demandwhich is projected to increase by about 14 percent per decade until 2050.

Agricultural strategy in Egypt favors increasing land reclamation to allow more agricultural land in desert areas. This drive is hampered bythe scarcity of water and the salinization of underground water that will need treatment. Another challenge is the availability of powerto lift water from the wells and distribute it to farms. Egypt already suffers from shortage of petrol and gas to generate electricity. The cost of extending the power network from the inhibited areas of the Nile valley is also considerably high. The solution was to introduce solar energy to generate electricity and operate the farming systems. The need of electric power for irrigation is only during the daytime where the radiation is strong enough almost all year round, which makes the operation cost effective.

As part of the scheme, a 12,000-acre farm was established for jojoba. Olives were cultivated in other areas,covering 20,000 acres. Photovoltaic solar panels were used to produce electricity for pumping the underground water,installed by trained local technicians.

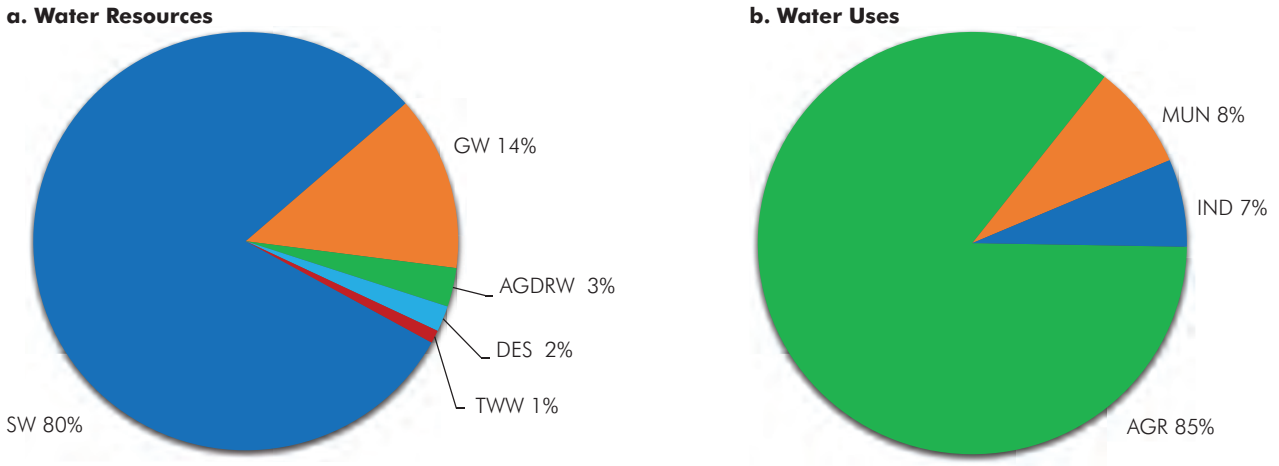
Due to the harsh conditions of the desert in this region, the solar equipment suffered damages from wind and sand storms. But with several trials and errors, simple low cost protection measures allowed the system to operate properly, and water is now being pumped from the depth of 80 meters. The concentration of salts ranging between 3000 to 5000 ppm was suitable for both jojoba and olive. More work is planned to treat brackish water using solar energy.

Various projects followed to utilize solar pumping for agriculture. In March 2015 Sekem Energy operated its first solar pumping system at its farm in Wahat, generating in total 60 kW. The system combines the solar technology with efficient irrigation technologies to optimize the use of water produced.

It is now time to move from pilot projects to widespread utilization of solar technology in agriculture.

Dr. Ayman Abou Hadid, Director of Climate Change Information Center and Renewable Energy (CCICRE), and former Minister of Agriculture and Land Reclamation, Egypt.

FIGURE 3 WATER RESOURCES AND USES IN THE ARAB REGION



a. Water Resources (SW=surface water, GW=groundwater, AGDRW=reused agriculture drainage water, DES=desalinated water, TWW=treated wastewater)

b. Water Uses (AGR=agricultural sector, MUN=municipal sector, IND=industrial sector)

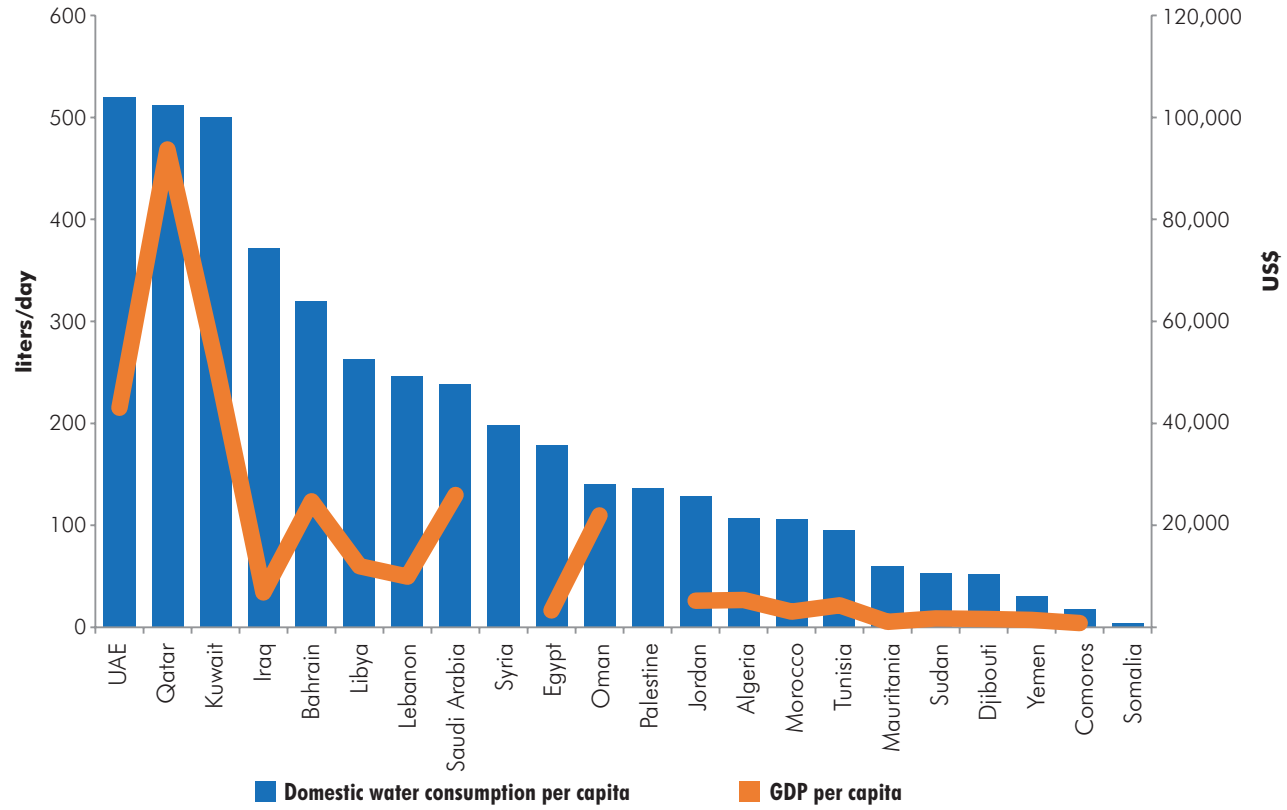
In addition to rapid population growth and urbanization, the rapid increase in urban water demands in the region can be explained by many factors, including a rise in per capita consumption, large losses in the supply network, and the absence of recycling programs within the sector.

A. Per capita domestic water consumption and water use efficiency

Municipal water withdrawal per capita is not necessarily equivalent to domestic water consumption per capita. This is due to the difficulty of accurately measuring water losses through municipal water supply networks and the gaps related to water metering and associated data collection on domestic water use in the region (ESCWA, 2011). In many instances the total amount of water supplied in the municipal supply network is taken to represent the domestic water consumption and is divided by the total population without consideration of the network losses – which could be as high as 40 percent – and non-domestic users (e.g., commercial, government, tourism facilities). Moreover, in countries with a significant rural population, these figures can vary considerably and the ratio between the net consumption and the water withdrawn can vary from 10 to 50 percent (FAO AQUASTAT Glossary). Furthermore, while reported figures on municipal water consumption are given as averages for a given country, these figures can vary significantly between the rural and urban population within the country. Despite these data and information challenges, the current available data can serve as a "proxy" for investigating the water consumption patterns in the domestic sector.

Municipal and domestic water demands have been exaggerated by the level of the per capita consumption in many countries in the Arab region. Average per capita domestic water consumption in the Arab region is about 200 liters/day, but varies considerably in the Arab region, both among and within countries (Figure 4). In the GCC countries, for example, it ranges between 140 and 520 liters, which ranks amongst the highest in the world. This volume has dramatically increased over the last three decades. For example, in Kuwait per capita water consumption was only around 200 liters in the 1980s and has increased to around 500 liters in the 2000s. This increasing trend has been observed across all the GCC countries. The reasons for the increase in high domestic per capita water consumption in the GCC countries are numerous; in general, the GCC countries' relatively high per capita income[4] and changing life style on one hand, and low municipal water tariffs which lead to the absence of a price-

FIGURE 4 PER CAPITA DOMESTIC WATER CONSUMPTION IN THE ARAB COUNTRIES IN 2011 AND GDP PER CAPITA IN 2010-2014 (WORLD DEVELOPMENT INDICATORS: HTTP://DATA.WORLDBANK.ORG/INDICATOR).



Source: World Development Indicators: http://data.worldbank.org/indicator

signaling mechanism on the other, are the most important.

Generally, in the Arab region high government subsidies for water supply focus on the supply side of management (i.e., water production from aquifers and desalination plants) without giving adequate attention to use efficiency. Demand side management provides no incentives for consumers to save water (World Bank, 2005). The municipal water tariffs in the majority of the Arab countries are so low that they provide no incentive for consumers to save water. Moreover, it seems that per capita municipal water consumption is closely related to the income levels of the countries, as high-income GCC countries consume a significantly larger amount of water compared to other countries (Figure 4). This analysis suggests that regionally, domestic water consumption can significantly increase with the rise of living standards if water use efficiency and demand management polices and interventions are not put into place.

B. Non-revenue water

As indicated earlier, municipal and domestic water requirements are further exaggerated by the high percentages of non-revenue water[5] (NRW) in the municipal distribution network, particularly its physical leakage component. It should be noted here that it was rather difficult to accurately estimate the actual physical losses in the distribution network because the reported NRW values are given without detailing their components (i.e., real losses, apparent losses, and unbilled authorized consumption). However, in most of the Arab countries the physical leakage of the municipal distribution network represents a major component of NRW, and therefore, in view of this data limitation, NRW measures can provide a reasonable indicator for these real physical losses, which is the main concern here in terms of water supply efficiency as part of the sustainable consumption and production analysis.

BOX 3: NON REVENUE WATER: THE CASE OF YEMEN

Although Yemen suffers from severe water scarcity, NRW constitutes a very high percentage, ranging between 20-60 percent on the level of the utilities in urban areas and 40-60 percent in rural areas. These estimates are based on random samples of some rural projects, and auditing of water utilities reports in the urban sector. In 2008 the amount of NRW reached about 43 million cubic meters, which costs the water utilities about US$22 million. Causes for NRW include: damaged and old networks of pipes and valves and spare parts; the use of pipes with poor specifications leading to random breakage in pipes in the distribution networks and obstructing the monitoring and tracking of NRW in the networks; low efficiency of the meters; errors in meter reading and data entry; illegal connections; direct connections with the pumping lines and the general feeding points; lack of awareness among the management and staff about the importance of minimizing NRW; lack of awareness of the material yields as a result of reducing NRW and the economic feasibility of it.

Yemen is implementing several measures for the reduction of NRW. Periodic maintenance programs are implemented for the meters with zero reading and extracted from the billing program reports and performance indicators system. In addition to the replacement of the old networks, maintenance of the network and the main valves in some large institutions, performance indicator programs are used to monitor NRW on a monthly basis. Follow-up and evaluation of the programs for the maintenance and monitoring of NRW are also implemented, and most of the institutions and utilities use performance indicator systems which help departments and supervisory authorities monitor the performance of the utilities.

Reduction of NRW can have technical and economical benefits, which are considered as incentives and motives for reducing water losses. These include providing a water source that covers the shortfall caused by the scarcity of resources, and earning customers' satisfaction, in addition to increasing sales revenue and relieving the pressure on water resources. In this context, it is worth mentioning that reducing NRW by 50 percent results in saving 15 percent of energy costs.

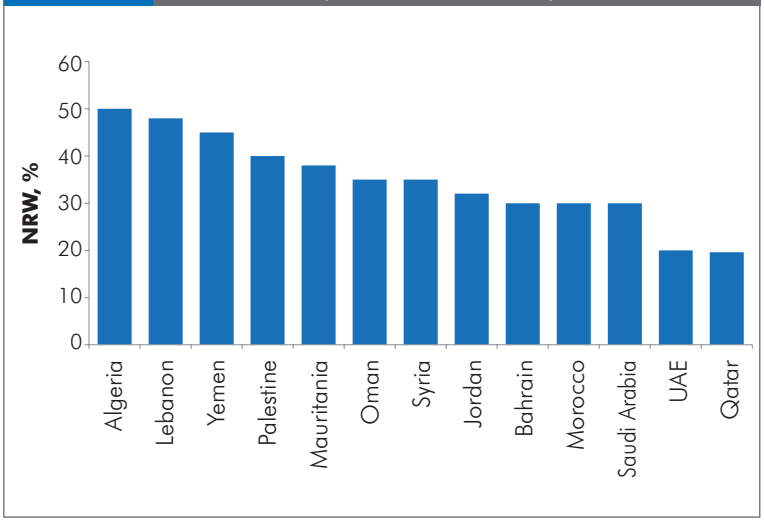
Source: ACWUA, 2014

NRW can reach more than 60 percent in poorly maintained distribution networks in some Arab cities (Box 3), and is generally high in both the financially capable and incapable countries (Figure 5). It is expected that the physical leakage component will be proportional to these high percentages of NRW, with considerably large volumes of water lost from the distribution network before reaching the consumer. In Jordan, for example, the total estimated average annual water loss to NRW for three water companies is about 80 million cubic meters (MCM). In a water-scarce country such as Jordan, where the marginal cost of new supplies is between US$0.90-1.05 for 1 cubic meter of water (Disi project and desalinated water), the economic benefit of reducing real losses should be of correspondingly high value (ACWUA, 2014). Reducing such high losses by efficiency measures can often obviate or delay the need for physical infrastructure investments, reducing burden on current financial and energy resources and providing real gain to society.

Many Arab countries have given the losses in the municipal distribution network (both real losses and apparent losses) their adequate attention and have made programs to minimize these to the acceptable international norms. A very good example is KAHRAMAA in Qatar. This successful program has succeeded in reducing NRW from 59.1 percent in 2007 (real losses = 33.6 percent and apparent losses = 17.7 percent) to 19.6 percent in 2012 (real losses = 6.8 percent and apparent 12.7 percent). Similarly in the UAE, DEWA in Abu Dhabi has reduced the total physical losses from its distribution network from 42 percent in 1990 to 10.88 percent in 2012, which is very close to the acceptable norms in developed countries such as the United States (10-15 percent). In Syria, an 8-year project on reducing physical leakage in Damascus has achieved a reduction from 36 percent to 20 percent.

The water supply utilities (WSUs) in the

FIGURE 5 **NON REVENUE WATER IN SOME SELECTED ARAB COUNTRIES (DATA: ACUWA, 2014)**



Arab countries are under increasing pressure to meet escalating municipal water demands. As indicated earlier this is due to rapid population growth, accelerating urbanization, high per capita consumption, in addition to high percentages of NRW, with very limited degrees of freedom in controlling demands and waste in water use, especially through economic instruments. In addition, existing high subsidies in the municipal sector result in very low cost recovery percentages, which impact their performance in terms of service quality and coverage, making many WSUs engulfed in a vicious cycle: high subsidies and low tariffs leading to low cost recovery, which leads to low levels of maintenance and gradual supply system break down and poor performance. Under such conditions, high across-the-board subsidies become in favor of the rich who are using more water, and not the poor.

With access to drinking water being a human right (UN General Assembly 2010) the issue of charging for drinking water supply has been always politically sensitive and thus requires careful consideration. In setting up a water tariff for drinking water, the Arab countries need to honor the human right of access to drinking water and contribute to the cost recovery of WSUs, in order to enhance its service delivery, and to use as a price-signaling mechanism to minimize waste and promote conservation (Box 4).

BOX 4: MUNICIPAL WATER TARIFF IN TUNISIA

One ofof the best examples for setting a water tariff that balances the goals of social, financial, and economic aspects of water management in the Arab region is the Tunisian water tariff. The social side of the tariff strives to enhance the access to water for low-income citizens and to meet their basic needs, with low tariffs both in urban and rural areas. This ensures the right of disadvantaged groups to adequately receive and access water as a human right. The purpose of the financial side is to maintain a utility with good financial health, thus enabling it to plan for and carry out capital investment projects that aim at ensuring sustainability of the sector and continuity of water supply. The core of the economical side is the optimal use of water resources and a control on water demand, and urging consumers to manage their consumption to help protect resources for future generations. The tariff is set up as an increasing block tariff with seven blocks:

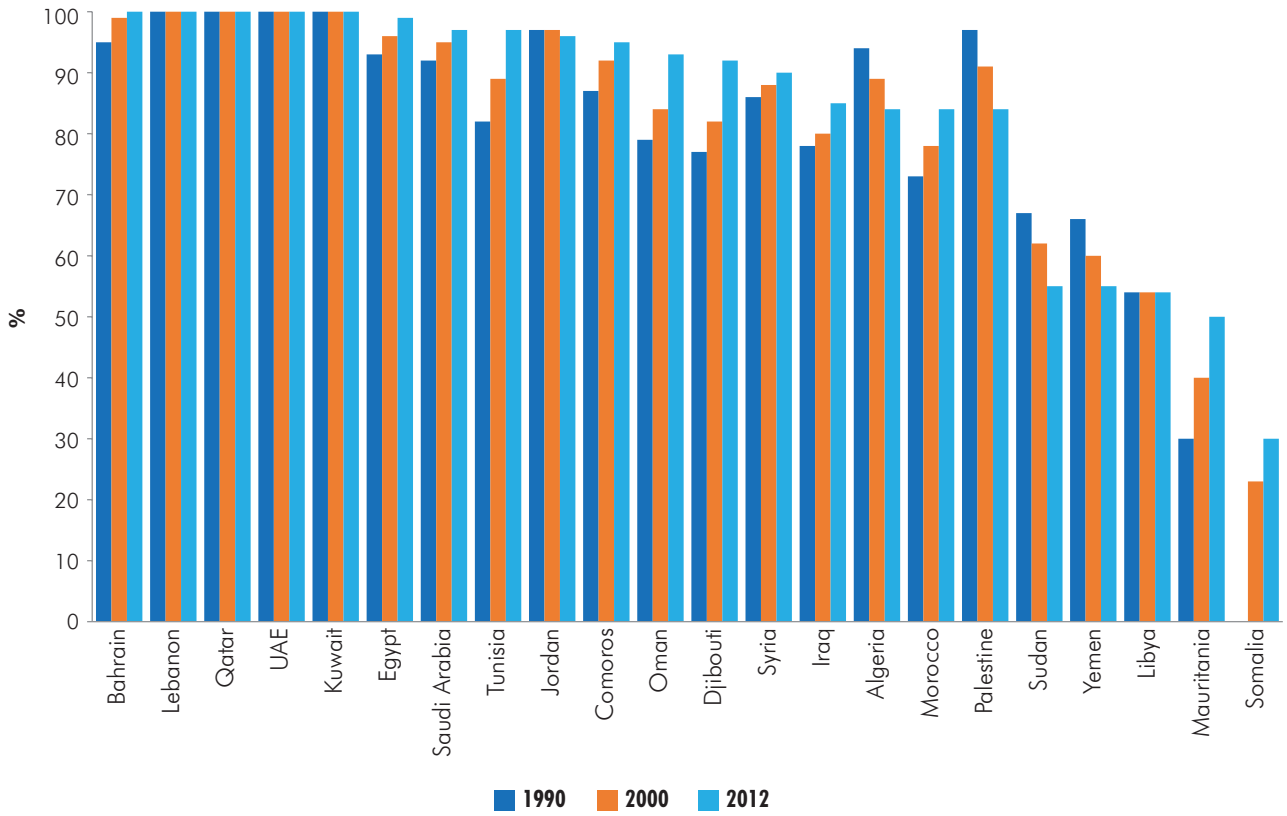
1. Two social blocks: Tariff equals 21 percent and 36 percent of average cost of service, respectively.
2. Two blocks for medium consumption: Tariff varies between 45 – 82 percent of average cost of service.
3. A fifth block: The tariff is equal to average cost of service.
4. Two last blocks for major consumers: The tariff exceeds the average cost of service (140 percent and 146 percent of average cost of service).

Additionally, the tariff system comes in two parts:

1. Fixed amount: depending on meter diameter, it is 3.8 Tunisian Dinar per billing period for almost 99 percent of subscribers (meter diameter is 15 millimeters). This is important as there are other types where consumption is zero.
2. Variable amount that depends on consumption block, with one tariff per block.

Source: ACWUA, 2014

FIGURE 6 **TRENDS IN POPULATION WITH ACCESS TO IMPROVED DRINKING WATER SOURCES IN ARAB COUNTRIES, IN PERCENTAGE OF TOTAL POPULATION, 1990, 2000 AND 2012.**



Source: WHO and UNICEF, 2014. Note: Somalia has no data for 1990

C. Water supply coverage

Despite the growth in domestic water consumption and the high per capita municipal water consumption in many countries, many Arab countries have made progress in providing improved water to their populations (Figure 6), and many are on track to achieve the target of the Millennium Development Goal (MDG7) related to the provision of safe drinking water to their population. However, many countries are lagging behind. Currently (2012) about 82 percent of the people in the region have access to improved drinking water. About 18 percent of the region's population, or about 62 million people, still lacked access to clean water in 2012 (WHO and UNICEF, 2014). Most of these people live in lower income countries, are under occupation, or are riddled by war and conflict. Furthermore, data indicate major disparity between rural and urban areas in water supply service. Across the Arab region, in 2012, about 71 percent in rural areas had access to improved drinking water sources compared to 91 percent in urban areas.

Moreover, although a relatively large percentage of people in the Arab region have access to improved drinking water, these services are not always reliable, especially in lower-income areas. Such water shortages are a problem in key cities such as Sana'a and Taiz (Yemen), Amman (Jordan), Damascus (Syria), Oran (Algeria), and the West Bank and Gaza, which experience long periods of daily water shut-offs ranging from 16-20 hours each day, lasting for several months, especially in the summer (UNDP, 2013). It should be mentioned here that intermittent supply of urban water accelerates degradation of infrastructure and leads to an increase in the percentages of NRW.

IMPACT OF PHASING OUT WATER SUBSIDIES IN TUNISIA AND MOROCCO ON CONSUMPTION: A GENERAL EQUILIBRIUM APPROACH

Chokri Thabet, Ali Chebil and Aymen Frija

Morocco and Tunisia are considered among the countries where the scarcity of water resources may cause a serious constraint to the development of their economies. The agricultural sector is the most important consumer of water with more than 80 percent of the total. Moreover, both countries have shown an increase in the share of GDP accounted for by the nonfarm sectors, which imply an increase in residential water demand as well as manufacturing and service sectors. Consequently, if production growth in the non-farm sectors requires a proportional increase of water demand factor* , then water can be a major constraint to economic growth in both countries.

The opportunity cost of water and economic concerns has become increasingly important. In order to cope with potential water shortages, both countries have undertaken a set of policies and technical measures at three levels. The first level, which still absorbs significant resources, is the investment in hydraulic infrastructure and the construction of dams in order to catch up a rising demand by increasing water supply. The second level of intervention is the implementation of rationalization measures aiming at controlling a steadily increasing demand, using water pricing instruments. The third level covers institutional organization reform towards more decentralized water management.

This overview focuses on the second level that is water pricing reform in Tunisia and Morocco. Both countries have made water available at low cost to farmers through public financing for reasons of food security, limiting rural-urban exodus and improving the agricultural trade balance. However, this policy has a drawback of not providing the right signal to stimulate water efficiency, such as the introduction of water efficient technologies or modernizing old infrastructures, which are currently responsible for huge losses. This situation led to the adoption of profitable, but water intensive crops. However, if present water policies continue to under-price the resource, this will increase the likelihood of severe water shortages and could even result in serious depletion. Governments have been compelled to revise their policies and engage in pricing reforms to improve cost recovery and to shift towards clear water demand management policies. Despite many previous attempts, progress has been compromised, given the key social role of agriculture in reducing social pressures. Thus, water pricing has usually been below full cost recovery.

The main objective of this case study is to explore the impacts of alternative domestic water policies in the form of a cut in irrigation water subsidies and/or increases in public expenditures on water mobilization needed to fulfill the expected water needs escalation by the different users. The evaluation of alternative policies is conducted on a comparison basis between Morocco and Tunisia, as similar policy instrument applied in two different countries can have different impacts. In fact, heterogeneous socioeconomic structures, different market features and economic policies, and various levels of natural resources endowments, explain the different impacts of same policies across countries.

An economy-wide analysis of water policies in Tunisia and Morocco is the most suited way to address the allocation and distribution issues of water resources facing policy makers. Those issues have high policy relevance as part of the efforts of policy makers to manage water resources in the long term and to reduce poverty in rural areas. Two dynamic Computable General Equilibrium (CGE) models have been built for the purposes of this study, and calibrated using two Social Accounting Matrixes of Tunisia and Morocco for the year 2005.

A reference scenario has been implemented. It assumes observed growth rates for both GDP and government consumption in 2006-2012. It also assumes a marked GDP deceleration in Tunisia related to the political unrest and a recovery of GDP at a rate of 5.5 percent/year by the end of the simulation period (2020). The reference scenario shows that maintaining the current level of water prices requires additional public spending by 0.8 percent in Tunisia and 1.1 percent in Morocco of GDP by the end of 2020.

Three alternative scenarios have been tested and compared to the reference scenario:

- Cutting subsidies on water price by 50 percent
- Doubling public spending on water mobilization progressively over the period 2014-2020
- Both above scenarios implemented simultaneously

In Tunisia, Removing 50 percent of water subsidies resulted in dissimilar effects. The first one is positive with an annual average improvement of public saving by 0.6 percent. The second is negative reflecting the deterioration of the rural household's welfare. In addition, efficiency gains resulting from a better use of water is also found to be high, thereby offsetting the negative effects. Consequently, the overall impact becomes positive with an annual average increase of the GDP by 0.2 percent. In this scenario, total exports fall by 1.4 percent each year.

Increasing public investments in the mobilization and distribution of water resulted in an increase of GDP and exports of agricultural and agri-food commodities by annual averages of 0.5 percent and 1.7 percent. The cumulative impact of the implementation of the two previous scenarios is also found to be positive with an increase of all the economic variables of interest such as GDP (+0.3 percent), private and government consumptions respectively 0.4 percent and 0.7 percent.

In Morocco, removing 50 percent of subsidies on water resulted in a negative overall impact on the economic activity through a reduction in the level of GDP by an average annual rate of 0.4 percent showing clearly that the Tunisian agricultural sector has more flexibility to positively adjust to higher water prices compared to Morocco, where agriculture is more rigid. Three main reasons can explain this pattern:

- In Morocco, the level of water subsidy is much higher than in Tunisia (45 percent against 20 percent)
- The contribution of the agricultural sector to the Moroccan economy is much higher than Tunisia (15 against 9 percent, in 2012).
- Irrigated agricultural sector contributes much largely to the economic activity, given its higher multiplier effects.

The results show also that large public subsidies to water mobilization and distribution significantly affected the structure of agriculture production in both countries. Reducing public subsidies on water affects directly farm incomes in the short and medium terms, which drop by 20 percent and 12 percent in Morocco and Tunisia respectively. A reduction in the number of crops available for farming resulting from water tariff hike can also lead to greater technical and economic vulnerability of the

agricultural sector in Tunisia and Morocco. Employment is also likely to be affected in both countries. However, the reduction in farmers' incomes will be largely compensated by the saving in public expenditures, and also in a better and more efficient use of water resources. In the medium-long term, Tunisian and Moroccan farmers will adjust their activities to accommodate to the new public managements of water resources which will be manifested by a substitution among activities towards those that are more efficient in water uses.

In terms of policy recommendations, the reform of water subsidy can be implemented through an outright or a phased elimination. In case of outright elimination, the substitution of crops with less water intensive ones can be used as a flanking measure, if financial and technical support is provided by the authorities simultaneously with the removal of subsidies.

If phased elimination is chosen, authorities can direct crop selection to less water intensive crops without removing subsidies immediately, using incentive instruments which imply smaller threats to farmer's income.

* What the economists define as a Leontief technology.

Dr. Chokri Thabet, Associate Professor and head of the Department of Rural Economics and Development at Institut Supérieur Agronomique de Chott Mariem, Tunisia; Dr. Ali Chebil, Associate Professor at Institut National de Recherche en Génie rural, Eaux et Forêt, Tunisia; Dr. Aymen Frija, Assistant Professor at Ecole Supérieure d'Agriculture de Mograne, Tunisia.

As supplying water to growing populations is becoming increasingly challenging for many Arab countries due to the scarcity of water resources as well as financial resources, increasing water efficiency in both the supply and demand sides, recycling and reusing water would provide additional water volumes. This would help in increasing water supply volumes and reliability and in meeting the MDG target of water supply as well as the water supply targets of the upcoming Sustainable Development Goals (SDGs) for the post 2015 world agenda.

IV. AGRICULTURAL WATER CONSUMPTION

Although urban demand for water has been rising steadily, agriculture continues to consume most of the water in the Arab region. Agricultural water use rose from about 165 billion cubic meters in 1995 (ACSAD, 1997) to more than 218 billion in 2012/2013 (UNDP, 2013) – an increase of about 32 percent in 15 years. However, despite this increase, agricultural performance and food production failed to advance in many Arab countries (Dabour, 2006; AFED, 2014). Over the last three decades, the Arab region has experienced a development boom with rapid population growth. To meet the accompanying rising demand for food, many countries have prioritized food security and socio-economic development through policies to expand agricultural land and irrigated cultivation. Despite this, they have failed to consider water's limited availability and the need for water use efficiency, conservation and demand management (LAS, UNEP, and CEDARE, 2010).

While agricultural water consumption is being driven by national agricultural development and food policies, the sector consumption is exaggerated by a number of factors that are related directly to water use efficiency. The most important of these factors are: 1) the predominance of traditional irrigation methods (flood irrigation); 2) unrestricted surface water and groundwater abstraction; 3) absence of water tariff for water use in agriculture which does not provide any incentive for water conservation; and 4) cultivating high water consuming crops.

In the Arab region, about half of irrigation water is wasted because of inefficient irrigation methods (Abu-Zeid and Hamdy 2004).

BOX 5: INCREASING WATER PRODUCTIVITY THROUGH RAISED BED IRRIGATION

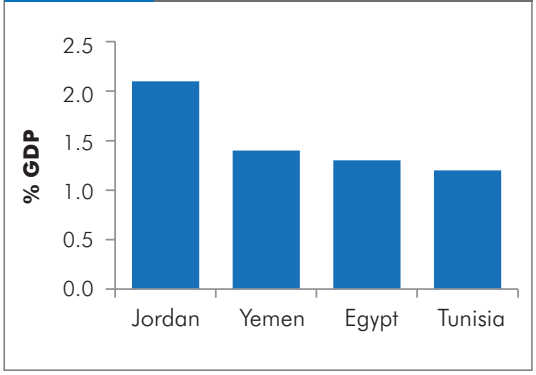
Raised bed farming is an ancient water-efficient farming practice in Egypt with many conservation benefits. It reduces water application to the land, which minimizes water loss from percolation. This results in good aeration of the roots, efficient use of fertilizer, and easier weed control. However, smallholder farmers have historically had difficulty benefiting from this technology because the machinery for bed planting is expensive and not suited for fragmented lands. ICARDA scientists, in partnership with NARES, recently developed an innovative adaptation of the machinery required for raised bed planting. This is changing the game for smallholder farmers in Egypt's Nile Delta region. Raised bed cultivation of wheat led to 24 percent saving in irrigation water, 34 percent increase in wheat yield, and 78 percent improvement in water use efficiency for farmers in the Al-Sharkia province. Given its simplicity and impressive results, the technology is rapidly gaining momentum in Egypt and is also being transferred to countries such as Sudan, Ethiopia, Eretria, Nigeria, Iraq and Morocco.

Source: AFED, 2014. (Arab environment 7: Food Security, Challenges and Prospects, edited by Abdul-karim Sadik, Mahmoud EL-Solh, and Najib Saab)

Surface irrigation is the most widely used method in the region and is practiced on 80 percent of the irrigated area, followed by sprinkler irrigation practiced on 23 percent of the area. The more efficient micro-irrigation is practiced on only 2.8 percent of irrigated area (FAO 2011; LAS, UNEP, and CEDARE 2010). Some studies estimate that irrigation efficiencies in the Arab region are as low as 30-40 percent (AFED, 2010). Such waste leads to weak agricultural performance and, more dangerously, salinization and water level decline due to overuse. Agricultural practices are also contributing to increased soil and water salinity, toxic pollution from agrochemicals, the loss of biodiversity through wetlands destruction and the construction of new dams (AFED, 2010; LAS, UNEP, and CEDARE 2010).

With about 85 percent of the water used in the Arab region consumed by the agricultural sector, the sector in which water losses are the highest, it becomes imperative for Arab countries to focus their efforts on improving the water efficiency in agriculture. The prospect to save water is notably higher here than in other sectors (Box 5). For instance, in the Arab countries in North Africa, which allocate more than 80 percent of their water resources to agriculture, reducing conveyance losses by 50 percent and improving irrigation efficiency from 40-50 percent to 80 percent could save nearly 52 BCM a year, or more than 40 percent of the region's water losses, and thus provide an additional supply of nearly 20 percent. Possible irrigation savings constitute more than 70 percent of water savings (Mehmet and Biçak, 2002.

FIGURE 7 **VALUE OF GROUNDWATER DEPLETION IN SELECTED ARAB COUNTRIES (RUTA, 2005)**



BOX 6: MONITORING AND CONTROLLING INDUSTRIAL WATER USE: QATAR CASE STUDY

In Qatar, the water used in industries (principally for cooling purposes) is mainly seawater as it is prohibited to use groundwater in process industries. Moreover, the law prohibits industrial effluent discharge to the sea. Industrial companies were invited to participate in the Sustainable Development Industry Reporting (SDIR) Program initiated a few years ago in Qatar. In 2012, 30 companies reported on their total water consumption, representing 91 percent of the total companies. In 2012, the total amount of water consumed by the sector was 43.3 MCM, an increase of 11.4 percent from the 2011 levels. Eleven companies reported improved performance, reducing water consumption by 2.96 MCM in 2012. Twenty-seven of the 30 participating companies in 2012 provided information on water consumption in 2011 and 2012. Of the 27, 15 showed increased water consumption, 11 reduced their consumption and one remained unchanged.

Cost of Depleting Groundwater Resources

Most Arab countries, especially in the Arabian Peninsula and the Maghreb region, draw heavily on groundwater resources (renewable and non-renewable) to meet the rising demand for water, particularly for domestic consumption and irrigation. Non-renewable groundwater resources are used in planned ways[6] and unplanned ways[7], with unplanned use far more common. Using groundwater resources beyond their natural replenishment rates has resulted in rapid depletion of aquifer reserves and salinization and deterioration in water quality due to seawater intrusion. Groundwater overexploitation and depletion have also had severe environmental impacts. Groundwater over-exploitation has dried natural springs and degraded or destroyed their surrounding habitats and ecosystems, diminishing these areas' historical and cultural value[8]. Over-pumping groundwater depletes national assets. While economic activities based on extracted water boost GDP in the short term, groundwater overexploitation, especially mining fossil water resources erodes a country's natural capital and threatens irrigated areas in the long term. The value

of national wealth consumed by overexploiting groundwater is estimated at as much as 2 percent of the GDP in four Arab countries (Figure 7).

V. INDUSTRIAL WATER CONSUMPTION

In general, data on the industrial sector water consumption in the Arab region are not well documented in many Arab countries. With the exception of few countries (Box 6), data and records on the industrial sector water use, effluent discharge, recycling, treatment and reuse are largely missing. Such lack of data constrains the proper evaluation and analysis of the water consumption in the sector. Yet there are some general observations and trends that can be deduced from the available data and information.

As in the municipal and agricultural sectors, the water consumption in the industrial sector in the Arab region has been increasing with time. In the mid 1990s the total water consumption of the industrial sector was about 10.1 BCM (ACSAD, 1997) and was representing about 5.5 percent of the total water consumption then. In 2011, the industrial sector was reported at 17.1 BCM (UNDP, 2013) with a share of 7 percent of the total water consumption. The main sources of supply of the industrial sector are surface and groundwater, with relatively smaller amounts of desalinated water.

The main driving force for the increase of water consumption in the industrial sector is the implementation of economic diversification policies towards industrialization (e.g., manufacturing, mining, cement factories, food industry, and many others) in many countries. For example, since the early 1990s the GCC countries have implemented policies of economic diversification to other non-oil and gas industries and manufacturing in order to lower their vulnerabilities to oil price fluctuations. The total water consumption in the industrial sector in the GCC countries increased from about 321 MCM in the mid-1990s (1.3 percent of total water consumption) to about 1.3 BCM in 2010 (5.3 percent of total water consumption). In the UAE, a major increase in industrial water consumption has been witnessed, from about 73 MCM in 1995 to about 480 MCM in 2010. The average annual growth in industrial water

consumption is registered at 24.2 percent, which is the highest of all sectors, reflecting the growth of the industrial sector in the country during this period. The majority of the industrial water demands are met by groundwater abstraction and complemented by desalinated water. These increasing trends in the industrial water use have been observed in all the GCC countries.

Undoubtedly, the current increasing industrialization trends in the Arab countries will be associated with increasing water demands as well as with industrial wastewater generation. These trends are expected to continue in the future, and will have impacts on the overall water management system not only in terms of the amounts of water utilization by the sector, but also in terms of the potential pollution resulting from the sector. The latter issue will require major attention and measures to mitigate the negative impacts resulting from industrial effluents (air, liquid and solid) by providing legislation and economic incentives and disincentives for the use of appropriate technology, imposing appropriate fees for the discharge of industrial wastewater and other industrial wastes (i.e., applying the "polluters pay" principle), and establishing and enacting legislation on treatment and reuse of wastewater in the industrial sector.

Moreover, alternative water sources such as treated wastewater can provide a source of low-grade water for many industries that do not need high-grade water (e.g., construction industry, chemical plants, metal working facilities, oil industry and enhanced oil recovery). However, pre-treatment might be necessary to meet the required quality for some industries. In either case, there is a need to audit and account for the industrial water use and its supply sources within the national water budget of Arab countries. In addition, it is important to identify the nature of water use and required associated quality in the various industrial subsectors, and to forecast the sector's future water demands and its impact on the overall water consumption as well as its wastewater discharge. The absence of this information limits the effective water management in the sector and hinders opportunities for sustainable consumption and production.

VI. THE WATER ENERGY FOOD NEXUS AND SCP

The water scarcity challenge in the Arab region is compounded by water's multiple links with the various development sectors including human

BOX 7: DESALINATION IN THE ARAB REGION

With more than half of the world's desalination capacity the Arab region leads the world in terms of desalination. Although desalinated water contributes only a very small share of Arab countries' total water supply (about 2 percent), it contributes nearly all the water supply for many Arab countries, such as the GCC. The overall share is expected to grow as a result of industrialization, accelerated urbanization, population growth and depletion of conventional water resources. Desalination plants in Arab countries have a cumulative capacity of more than 24 million cubic meters a day. The plants with the highest capacity are in the Gulf countries (81 percent), Algeria (8.3 percent), Libya (4 percent) and Egypt (1.8 percent). Growth is expected to remain high for the next decade to meet escalating domestic water demand, concentrated mainly in the region's high-income, energy-exporting countries such as the Gulf countries, where desalinated water will be used to supply water to cities and industries.

The two main types of desalination technology are thermal and mechanical. Thermal, the older technology, separates water from minerals through evaporation-distillation using multi-stage flash (MSF) technology, a very energy-intensive process. Mechanical processes use reverse osmosis to force pressurized saline water through membranes that exclude most minerals. In the Arab region, the MSF technology still dominates, particularly in the GCC, although installed capacity for reverse osmosis is growing. The reverse osmosis technology, easily scalable due to its high modularity, requires no thermal energy and less than or as much electric energy as distillation. Most Gulf countries still prefer thermal technology, however, because they use the disposed heat in cogeneration systems. More recently, hybrid reverse osmosis and multi-stage flash systems have been used in cogeneration systems.

Source: Al-Jamal and Schiffler 2009; Bushnak 2010; GWI 2010

BOX 8: POTENTIAL COSTS REDUCTION ASSOCIATED WITH WATER EFFICIENCY MEASURES IN BAHRAIN

An evaluation was done in Bahrain of the most suitable and practical options in the municipal water sector in enhancing the efficiency and sustainability, individually and combined, of the water management sector using dynamic simulation of the water management system. Efficiency and sustainability are quantified in terms of financial, economical, and environmental costs. These options are: 1) reduction of leakage in the municipal water distributions network; 2) raising water awareness among municipal water consumers; and 3) using water saving devices in residential units. The simulation results of these three options indicate that there is a large potential for reducing the municipal water demand and its associated cost by implementing the above interventions. When all the adaptation options are implemented at the same time, the simulation results indicate that by the year 2030 there is a potential for a cumulative financial saving of about US$2.9 Billion, a CO_2 emission reduction of about 19.7 Million tons, and a preservation of the nation's natural gas of about 1.2 Billion m^3. Other benefits include the reduction of thermal brine discharge by desalination plants (average ratio of reject water to water produced is about 3:6) adversely affecting the surrounding coastal and marine environment and financial and energy costs of wastewater treatment process. Adopting such management interventions by the water authorities will not only reduce the financial, economic and environmental cost/burden and enhance the effectiveness and level of sustainability of the water resources management system, but it will also help Bahrain in its efforts to adapt to the impacts of climate change.

Source: Al-Zubari, 2014

health, the environment, food and energy. Many other interdependencies exist, which carry within them many cross-cutting issues of human rights, social, economic, legal, technical, political, and security nature. It is therefore important to address much more explicitly the various linkages of the water sector with other sectors like energy, food, health, and economic development as a whole. Water management should go beyond the boundary of the sector to achieve effective and integrated resources planning and management.

Amongst the most important inter-dependencies in the Arab region is the water, energy and food nexus. The three sectors are inextricably linked in the region – perhaps more than in any other region in the world, and actions in one area have strong impacts on the others. Energy is needed in every step of the water cycle (i.e., production, transmission, distribution, collection, treatment, and reuse). Water is needed in many energy operations (hydropower, cooling, energy exploration & production, refining, and EOR). Energy and water together are needed for food production. From this WEF nexus perspective, programs of water efficiency measures in the water consuming sectors would not only be more cost-effective than expanding supply, but would also result in a multitude of successive benefits that go beyond the water sector to other sectors. Furthermore, it is expected that the water-energy-food nexus will become more challenging and more complicated in the future due to the impacts of climate change. Available water resources are expected to decrease further, while municipal and agricultural water demands are increasing in the region. At the same time, Arab countries are working towards meeting their obligations in reducing their greenhouse gas emissions. Hence, adaptation to climate change impacts requires a comprehensive and integrated approach that aims at various WEF nexus issues.

Links in production and consumption of energy and water present a variety of opportunities to improve sustainable production and consumption patterns of energy and water resources. An integrated approach can help to identify mutual benefits for each sector, as well as prevent the adoption of conflicting policies that might increase the sustainability of one sector to the detriment of the other (ESCWA, 2011). Improving energy efficiency during the production and transport of freshwater can contribute to SCP of both energy and water. Investing in energy-efficient or renewable energy desalination technologies and water-pumping schemes can also result in mutual benefits that advance the sustainable

consumption and production of energy and water resources. The integrated management of energy and water resources can further improve policy coherence for SCP.

For example, in the GCC countries, home of the highest desalination capacity in the world (Box 7), reducing the production of desalination plants by implementing water efficiency and/or demand management measures has numerous benefits. Reducing the leakage in the distribution network, investing in water-saving devices and recycling will not only save consumers' money and governments' financial resources and lower the burden on the national budget, but will also save natural energy resource assets (oil and gas). Furthermore, in addition to the increase in the added-value per cubic meter and the freeing up of water for other uses, these changes will reduce the environmental costs in terms of greenhouse gases emissions and effluents discharged to the marine environment by desalination plants, thus reducing environmental degradation. This will consequently reduce the costs of wastewater treatment and carryover problems (Box 8).

Similarly, increasing water efficiency (conveyance, use, and reuse) in the agricultural sector is more cost-effective than increasing groundwater abstraction, it would enhance the sustainability of the water source in serving the sector and would reduce environmental degradation resulting from irrigation return flows. It would also result in major energy savings as many Arab countries such as the GCC currently make use of energy intensive groundwater withdrawals to pump water from deep aquifers.

VII. POLICIES AND MEASURES TO SHIFT TO WATER SCP

In general, water policies in the Arab countries have focused on enhancing supply to meet growing

BOX 9: USE OF ECONOMIC INSTRUMENTS IN ENHANCING WATER USE EFFICIENCY IN THE AGRICULTURAL SECTOR IN THE ARAB REGION

To increase water use efficiency in the agriculture sector, several Arab countries are reducing irrigation water subsidies. Morocco and Tunisia have introduced volumetric pricing for public irrigation, charging farmers by the amount of water they use rather than by hectares under cultivation. Metering is a condition for estimating water balance and a technical tool for preserving water. Irrigation charges almost completely cover operations and maintenance costs in Tunisia and are approaching full coverage in Morocco (IFAD, 2009). However, such removal of subsidies needs to be carefully studied and well planned and implemented to minimize such removal negative impacts on farmers and their livelihood.

In a study conducted on the impacts of alternative scenarios of water pricing policies in the agricultural sector in these two countries, the results showed that low cost of water has encouraged farmers to adopt more water-intensive activities. Reducing public subsidies on water will directly affect farmers' incomes, which are expected to drop by about 20 percent in the short and medium terms. However, the reduction of farmers' incomes will be largely compensated by the savings in public expenditures and also in a better and more efficient use of water resources. Both social and economic negative impacts are expected to follow the reduction of water subsidies, especially in terms of reduced farmers' income, reduced level of employment, and in extreme cases land abandonment. Negative impacts can be addressed either through: 1) flanking measures that support the removal of water subsidies to reduce the negative impact this removal might have on farmers' income; 2) compensatory measures that make up for the farmers' income loss following the removal of water subsidies in sustainable ways. Measures that address negative economic impacts through production changes (e.g., adoption of new technologies and production processes, introduction of new cultures with crop replacement and crop diversification) that improve farmers' competitiveness and consequently support farmers' income should be preferred to the ones that address primarily farmers' income. This is so since the former tend to be transitory, enabling the individuals to recover or improve their initial income without further support in the medium term, whilst the latter tend to delay the adaptation to the new conditions (Thabet, et al. 2014).

BOX 10: PROMOTING SUSTAINABLE WATER CONSUMPTION IN OECD

Following UNESCO's 'Decade of Education for Sustainable Development', many OECD countries are now developing curricula on sustainable development and sustainable consumption, including water use. The concept of a 'sustainable school' and 'eco-school' has been promoted in various countries, and environmental education has been sponsored at primary, secondary and tertiary levels.

Source: OECD, 2008

demand rather than on enhancing water efficiency, managing demand, and regulating water use. In many Arab countries, water efficiency in both the supply-side and the demand-side is generally very low. For example, on the supply side the physical leakage component of the non-revenue water in the municipal networks could reach as high as 30 percent, and in some cases more than 40 percent. Moreover, recycling in the Arab countries is scarce and the reuse rates of treated wastewater are negligible. On the demand side, the per capita water consumption in the domestic sector in many Arab countries ranks amongst the highest in the world. Furthermore, in the agricultural sector, which consumes on average about 85 percent of the total water used in the region, the predominance of inefficient irrigation practices leads to the loss of more than 50 percent of the amounts of irrigation water applied. Similarly, in the industrial sector wasteful water practices are common with negligible recycling efforts.

Moreover, there is a large potential for increasing land and water productivity in many Arab countries. For example, while the world average yield for wheat has increased by 20 percent, from 2,560 kg/ha to 3,090 kg/ha, during the period between 1990 and 2012, the regional average has risen by 28 percent during the same period. The low yield in many countries of the region can be seen as a challenge and an opportunity at the same time. The potential for the lower yield countries to benefit from regional cooperation is high; especially that many of the low and high yield countries share similar climatic and agronomic conditions. This large potential saving raises the need for increased regional technical cooperation as well as systematic and targeted research and development efforts at the national level (ESCWA, 2014).

While the Arab countries have spent billions of dollars on water supply infrastructure (i.e., desalination plants, treatment facilities, dams, and drilling of wells) in the provision of water supply, inadequate attention has been given to how efficiently the existing water is being used, supplied, recycled, or reused. To enhance the sustainability of the water management system and strengthen water demand management policies, there is an urgent need to reconsider the existing traditional supply-side management approach, and to improve water efficiency by reducing wasteful use in all the water consuming sectors. There must also be more awareness raised to influence consumers to make behavioral changes to reduce water wastage. It is becoming imperative for the Arab countries to focus on improving water efficiency to sustain water supplies with the least costs and minimum risks, and to achieve maximum productivity per cubic meter consumed.

Water efficiency must be addressed at all levels in water management, through technical means, improved management practices, and societal behavior changes. In short, before simply "providing more water" (i.e., a supply management approach), which often implies construction of new and expensive infrastructure, the first and more cost-effective approach should be to improve the water efficiency of the water management system, addressing the demand side issues, and as a last resort augmenting supplies.

The availability of inexpensive, heavily subsidized water has led to overuse and waste. Yet water remains a scarce resource in almost every Arab country, making conservation essential. While pricing is being looked at as the most effective method to ensure conservation, a major governance issue is how to provide the public with adequate and inexpensive water from a human right perspective. An answer lies in imposing progressive tariffs for drinking water and rationing water in agriculture, while demanding water pricing at actual cost in commercial activities and industry. A progressive water tariff ensures that basic human needs for fresh water are met at a low, subsidized price, while excessive use is

priced at a tariff that reflects cost (Box 4). In the agricultural sector – the major water consumer – incentives, particularly financial, are needed to improve irrigation efficiency. Managing irrigation water demand, including adopting water-saving technologies and crops, is essential. Economic and financial mechanisms include permits, rebates, tax incentives, targeted subsidies, price controls and water rights. Relevant research and development (R&D) must also be promoted and properly targeted (Box 9).

There is an urgent need for "water-oriented" Arab societies that value water, participate in the decision-making processes, and manage water wisely and efficiently. This long-term goal can be achieved by changing the mindset, attitude and practices in the Arab societies through raising water awareness and the application of appropriate social change instruments and incentives, resulting in a widespread culture where water resources are not wasted, polluted or overused.

In this regard, incorporating locally relevant water sustainable consumption and production topics in schools curriculums (KG to secondary) will be instrumental towards achieving this goal and will have long-term impacts on the youth to understand the effects of their own behavior on water, its quality, and ecosystems (Box 10). Moreover, implementing targeted conservation campaigns to water users (i.e., domestic, agricultural and industrial) and applying a social marketing approach for water conservation would be important in changing current unsustainable water consumption patterns. In addition, water awareness programs that target all levels of society, from KG to decision makers and politicians, are a major foundation for achieving good water governance and enhancing water security. This would result in considerable water saving through behavioral change and good practices that would enhance water SCP in the region. Finally, NGOs can play an important role in raising awareness, particularly at the community level. Thus there is a need to enhance the role of NGOs in awareness

BOX 11: THE KING ABDULLAH INITIATIVE FOR SOLAR WATER DESALINATION

In the GCC countries, there are a number of initiatives related to the water-energy nexus. Probably one of the most important on the supply side is the King Abdullah Initiative for Solar Water Desalination, which was launched in 2010. The initiative aims to use solar energy to desalinate seawater at a low cost to contribute to Saudi Arabia's water security and the national economy (Al Saud, 2010). The implementation of the initiative will be done in three stages over nine years. The first phase, which will last three years, aims to build a desalination plant with a production capacity of 30,000 m^3/day to meet the drinking water needs of the town of Al Khafji. The plant will use reverse osmosis technology and will be powered by solar energy farms that are currently being constructed. The second phase aims to build another solar desalination plant with a production capacity of 300,000 m^3/day. The third phase would involve the construction of several solar plants for desalination in all parts of the country. The ultimate goal is to enable all seawater desalination in the country to be carried out using solely solar energy by 2019, and at a significantly lower cost of US$0.4/$m^3$ compared to the current cost of between US$0.67/$m^3$ and US$1.47/$m^3$ when using thermal methods. The technology developed here would also be licensed outside Saudi Arabia (Sustainable Energy, 2010).

programs and adopt their appropriate initiatives in the area of SCP by governments.

However, SCP experiences have shown that combining policy tools and instruments to achieve the desired consumption changes is generally considered to be more effective. Economic, legislations and other instruments will need to be combined with public awareness and information campaigns to reinforce each other.

VIII. POLICIES AND MEASURES TO PROMOTE THE WEF-CC NEXUS APPROACH WITHIN SCP

The Arab region is energy intensive, water scarce, food deficient, and highly vulnerable to the potential impacts of climate change. Climatic variability will add further pressures to these conditions manifested by less reliable water supplies, more frequent and intense extreme events, increased water and energy demand, less reliable agricultural productivity, and many other anticipated negative impacts.

Climate change adaptation measures, such as desalination, are often energy intensive. Furthermore, increased groundwater use may require additional pumping. Thus climate policies can have an impact on water, energy and food security, and adaptation action can in fact be maladaptive if not well aligned in a nexus approach and implemented by appropriately interlinked institutions (SEI, 2011). Climate change underpins the triple context of water security, food security and energy security, so there is an urgent need to understand better why this nexus requires urgent attention, especially in the Arab region which is energy rich, water scarce, and food deficient. Based on a better understanding of the interdependence of water, energy, food and climate policy, this new approach identifies mutually beneficial responses and provides an informed and transparent framework for determining trade-offs and synergies that meet demand without compromising sustainability.

The strong interdependency between water, energy, food and climate change makes it imperative that policy formulation becomes coordinated, particularly with respect to mitigation of adaptation to climate change effects. Traditionally, water, energy and food policies are developed within each sector with little coordination. Change from fossil fuel with large emissions and considerable water use towards renewable energy resources, with minimal emissions and water use, should be pursued. Conventional policy- and decision-making in 'silos' therefore needs to give way to an approach that reduces trade-offs and builds synergies across sectors. This new development has created unprecedented opportunities for fundamental policy changes in various economic, institutional, technological, social and political systems. It is important to recognize that there has been weak or lack of real coordination in the Arab region in terms of policies and strategies for water, agriculture, land, energy, and addressing climate change.

The scarcity of fresh water in the Arab region promoted and intensified the technology of

desalination and combined co-production of electricity and water, especially in the GCC countries, while many Arab countries are also turning to this option to augment their water supplies. Desalination, particularly through cogeneration power desalting plants (CPDPs), is an energy-intensive process. Given the large market size and the strategic role of desalination in the Arab region, the installation of new capacities will increase the overall energy consumption. As energy production is mainly based on fossil fuels and this source is limited, it is clear that development of renewable energies to power desalination plants is needed (Box 11). Meanwhile, to address concerns about carbon emissions, Arab governments should link any future expansion in desalination capacity to investments in abundantly available renewable sources of energy. There is an urgent need for cooperation among the Arab Countries to enhance coordination and investment in R&D in desalination and treatment technologies. Acquiring and localizing these technologies will help in reducing their cost, increasing their reliability as a water source, increasing their added value to the countries' economies, and in reducing their environmental impacts. Special attention should be paid to renewable and environmentally safe energy sources, of which the most important is solar, which can have enormous potential as most of the Arab region is located within the "sun belt" of the world.

Finally, The Arab countries need to formulate an overall national sustainable consumption and production strategy and action program that is based on the initiated "Arab Regional Strategy for Sustainable Consumption and Production", which include water and other vital resources. Such strategy should have key performance indicators on water consumption and production, and include targets within a specific timeframe, to be monitored and evaluated periodically.

REFERENCES

Abu-Zeid Abu-Zeid M., and A. Hamdy (2004). "Water Crisis and Food Security in the Arab World: Where We Are and Where Do We Go." Arab Water Council Meeting, 14 April, Cairo.

ACSAD and BGR (2005). (Arab Center for the Study of Arid Zones and Dry Lands and German Federal Institute for Geosciences and Natural Resources. Management, Protection and Sustainable Use of Groundwater and Soil Resources in the Arab Region. Phase II Draft Final Report. Unpublished. Damascus, and Hannover, Germany.

ACSAD (Arab Center for the Study of Arid Zones and Dry Lands). (1997). Water resources and their uses in the Arab world. In: Proceedings of the first Arab symposium on water resources and their uses in the Arab world. Organized by ACSAD, Arab Fund for Economic and Social Development (AFESD), and Kuwait Fund for Arab Economic Development (KFAED), Kuwait City, Kuwait, 8-10 March, 1997, pp: 25-121 (in Arabic).

ACWUA (2014). Management of water utilities case studies from the Arab region. Arab Countries Water Utilities Association, Jordan. [Available at: http://www.acwua.org/sites/default/files/management_of_water_utilities_-_case_studies_from_the_arab_region-email.pdf].

AFED (2014). Arab Environment: Food Security. Annual Report of the Arab Forum for Environment and Development, 2014; Sadik, A., El-Solh, M. and Saab, N. (Eds.); Beirut, Lebanon. Technical Publications.

AFED (2010). Arab Environment: Water - Sustainable Management of a Scarce Resource. Annual Report of the Arab Forum for Environment and Development (AFED), El-Ashry, M., Saab, N. and Zeitoon, B. (Eds.). Beirut, Lebanon. Technical Publications.

Al Saud, T. M., (2010). King Abdullah Initiative for Solar Water Desalination. Presented in Saudi International Water Technology Conference, November 21 - 22, 2011. [Available at: http://kacstwatertech.org/eng/presentatoins/Day1/Session_1_1/Turki.pdf].

Al-Asam, M.S., and Wagner, W. (1997). Investigations for Development of Groundwater Management Strategies in the Eastern Coastal Plain of the United Arab Emirates. Proceedings of the Water Science

and Technology Association (WSTA) Third Gulf Water Conference: Towards Efficient Utilization of Water Resources in the Gulf, 8–13 March, Muscat.

Al-Jamal, K., and Schiffler, M. (2009). Desalination Opportunities and Challenges in the Middle East and North Africa Region. In: N.V. Jagannathan, A.S. Mohamed, and A. Kremer, eds., Water in the Arab World: Management perspectives and Innovations. Washington, DC: World Bank. [Available at: http://siteresources.worldbank.org/INTMENA/Resources/Water_Arab_World_full.pdf].

Al-Zubari, W. K. (2014). The Costs of Municipal Water Supply in Bahrain. Valuing Vital Resources in the Gulf series, Chatham House. [Available at: http://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20141216MunicipalWaterBahrainAlZubari.pdf].

Bushnak, A. (2010). Desalination. In: Arab Water: Sustainable Management of a Scarce Resource, El-Ashry, M., Saab, N., and Zeitoon, B. (Eds.). The Arab Forum for Environment and Development (AFED), Beirut. [Available at: http://www.afedonline.org/en/inner.aspx?contentID=583].

Dabour, N. (2006). Water resources and their use in agriculture in Arab countries. Journal of Economic Cooperation, 27 (1): 1-38. [Available at: http://www.sesrtcic.org/files/article/25.pdf].

Doumani, F. M. (2008). Climate Change Adaptation in the Water Sector in the Middle East and North Africa: A Review of Main Issues. PAP/RAC Workshop, 19-21 May, Sardinia, Italy.

ESCWA (2011). Sustainable Production and Consumption Patterns in Energy and Water Sectors in the ESCWA Region. Document: E/ESCWA/SDPD/2011/WP.1, ESCWA, Beirut.

ESCWA (2014). Pathways towards food security in the Arab region: An assessment of wheat availability (Draft). ESCWA, Beirut.

Falkenmark, M. (1989). The massive water scarcity now threatening Africa-Why isn't it being addressed. Ambio, 18: 112-118.

FAO (2011). Global Food Price Monitor: With Focus on the Horn of Africa. 9 August. Rome. [Available at: www.fao.org/giews/english/gfpm/GFPM08_2011.pdf].

GWI (Global Water Intelligence) (2010). Desalination Markets 2010. GWI [Available at: www.globalwaterintel.com/client_media/uploaded/files/DSM_2010_sample_chapter.pdf].

Hamoda, M.F. (2004). Water Strategies and Potential of Water Reuse in the South Mediterranean Countries. Desalination 165: 31–41.

IFAD (International Fund for Agricultural Development) (2009). Fighting Water Scarcity in the Arab Countries. Rome.

LAS (League of Arab States), UNEP (United Nations Environment Programme), and CEDARE (Center for Environment and Development for the Arab Region and Europe) (2010). Environmental Outlook for the Arab Region. UNEP, Nairobi. [Available at: http://eoar.cedare.int/report/EOAR%20Full.pdf].

LAS (League of Arab States), UNEP (United Nations Environment Programme) (2010). "Environmental Outlook for the Arab Region: Environment for Development and Human Welfare." Nairobi. [Available at: www.unep.org/dewa/westasia/eoar/].

Mehmet, O., and Bicak, H.A. (2002). Modern and Traditional Irrigation Technologies in the Eastern Mediterranean. Ottawa: International Development Research Centre. [Available at: http://web.idrc.ca/en/ev-9329-201-1-DO_TOPIC.html].

OECD (2008). Promoting Sustainable Consumption, Good Practices in OECD Countries. OECD. [Available at: http://www.oecd.org/greengrowth/40317373.pdf].

Ruta, G. (2005). Deep Wells and Shallow Savings: The Economic Aspect of Groundwater Depletion in MENA Countries. Background paper to Making the Most of Scarcity: Accountability for Better Water Management Results in the Middle East and North Africa. World Bank, Washington, DC.

SEI (Stockholm Environment Institute) (2011). Understanding the Nexus. Background paper for the Bonn 2011 Nexus Conference: The Water, Energy and Food Security Nexus, Solutions for the Green Economy, 16 – 18 November 2011, Bonn, Germany. [Available at: http://www.sei-international.org/mediamanager/documents/Publications/SEI-Paper-Hoff-UnderstandingTheNexus-2011.pdf].

Sustainable Energy (2010). Regional News and Trends: Saudi Arabia. Volume I, Number 3, issue May – June, 2010, page 23. Middle East Economic Survey, available online: www.mees.com.

Thabet, C., Chebil, A., and Frija, A. (2014). "Water Policy and Poverty Reduction in Rural Area: A Comparative Economy-wide Analysis for Morocco and Tunisia". Paper presented at the EAAE 2014 Congress: Agri-Food and Rural Innovations for Healthier Societies, August 26-29, 2014, Ljubljana, Slovenia.

UN General Assembly (2010). Resolution A/RES/64/292, 3 August, 2010. The United Nations. [Available at: http://www.un.org/es/column/docs/?symbol=A/RES/64/292&lang=E].

UN Urbanization Prospects (2014). [Available at: http://esa.un.org/unpd/wup/].

UNDESA (United Nations Department of Economic and Social Affairs) (2012) World Population Prospects, the 2012 Revision. New York. [http://esa.un.org/unpd/wpp/Excel-Data/population.htm].

UNDP (2013). Water Governance in the Arab Region: Managing Scarcity and Securing the Future. UNDP Regional Bureau of Arab States (RBAS). [Available at: http://www.arabstates.undp.org/content/rbas/en/home/library/huma_development/water-governance-in-the-arab-region.html].

WHO and UNICEF (2014). Progress on Drinking Water and Sanitation, 2014 Update. [Available at: http://www.unicef.org/publications/files/JMP_report_2014_webEng.pdf].

World Bank (2005). A Water Sector Assessment Report on the Countries of the Cooperation Council of the Arab States of the Gulf. Report No.32539-MNA. World Bank. Washington, DC. [Available at: http://siteresources.worldbank.org/INTMNAREGTOPWATRES/Overview/20577193/GCCWaterSectorReport--Englishversion.pdf].

NOTES

1. Sustainable Consumption definitions

a) Sustainable Consumption Symposium, Oslo, Norway; 19-20 January 1994: «the use of services and related products, which respond to basic needs and bring a better quality of life, while minimizing the use of natural resources and toxic materials as well as emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations.»

b) Edwin G. Falkman, Waste Management International. Sustainable Production and Consumption: A Business Perspective. WBCSD, N.D.: «Sustainable production and consumption involves business, government, communities and households contributing to environmental quality through the efficient production and use of natural resources, the minimization of wastes, and the optimization of products and services.»

c) Nick Robins and Sarah Roberts, Changing Consumption and Production Patterns: Unlocking Trade Opportunities. International Institute for Environment and Development and UN Department of Policy Coordination and Sustainable Development, 1997: «The emphasis of sustainable production is on the supply side of the equation, focusing on improving environmental performance in key economic sectors, such as agriculture, energy, industry, tourism and transport. Sustainable consumption addresses the demand side, looking at how the goods and services required to meet basic needs and improve quality of life - such as food and health, shelter, clothing, leisure and mobility - can be delivered in ways that reduce the burden on the Earth's carrying capacity.»

d) Emil Salim, The challenge of sustainable consumption as seen from the South. In Symposium: Sustainable Consumption. Oslo, Norway; 19-20 January 1994: «Sustainable consumption implies that the consumption of current generations as well as future generations improves in quality. Such a concept of consumption requires the optimization of consumption subject to maintaining services and quality of resources and the environment over time.»

2. Municipal water refer to the water supplied by the distribution network and include domestic (households), government, schools, hospitals, commercial, tourism facilities, and many other uses including in certain cases small industries. In the majority of the Arab countries, household consumption represents the majority of the municipal water supply.

3. However, this average varies in the Arab countries and ranges from 28.3 percent in Comoros to 99.2 percent in Qatar.

4. The average per capita income in the GCC stood at about US$43,900 in 2012, while total GDP was about US$1.6 trillion in the same year.

5. Non-revenue water is the difference between the volume of water put into a water distribution system and the volume that is billed to customers. NRW comprises three components: real losses, apparent losses, and unbilled authorized consumption. Real losses are through leaks, sometimes also referred to as physical losses. Apparent losses are through theft, metering inaccuracies, data-handling errors, etc.

6. Examples of non-renewable groundwater resources that are used in under planned mining are the Sarir basin in Libya and Al-Sharqiyah Sand and Al-Massarat basin in Oman.

7. Examples of non-renewable groundwater resrouces that are used in an unplanned mining are the Saq Aquifer, Tawilah Aquifer and Sana'a basin in Yemen and the Palaeogene aquifer in the Arabian Peninsula.

8. For example, most springs in the Syrian Palmyra oasis have dried up, including Afka, former site of the Kingdom of Zanobia (ACSAD and BGR 2005). The South Algerian oases, natural springs in Bahrain, most of the oases of the Egyptian Western Desert, the Al Kufrah oasis in Libya, the Al Ahsa oasis in Saudi Arabia and the natural springs used to irrigate Tozeur and Kébili in southern Tunisia have all been lost through excessive pumping and sinking groundwater levels. In the United Arab Emirates, intensive groundwater abstraction in the eastern coastal plains increased water salinity, leading to abandoned irrigation wells and dying date plantations (Al-Asam and Wagner 1997). In Yemen, excessive groundwater withdrawal for extensive irrigated agriculture has led to seawater intrusion in several coastal areas, especially Abyan Delta along the Gulf of Aden, the Tihama area and Wadi Mawr.

Sustainable Food Consumption in Arab Countries

Nahla Hwalla
Rachel A. Bahn
Sibelle El Labban

The need for sustainable food consumption in Arab countries has emerged from the regional concern for food and nutrition security that requires special consideration on multiple levels and disciplines. In response to population growth and demand, the current Arab food system – characterized by intensive agricultural production as well as environmentally damaging, inefficient practices – is facing climate change and depleted land, energy, and water resources, making it no longer sustainable.

In parallel, Arab countries are experiencing a nutrition transition marked by adoption of an unhealthy, 'westernized' diet, and facing the triple burden of disease illustrated by escalating obesity and diet-related non-communicable diseases, under nutrition, and micronutrient deficiencies. These challenges are negatively impacting the population's well-being and can be addressed by enhancing the sustainability of the food system. To date, Arab countries have fallen short of achieving food security, possibly due to efforts that have solely focused on increasing the food supply while overlooking its quality and sustainability. This situation is impacted by a high burden of diet-related non-communicable diseases and micronutrient deficiencies, even in resource-rich countries, which brings about the need to promote sustainable food consumption patterns to alleviate these challenges.

Sustainable food consumption and sustainable diets can be achieved by incorporating sustainability principles in all aspects of food security, where production of food is environmentally friendly, access is fair and economically sensitive, and utilization is healthy. Embracing these essential elements and concerns would make sustainable food consumption an integral part of food security and of all policies and programs related to its four dimensions: availability, accessibility, utilization, and stability.

Policy recommendations should include adopting a sustainable food consumption lens in agricultural production as well as in access and utilization of food, and ensuring stability of the food system. This can be achieved by considering sustainable production and consumption simultaneously, and adopting public policies (agricultural subsidies, tax incentives, awareness campaigns, marketing regulations, investment in agricultural technologies and infrastructure, and public procurement) that discourage food losses and waste and that support sustainable food consumption. This should be accompanied by revisiting the region's food-based dietary guidelines to promote sustainable diets in Arab countries, thus making sustainable food choices the easy choice.

I. INTRODUCTION

It is well known that food consumption patterns have significant influence on food production and food security, and vice versa. The growing need for food to satisfy an increasingly urbanized global population, a growing world economy, and a rising demand for certain types of food, has resulted in proliferation of resource-intensive agriculture for ever-greater food production. These practices, compounded by climate change, declining per capita land, energy, and water resources, as well as the nutrition transition and shifting consumption toward resource-depleting, 'westernized' dietary patterns, have increased the burden of malnutrition and diet-related diseases and damaged the health of individuals, society, and the planet. This situation has led to the call for sustainable food consumption and sustainable diets as measures that could help mitigate the deleterious rise and consequences of food and nutrition insecurity.

While there is no consensus on a single definition of sustainable food consumption, FAO (2012) has defined sustainable diets as follows:

> Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.

Arab countries, being most vulnerable in terms of food and nutrition security worldwide, are thus the most concerned with addressing the issue of sustainable food consumption at all levels of production, access, and utilization. Arab countries already import around a third of all globally traded cereals (World Bank and FAO, 2012), and have rising populations that will reach approximately 604 million people by 2050 (UN, 2013). This is augmented by limited and declining resources including arable land and fresh water, climate change, and the persistent and disruptive effects of conflict on both production and food markets. An additional burden is the rapid change in food consumption patterns and the nutrition transition, which have contributed to drastic increases in diet-related diseases, burdening the healthcare systems and raising the need for adoption of sustainable food consumption and sustainable diets.

The quest for sustainable diets evolved due to key challenges in addressing food security and food systems in Arab countries. Promoting sustainable diets, taking into account agricultural systems, environmental systems, food processing and safety, economic development, and nutrition, is essential to move forward. This paper will examine trends in food consumption patterns as they relate to achieving food security in Arab countries, and will recommend new initiatives that may help in achieving sustainable food consumption for food and nutrition security.

II. LANDSCAPE OF FOOD SECURITY AND SUSTAINABLE FOOD CONSUMPTION

Agricultural production and food distribution have always been major concerns for governments and social organizations as they seek to feed their populations and prevent extreme outcomes like hunger and famine. Fortunately, improvements in production technology, processing, and transportation have helped to make food more available, affordable, and convenient.

Unfortunately, these changes have negatively impacted diets, making food less diverse, less healthy, and less sustainable. This has had negative outcomes for human health and the natural environment. While the debate around food security generally focuses on how to secure sufficient food calories for every man, woman, and child, attention to wider concerns around the sustainability of the food system is drawing increased attention to the concept of sustainable food consumption and sustainable diets.

Arab countries are generally falling short in achieving food security. In its 2014 report on "The State of Food Insecurity in the World," the FAO reveals that the Near East and North Africa[1] is the only region in the world experiencing an increase in both the absolute number and the proportion of undernourished people within the total population. At the national level, countries with the financial resources to procure food through imports, such as the Gulf Cooperation Council (GCC) countries, are sometimes considered much more food-secure than countries with limited agricultural production, poor infrastructure, and weak economic development (Ahmed et al., 2013, and Breisinger et al., 2010). However, even in these resource-rich countries, ensuring adequate energy availability and intake has not been sufficient to achieve total food and nutrition security, as micronutrient deficiencies remain problematic in these countries (Micronutrient Initiative, 2009).

Accordingly, almost all Arab countries are facing serious challenges in terms of food and nutrition security. In many Arab countries, efforts to achieve food security have focused on increasing agricultural production without considerable attention to the quality and sustainability of the food supply, or to the distribution, allocation, and diversity of food consumed by the population (Meerman et al., 2013). Many policies, programs, and strategies related to food security are skewed towards agricultural production, technological approaches, and food availability. However, the accessibility and quality of the food consumed by the population has received less attention. Moreover, issues of environmental, health-related, social, and economic sustainability have been neglected.

Concomitantly, Arab countries are experiencing a nutrition transition characterized by a shift away from a traditional, more seasonal, and more diverse diet, rich in whole grains, fruits, and vegetables, towards a 'westernized' diet that is high in refined cereals, animal protein, fats, sugar, and salt (Johnston et al., 2014). Factors driving this transition include economic growth and increased incomes, globalization of trade and marketing, and rapid urbanization – all which affect food production, supply, and intake of the population.

Although the rate of undernutrition and levels of stunting, wasting, and underweight, have been on the decline in some Arab countries, there has been a parallel dramatic increase in the prevalence of overweight and obesity[2] and diet-related non-communicable diseases (such as diabetes, cardiovascular disease, and cancers) in the region (Popkin, 2000). This is in light of the nutrition transition, which has contributed to what is known as the triple burden of disease, which is the combined presence of undernutrition, micronutrient deficiencies, and overweight and obesity within a population, sometimes within a single household (Johnston et al., 2014). The rising prevalence of malnutrition has been illustrated by an increase in the number of undernourished children over the past two decades in the Near East and North Africa – the only region in the world to witness both an absolute and a relative increase in malnutrition. While approximately 9 percent of the population was undernourished in 1990-1992, a higher prevalence rate of 10 percent was reported in 2011-2013 (FAO, 2014). Moreover, at least one third of the population in the region is anemic and at risk of iodine deficiency, while 13 million young children suffer from Vitamin A deficiency (WHO, 2011). On the other hand, an estimated 65 percent of adults in Arab countries are overweight and obese, approaching the highest rates worldwide (WHO, 2011).

Popkin (2000) has classified countries according to their nutrition transition stage where many Arab countries fell within the second stage of the nutrition transition, consuming diets which offer adequate access to calories, but with inadequate diversity or access to micronutrients with a concomitant state of undernutrition and increasing prevalence of overweight, obesity, and non-communicable diseases (see Appendix I). However, this generalization masks significant

CONSUMERS AND SUSTAINABILITY

Martine Padilla, Giulia Palma, Fatiha Fort and Sophie-Anne Sauvegrain

WHAT IS A SUSTAINABLE FOOD FOR CONSUMERS?

Sustainable development is a social, political and cultural construction in which consumers hold a prominent place. For them sustainability is reflected in relationship to a specific and variable time. Thus, certain traditional practices are considered a guarantee of sustainability, to perpetuate the food heritage for future generations. The relation to the past, present and future, which is eminently cultural, directly impacts daily practices and the integration of the notion of sustainability. Communication, usually based on the protection of resources, should focus on the interest of perpetuating past practices guaranteeing the balance between personal well-being and that of the planet. Environmental sensitivity is also expressed through certain dietary practices that can contribute to the conservation of resources, their diversity, and their quality, connecting the benefits of the individuals to those of the collective. Consumers' understanding of the discourse on sustainability can be culturally dependent and sometimes difficult to translate into daily habits. Those practices constitute a frame of small actions by individuals, which are spread by imitation or custom, and contribute to global action. Beyond the altruistic motives that underpin these approaches, it is important to understand the mechanisms and levers for change.

New consumers are increasingly sensitive to the issue of environmental protection. A new awareness towards sustainable development and the well-being of the population has replaced the traditional price-quality criteria used for choices. They demonstrate their awareness through a demand for organic and local products. Consumers also appreciate the social commitment of the companies concerned and demand fair-play and respect for animal welfare.

Many aspects are related to sustainable food in the consumers' minds. According to a large survey in France*, the sustainability of food products has three main dimensions: (I) the origin of the product; origin is seen as an act of environmental protection, and is closely related to the way of producing; it's also linked with organoleptic and nutritional quality of product; thus nearby products are considered more sustainable than others (II) the seasonal production that is related to the naturalness of products; and (III) the organic products: the main motivation of the consumer is not only protecting the environment, but also a set of heterogeneous motivations including health, taste, safety of food, respect for tradition.

Similarly, results show that even if the majority of consumers have a positive attitude towards "sustainable" products, only a quarter of them are ready to adopt new behaviour, mainly explained by the price of sustainable products.

THE PLACE OF CONSUMERS IN THE FOOD SYSTEM'S SUSTAINABILITY

As a central actor in the food supply chain, consumers play an important role as their consumption patterns can be highly polluting. However, few studies focus on the environmental impact of consumer behavior. Within the existing studies, consumers have been shown to generate 29 percent of greenhouse gas emissions (GHG) of the food system as a whole in Germany, 25 percent in England, and 15 percent in the United States. Considering specific food chains, consumers' impact on GHG emission was 64 percent for fresh carrots, 32 percent for frozen carrots and 5 percent for canned carrots in 2005; 23 percent for kiwi fruits produced in New Zealand and exported to Europe in 2008; and 7 percent for tomato sauce using French paste in 2014.

variations between Arab countries. WHO (2011) has classified Arab countries into four groups with regard to nutrition transition stages and dominant nutrition problems, major risk factors and underlying causes for non-communicable diseases, intervention programs in response to these problems, and enabling environmental factors for improved action. It is worth mentioning that even relatively wealthy Arab countries are subject to the triple burden where they simultaneously report stunting, overweight and obesity, and micronutrient deficiencies and, as such, are classified in advanced stages of the nutrition transition (Table 1).

An important factor behind the above mentioned nutrition transition in Arab countries is possibly the change in per capita energy consumption

THE PRACTICES OF CONSUMERS AND SUSTAINABILITY

Although consumers are generally not very sensitive to the effect of the environmental impact of their choices, their sensitivity is expressed through certain dietary practices that can contribute to the conservation of resources. For instance, in 2000, a German family generated in average 4360 CO_2 kg for feeding (material flow attributable to the production till waste), with 78 percent resulting from home consumption and 22 percent from out of home consumption. Production, processing, transport and distribution accounted for just under half the emissions, whereas 52 percent were due to home storage and refrigeration, dishwashing, heating and air-conditioning. Thus, consumers have a significant impact due to their purchasing and cooking practices, storage and the way they manage wastes. The impact is highly variable, according to the distance driven between shops and home, CO_2 emissions ranging from 20 to 53 percent in the whole supply chain. Similarly, a research study in 2011 on coffee indicates that 30 percent of all emissions are due to the preparation by consumers. Moreover, a difference in energy use from 50 to 70 percent can be observed when using a more efficient cooking method.

It was estimated in 2005 (edited in 2011) that in average (5449 interviews) a Finnish household's food maintenance (transportation, preservation and preparation of food) produce 170 kg of CO_2 every year, 50 percent of which come from storage, 27 percent from transport and 23 percent from cooking. For processed products, processing and packaging has the highest contribution in many impact categories whereas for energy use, fridge storage time can have the greatest consequences. The consumer phase is therefore very important, as shopping and storage time account for 13 to 50 percent of energy use and 12 percent of global warming.

The FLONUDEP project demonstrates the complexity of interpreting the results in the case of tomatoes. Results of fresh tomatoes show that of the four stages identified at consumer level (i.e. purchasing, storage, preparation and end of life), purchasing – driving to the supermarket – has the greatest effect. Results concerning processed tomatoes highlight that other stages (cooking and recycling of packaging are also important contributors to the whole environmental impact. Human toxicity levels vary significantly between fresh tomato and processed tomatoes because of the recycling of the steel can used. Finally, 1 kg of processed tomatoes generates 0.18 kg equivalent CO_2, whereas fresh tomatoes generate 0.07 kg. However, if we consider the fact that 6 kg of fresh tomatoes are needed for 1 kg of processed tomatoes, results can be read differently. In this case, the impact of fresh tomatoes is 2.3 times higher than that of processed tomatoes. If we compare fresh tomato sauce with tomato sauce made with processed tomatoes, at consumer level, global warming impact levels are equal.

Conclusion

We have shown that consumers put different dimensions in correlation to sustainable food. It is important to emphasize the role of awareness in order to stimulate the appropriation of more sustainable practices. The different steps of transmission of knowledge have to be mobilized to promote its dissemination and the sustainable food practices contribute to make the consumer more responsible.

Note

* FLONUDEP is a French National Research Agency funded project regarding environmental, social and nutritional sustainability of tomato supply chains. It was coordinated by CIHEAM-Montpellier.

Dr. Martine Padilla, Associate Professor, and Giulia Palma, Researcher, CIHEAM Montpellier; Dr. Fatiha Fort, Professor, and Sophie-Anne Sauvegrain, Researcher, Montpellier Supagro-IRC.

pattern. The World Health Organization (n.d.) reports a substantial increase in energy consumption in the Near East and North Africa region in recent decades, with levels that have exceeded the global average and that are expected to remain so in the next decade (Table 2).

These regional trends in food consumption patterns again mask significant variation at the national level. Table 3 shows a gradual and significant increase in daily energy supply[3] across most Arab countries, as well as variations therein, over the past few decades. For example, while per capita energy supply has increased by only 19 percent in Yemen over the period 1965-2011, it has more than doubled in Algeria (102 percent) over the same period. A sharp increase in daily energy supply has been also observed in Egypt

(60 percent), Saudi Arabia (68 percent) and Libya (80 percent). Only five Arab countries (Iraq, Palestine, Somalia, Sudan, and Yemen) have reported an energy supply of<2,500 kcal/capita/day, while nearly all other countries have reported energy supply of>3,000 kcal/capita/day (Table 3).

Total energy supply, as noted above, does not fully reflect food and nutrition security. A diversity of nutrients is also required to ensure good health and prevent disease. No single food can provide all of the nutrients necessary for optimal health. Rather, a varied diet that is nutritionally-complete is needed to ensure adequate amounts of essential macro- and micronutrients (Horwath et al., 1999; Bernstein et al., 2002; Hollis and Henry, 2007).

Data on changes in percent dietary energy supply from various food groups in selected Arab countries over the past few decades are shown in Figure 1. A dramatic increase in the proportion of energy from vegetable oils has been particularly documented in Kuwait, Saudi Arabia and Lebanon, and to a lesser extent in

TABLE 1 CLASSIFICATION OF ARAB COUNTRIES ACCORDING TO NUTRITION TRANSITION

Category	Characteristics	Countries
Countries in advanced nutrition transition	• high levels of overweight and obesity • moderate levels of undernutrition and micronutrient • deficiencies in some population subgroups	GCC countries Tunisia
Countries in early nutrition transition	• moderate levels of overweight and obesity • moderate levels of undernutrition in specific population and age groups • widespread micronutrient deficiencies	Egypt Jordan Lebanon Libya Morocco Palestine Syria
Countries with significant undernutrition	• particularly high levels of acute and chronic child malnutrition • widespread micronutrient deficiencies • emerging overweight, obesity and malnutrition of affluence in certain socioeconomic subgroups	Djibouti Iraq Yemen population subgroups in GCC countries, Palestine (Gaza) and Tunisia
Countries in complex emergency	• severe child and maternal undernutrition • widespread micronutrient deficiencies	Somalia Sudan

Source: Adapted from WHO, 2011

TABLE 2 GLOBAL AND REGIONAL PER CAPITA ENERGY CONSUMPTION OF FOOD (KCAL/CAPITA/DAY)

	1964-1966	1974-1976	1984-1986	1997-1999	2015	2030
World	2,358	2,435	2,655	2,803	2,940	3,050
Near East and North Africa	2,290	2,591	2,953	3,006	3,090	3,170

Source: WHO, n.d.

SEKEM: SUSTAINABILITY AT THE CORE OF A BUSINESS DEVELOPMENT STRATEGY

Meryem Cherif

Among the successful experiences on sustainable food in the Arab world, a pioneer example to be noted is the Sekem initiative in Egypt. Sekem is an initiative founded in the 1970's by Ibrahim Abouleish, a doctor in chemistry who designed a humanist project with and for the people.

The initiative is based on the principle of biodynamic farming, a branch of organic farming, defined and conceptualized by Rudolph Steiner in the early 1920's. Biodynamic farming considers that the entire farm should be organized like a living organism or ecosystem, a unique individual seeking to improve its environmental, economic and social well-being. Following this approach, all the services needed by the farm should be sourced within the farm. For instance, fertilisers and pest management systems are considered as ecosystem services that should be provided by the farm agro-ecosystem. Fertilisers, also called preparations, are made of medicinal herbs cultivated on the farm, and bring special proprieties to the soil, helping with the plant's growth. As for pest management, it is regulated by the ecosystem itself, through the interactions of species within the farm. Moreover, a biodynamic farm should be anchored in its environment; the farming techniques, crops, fertilisers, preparations, as well as the planting and harvesting calendar should adapt fully to the site conditions and dynamics.

Sekem began its activity in the 1970's by developing biodynamic farms, and slowly expanded its activity according to the same approach, always considering its environmental, social and economic sustainability as equally essential for its success.

At present, Sekem cultivates around 840 hectares of agricultural land with its own organic farms. Furthermore, more than 120 small-holding farmers are supplying SEKEM. They are located on Egyptian desert land that was developed through biodynamic farming, mainly through composting. These farms have participated in the creation and preservation of a productive ecosystem that hosts more than 60 bird species, over 90 varieties of trees and shrubs, and a broad range of small animals like hedgehogs, lizards, snakes, mongoose and foxes.

Sekem not only preserves the environment, it also gives great importance to social development and its contribution to social well-being. From the very beginning, Sekem was a project conceived to strongly involve and give back to the local community. It not only provides work and regular income to the community but also creates a network of actors around the farm and invests in it, thus integrating the local community within the Sekem ecosystem. Moreover, many community-oriented projects are funded by SEKEM and managed by the Sekem Development Foundation. These projects include a kindergarten, two schools, a university, a vocational training centre, laboratories, a medical centre, and programmes for disadvantaged children. Sekem has also developed a very strong corporate social responsibility policy towards its employees, earning the company many awards on the international scene.

While preserving and restoring the environment as well as giving back to the community, Sekem has managed to become a flourishing holding of companies. Indeed, Sekem developed and diversified from biodynamic farming through a vertical integration into several sectors, using its bio-dynamically grown agro-production for a wide range of organic products.

In the pharmaceutical sector, Sekem has developed ATOS Pharma and Sekem Healthcare, which are two companies that manufacture and market natural medicines, remedies and healthcare products. In the food sector, Sekem accounts for several companies, among them Lotus, which produces organic spices and ISIS, which produces organic food and beverages. Another line of business that was developed is Naturetex, a company producing organic textiles for men, women, children, home textiles and fabrics. Products from these several companies are sold in Egypt, the Gulf States, and countries as far as the USA and Germany.

There are several valuable lessons to be learnt from Sekem's experience, such as perseverance despite the obstacles and challenges one can encounter on one's road. Indeed, Sekem was born in the 1970's in Egypt, where consumers awareness about organically grown products wasn't very developed, making Sekem a difficult business model to be pitched to investors and for partnerships. The most important lesson however, is that a business model such as Sekem's, based on environmental preservation and social development, can work in the context of an Arab country. Sekem is a modern and profitable company, recognized globally for its success in basing its business development strategy on sustainability. Nowadays, Sekem is a role model in the agro-food sector, invited to share its best practices in other countries around the world, and in the Mediterranean, namely in Palestine and Turkey. It proves every day that sustainable consumption and production in the food sector are not only viable, but also successful in an Arab country.

Meryem Cherif, Project Manager at the Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC).

TABLE 3 NATIONAL PER CAPITA ENERGY SUPPLY (KCAL/CAPITA/DAY)

Country	1965	1975	1985	1995	2005	2011	Percent Increase 1965-2011 (%)
Algeria	1,591	2,058	2,613	2,785	2,958	3,220	102
Bahrain	-	-	-	-	-	-	-
Comoros	-	-	-	-	-	-	-
Djibouti	1,586	1,661	1,562	1,707	2,264	2,526	59
Egypt	2,229	2,430	3,069	3,315	3,367	3,557	60
Iraq	2,054	2,200	3,321	2,202	2,354	2,489	21
Jordan	2,158	2,138	2,651	2,687	3,119	3,149	46
Kuwait	2,556	2,538	2,922	3,214	3,576	3,471	36
Lebanon	2,472	2,437	2,933	3,287	3,128	3,181	29
Libya	1,783	2,995	3,251	3,225	3,190	3,211	80
Mauritania	2,129	1,959	2,449	2,533	2,632	2,791	31
Morocco	2,173	2,617	2,864	2,952	3,207	3,334	53
Oman	-	-	-	-	-	-	-
Palestine	-	-	-	-	2,237	2,032	-
Qatar	-	-	-	-	-	-	-
Saudi Arabia	1,857	1,795	2,703	2,852	2,973	3,122	68
Somalia	1,863	1,898	2,028	1,624	1,779	1,696	-9
Sudan	1,610	1,907	2,006	2,169	2,296	2,346	46
Syria	2,143	2,559	3,039	2,967	3,101	3,106	45
Tunisia	2,393	2,674	3,064	3,129	3,223	3,362	40
United Arab Emirates	2,587	3,141	3,477	3,261	3,210	3,215	24
Yemen	1,842	1,870	2,054	2,043	2,093	2,185	19

Source: FAOStat (2015) and authors' calculations

Egypt and Jordan. The proportion of energy from fruits and vegetables has also decreased in Kuwait and Saudi Arabia, but increased in Lebanon.

It should be noted that supply levels should be treated with caution as they do not reflect actual consumption. More recently, Afshin et al. (2015) evaluated national intakes of harmful and protective foods in countries of the MENA region using 2010 consumption data.[4] Most, if not all, Arab countries showed insufficient per capita consumption of protective foods (fruits, vegetables and beans, nuts and seeds, whole grains, and seafood omega-3 fatty acids) that fell well below recommended levels. In fact, all Arab countries consumed fruits in amounts less than the recommended level of >300 g/day. Similarly, no Arab country consumed the recommended level of vegetables and beans of >400 g/day. Only three countries (Tunisia, Syria, and Lebanon) met or exceeded the recommended level of >16 g/day for nuts and seeds. As for whole grains, the majority of Arab countries consumed 59-63 g/day, which is below the recommended level of >125 g/day. Similarly, the majority of Arab countries consumed 50-75 mg/day of seafood omega-3 fatty acids, well below the recommended level of >250 mg/day. Lowest intakes of protective food components were observed in Libya for fruits and for vegetables and beans; in Saudi Arabia for nuts and seeds; in Egypt for whole grains;

THE MEDITERRANEAN DIET FOR SUSTAINABLE DEVELOPMENT: CIHEAM'S MEDITERRA REPORT

Sébastien Abis and Javier Albarracin

Mediterranean diet as a model for sustainable development was the topic of the 2012 edition of Mediterra, the flagship publication produced by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM). The report proposes a multidimensional approach involving socio-demographics, health, ecology, enterprise, geo-economics and citizens' initiatives. The report is divided into eight parts in view of the multidimensional aspect of the Mediterranean diet. Given the region's historical heritage and its place in the focus of researchers, it seemed obvious to take these considerations as a point of departure before developing the other aspects.

Since the Mediterranean diet is a multifaceted concept, the Report endeavours to deal with all of the issues involved in the topic as a whole, from economy to society, from the cultural to the commercial, from population trends to the environment, from consumption to economic intelligence, and from education to political action. Since the Mediterranean diet is a plural concept, CIHEAM's report reveals the controversies it creates with a view to furthering scientific debate. It compares viewpoints in order to illustrate both the brakes and the forces that the diet can generate in the debate on the implementation of sustainable food patterns. Since the Mediterranean diet is a dynamic concept, Mediterra highlights how it can play a role in the efforts to seek a more sustainable food system and greater regional cooperation. Furthermore, it shows how the diet can be a vector for implementing responsible development strategies by participating both in the action to combat climate change and in the efforts to mitigate food insecurities.

The Mediterranean diet is a subject on which research and cooperation are at the service of responsible development in the countries of the region. Although the existence of Mediterranean values or of a Mediterranean identity may be debatable, it is clear that the relation of its people with food, gastronomy and the land is a consistent link.:It is one which is further strengthened by cultural attachment to the family, sharing and sociability. Food and the flavours of local fare are a common language to the peoples of the countries on the Mediterranean shores: they are rarely indifferent to what is served on their plate. Although this is applicable the world over, it is particularly true in the case of the Mediterranean region, precisely because Mediterranean foods have evolved there and have blended over time, producing the wide variety of cuisines we know today. This historical and intercultural dimension is one of the Mediterranean's greatest assets, which is reflected first and foremost in the dishes served. A mythology has thus gradually evolved around the Mediterranean diet – a term that is derived from the Greek "díaita", which denotes a localised lifestyle based on both behavioural and culinary patterns.

Consumers in the countries of the Mediterranean Basin have progressively changed their dietary practices as they have gradually become caught up in the dynamics of urbanization and the globalization of agricultural trade. They are adhering less and less to the Mediterranean diet, despite the fact that it is the basis of their identity and one of the major assets of the region. Pressures on natural resources and the emergence of new private actors are intensifying the complexity of diet-related issues.

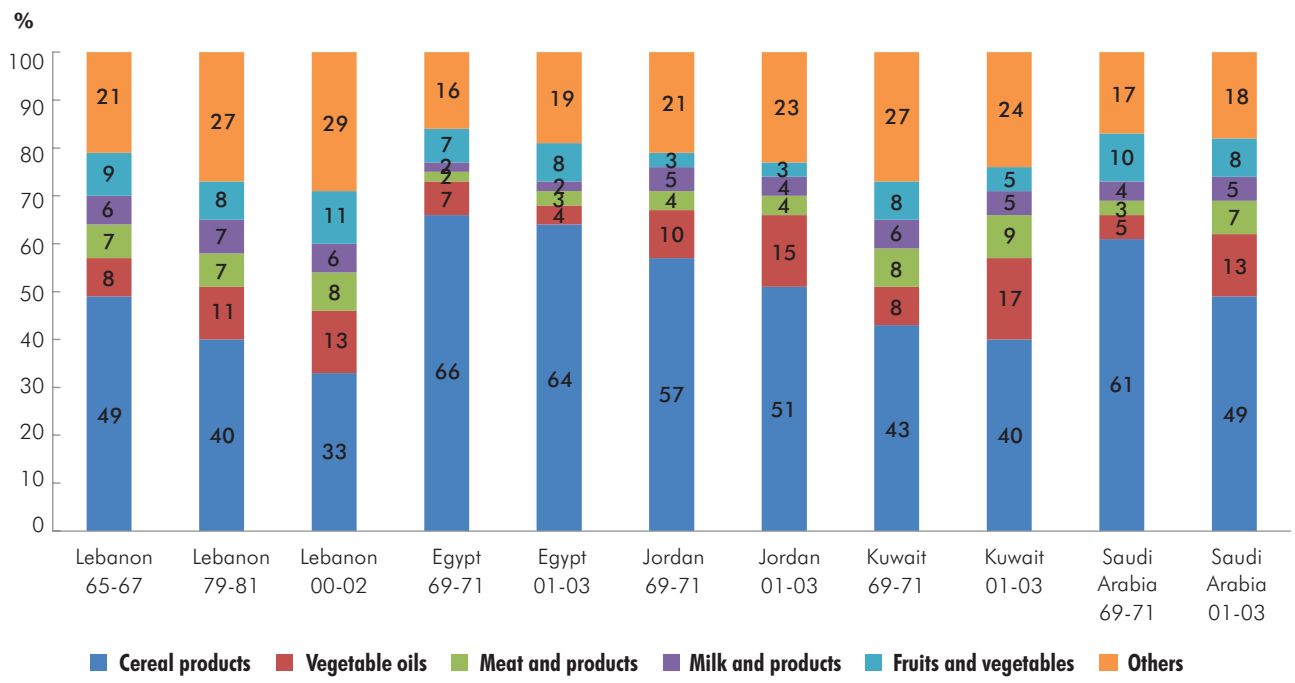
By bringing people closer to the land, the Mediterranean diet clearly shows that the food question must be analysed "from field to table" approach, as Mediterra report puts it. This involves examining all of the dynamics of this vast topic– political, social, cultural, economic and legal.

The agenda of the priorities of Euro-Mediterranean cooperation should clearly include the challenges related to the Food and Nutrition Security. The Mediterranean diet canin fact, beyond its health and nutritional benefits, serve as a vector for action to change the trajectories of human and economic development in the countries of the region towards a convergence and a more cooperative framework.

Download Mediterra 2012 report at:
www.ciheam.org/index.php/en/publications
mediterra-2012.

Sébastien Abis, Administrator, CIHEAM General Secretariat; Javier Albarracin, Director of the Socio-economic Development Department, IEMed.

FIGURE 1 PERCENT DIETARY ENERGY SUPPLY FROM FOOD GROUPS: A COMPARISON OF MENA COUNTRIES (FAOSTAT)



Source: Sibai et al., 2010

and in Lebanon for seafood omega-3 fatty acids. Appendix II displays national consumption data of protective food components across Arab countries as reported by Afshin et al. (2015).

As for harmful food components, all Arab countries showed higher than recommended per capita consumption of selected food components (processed meat, red meat, trans fatty acids, sugar-sweetened beverages, and sodium). For instance, while consumption of processed meat is not recommended, intake ranged between 3.4-6.5 g/day across most countries. As for red meat, while the recommended level is 100 g/week, all Arab countries consumed levels ranging between 300-700g/week. Regional consumption of trans fatty acids was in the range of 1-3 percent E/day, higher than the recommended level of <0.5 percent E/day. While consumption of sugar-sweetened beverages is not recommended, most Arab countries had intakes between 100-185 g/day. The MENA region also suffers from high sodium intake above the recommended level of <2,000 mg/day, as evident by the majority of Arab countries consuming 3,500-5,000 mg/day of sodium. Highest intakes of harmful food components were observed in UAE for processed meat; in Algeria for red meat; in Egypt for trans fatty acids; in Lebanon for sugar-sweetened beverages; and in Bahrain for sodium. Appendix III displays national consumption data of harmful food components across Arab countries as reported by Afshin et al. (2015).

Looking at cross-country trends, Afshin et al. (2015) have also reported similar and important changes in food consumption patterns in the MENA region between 1990 and 2010, where whole grain consumption was reduced by 21 percent, paralleled by an increase in the consumption of refined grains. However, trans fatty acids and sodium intakes increased by 20 percent and 7 percent, respectively, to well above recommended levels (<0.5 percent E/day and <2,000 mg/day, respectively). This study further showed the association between such food consumption patterns and risk of cardio-metabolic diseases (including diabetes, systolic blood pressure, BMI, fasting plasma glucose, and total cholesterol) across all countries of the

MENA region, whereby food consumption patterns in Arab countries are strong predictors of these diseases (Afshin et al., 2015).

It is important to note that many such possibly harmful components of the Arab diet are also examples of foods that have a negative impact on the sustainability of the current food production system and hence on food and nutrition security. For example, red meat is currently over-consumed with negative impacts on both human health and sustainability of the food system, while fish and seafood are protective foods that are under-consumed but whose production may or may not be sustainable. This has serious implications for recommended sustainable consumption guidelines for Arab countries.

Hence, in considering and recommending sustainable food consumption, the complex trade-offs between nutritional impact and sustainability of production should be measured. The integration of sustainable food consumption in the four dimensions of food security is elaborated below, keeping in mind the nutritional value of sustainable diets.

III. SUSTAINABLE FOOD CONSUMPTION FOR FOOD AND NUTRITION SECURITY

Sustainable food consumption is an integral part of food security, as consumption drives the four dimensions of food and nutrition security – that is availability, accessibility, utilization, and stability – and should, therefore, be incorporated in all policies and programs related to these four dimensions.

A. Food availability and sustainable food consumption

Sustainable food consumption is inherently tied to food production, both at the farm and along the food supply chain. This is, in turn, tied to natural resources including flora, fauna, soil, water, and air. Unfortunately, consumption trends are negatively affecting the agro-ecological resource base and its ability to sustainably provide food: current practices to satisfy the demand for non-sustainable diets are affecting global food production, which "is responsible for more than 70 percent of fresh water consumption, for 80

THE FOOD SECURITY PROGRAM AT THE AMERICAN UNIVERSITY OF BEIRUT

A Multi-Disciplinary Approach to Address Food Consumption and Production

Rachel A. Bahn and Sibelle El Labban

To date, a holistic and multi-disciplinary approach to food security has too often been missing in the Middle East and North Africa (MENA) region. Food security is still equated with food self-sufficiency and proposed solutions focus heavily on agricultural production. Such a narrowly focused view of food and nutrition security is particularly ill suited to the MENA region, given its limited land and water resources. Moreover, this narrow focus neglects important issues such as food accessibility, post-harvest loss, value chain management, food safety, nutritional value, environmental sustainability, and linkages with health issues and wider economic development.

The complexity of food and nutrition security and sustainable diets demands that policymakers and program experts have a wide knowledge of the interconnections between agricultural technologies, supply chains, human nutrition, economic development, and consumer behavior. Armed with this knowledge and a commitment to working across disciplines, individuals will be better equipped to provide the MENA region with sound policies that support not only food and nutrition security, but also sustainable diets.

In response to these challenges and in order to fill this critical gap, the Faculty of Agricultural and Food Sciences at the American University of Beirut (AUB) has established the Food Security Program (FSP) to promote food and nutrition security through education, research, community action, and policy-oriented professional practice. The FSP is the first graduate-level academic program in the MENA region to focus specifically on food and nutrition security. An over-arching principle of the FSP is the multi-disciplinary nature of food and nutrition security, which cannot be achieved without sustainable food production and consumption: policies and programs to support sustainable food production and consumption in the MENA region and Arab countries are needed to achieve food and nutrition security.

The FSP adopts a holistic approach to the many aspects of food security and sustainable diets, to overcome compartmentalized thinking and foster dialogue between relevant disciplines like agriculture,

nutrition, health, and development economics. A multi-disciplinary perspective allows students and faculty members to consider and address the complex challenges of food and nutrition security and sustainable diets with a particular focus on the MENA region. The cyclical relationship between food security and sustainable food production and consumption means that these latter issues are inherently part of the FSP.

The FSP strives to educate a new generation of leaders throughout the MENA region, preparing them with the technical and decision-making tools to address the vital issue of food and nutrition security. The FSP will offer graduate-level academic programming through an innovative summer Diploma in Food Security (launching summer 2015) and a full Master of Science in Food Security (planned for spring 2016). As for research, the FSP prioritizes demand-driven topics that expand the boundaries of our knowledge and can inform food and nutrition security policies and programming. Finally, the FSP seeks to direct and lead efforts to translate research, knowledge, and education into action and intervention at the local level, by engaging our university community of students, faculty and staff. Such engagement helps raise awareness in and around the university community, working through the student body and with our partner organizations to achieve a wider impact on food and nutrition security and sustainable production and consumption over time.

Rachel A. Bahn, Director, Food Security Program; Sibelle El Labban, Senior Research Assistant, Faculty of Agricultural and Food Sciences, American University of Beirut.

TABLE 4 **WATER SAVINGS FROM REDUCED RED MEAT INTAKEIN ARAB COUNTRIES (billion m³/country/year)***

Country	Total Availability * (1000 MT /year)	Total Population* (1000s)	Per capita Availability (kg/capita/year)	Recommended Per capita Intake** (kg/capita/year)	Water Footprint of Red Meat *** (m³/kg)	Per capita Water Saved from Red Meat Reduction (m³/capita/year)	Total Water Saved from Red Meat Reduction - 2015 (m³/country/year)
Algeria	329.69	36,414.29	9.1	5.2	15.5	3,220	2,427,235,077
Bahrain	34.32	1,234.00	27.8	5.2	15.5	-	476,564,790
Comoros	N/A	N/A	N/A	5.2	15.5	-	N/A
Djibouti	20.19	906.00	22.3	5.2	15.5	2,526	238,241,950
Egypt	1020.13	80,410.00	12.7	5.2	15.5	3,557	9,829,450,112
Iraq	65.82	33,226.00	2.0	5.2	15.5	2,489	1,784,573,493
Jordan	115.86	6,249.00	18.5	5.2	15.5	3,149	1,590,079,196
Kuwait	58.15	4,009.59	14.5	5.2	15.5	3,471	516,698,581
Lebanon	54.63	4,942.44	11.1	5.2	15.5	3,181	458,491,537
Libya	187.46	6,423.00	29.2	5.2	15.5	3,211	2,348,557,374
Mauritania	232.61	3,296.96	70.6	5.2	15.5	2,791	4,133,142,591
Morocco	361.35	32,245.00	11.2	5.2	15.5	3,334	3,161,191,946
Oman	43.81	3,295.00	13.3	5.2	15.5	-	521,745,614
Palestine	32.74	4,231.08	7.7	5.2	15.5	2,032	178,944,216
Qatar	42.03	1,732.72	24.3	5.2	15.5	-	694,301,005
Saudi Arabia	234.44	28,376.36	8.3	5.2	15.5	3,122	1,418,887,088
Somalia	198.25	13,039.80	15.2	5.2	15.5	1,696	1,724,615,689
Sudan	1922.34	33,975.59	56.6	5.2	15.5	2,346	31,547,590,087
Syria	271.03	25,083.71	10.8	5.2	15.5	3,106	1,934,334,254
Tunisia	126.59	10,673.60	11.9	5.2	15.5	3,362	1,159,832,663
UAE	496.65	8,400.00	59.1	5.2	15.5	3,215	8,004,922,725
Yemen	104.20	23,830.00	4.4	5.2	15.5	2,185	327,464,172
Arab Countries							**70,252,788,832**

Source: Authors' calculations, based on AOAD (2012)*, and Afshin et al. (2015)**, BCFN (2012)***, and UN (2013)

Units are as follows - MT: metric tons; m³: cubic meters; kg: kilograms.
Per capita availability = total availability / total population (both figures 2011 estimates, from AOAD (2012))
Per capita water saved from red meat reduction = (per capita availability – recommended per capita intake) x water footprint of red meat
Total water saved from red meat reduction = per capita water saved from red meat reduction x total population (2015 estimates from UN (2013), not shown)

percent of deforestation, is the largest single cause of species and biodiversity loss and produces more than 30 percent of global greenhouse gas emissions. It continues to represent the single greatest cause of land-use change" (Moomaw et al., 2012). Human diets have come to depend on a concentrated basket of foods, as just 30 crops now provide 90 percent of all food energy intake at a global level (Johnston et al., 2014), with negative implications for our dietary diversity, biodiversity, and the sustainability of our environment.

SUSTAINABLE FOOD PRODUCTION FOR FARMING HOUSEHOLDS IN ARID ZONES: THE CASE OF SIDI-BOUZID IN TUNISIA

Ahmed Ferchiou, Florence Jacquet and Hatem Belhouchette

Arid zones make up more than 40 percent of the total land where more than a third of the world population resides. Agricultural ecosystems in dry areas have undergone significant socio-economic transformations to meet increasing food needs. Despite the improvements in living standards of local populations thanks to this evolution, their environment has been irreversibly damaged in several situations.

Beyond the question of agricultural productivity, these societies now face a more complex challenge in trying to guarantee sustainable food production – consider production, food-consumption and natural resources. Questions arise concerning this challenge and the actions to be taken under climatic and socioeconomic pressures that pose a threat to population viability in arid zones.

We consider the case of Tunisia, whose population doubled between 1960 and 1990, worsening the trade balance due to food demand increase in the late 80's. As a result, Tunisia adopted the structural adjustment program in 1986 to emphasize on agricultural reform, which reflected the government tendency towards liberalism and supported an agricultural modernization process based on the exploitation of natural resources and technical improvements causing significant agrarian transformation. One such adjustments was the privatization of land which led to a growing shortage of rangeland and the transformation of a pastoral society into an agro-pastoral society and to the introduction of lands into the economic cycle. There had also been a progressive liberalization of the hydro-agricultural resources, therefore further underlining a two-tier Tunisian agriculture: a productive capitalist agriculture vs. a family-based agriculture. These "productivist" measures have nonetheless made it possible for Tunisia to establish a good position in terms of food security, less than 5 percent of its population being underfed. However, health studies have shown the importance of chronic food-related diseases, suggesting the unsustainability of the Tunisian diet.

To illustrate these transformations and the resulting threats, we chose Sidi-Bouzid, a Tunisian rural arid zone where the Tunisian revolution was triggered in 2010. The area has undergone considerable agricultural development since the late 80's through intensification, using irrigation and the privatization of land ownership. This has neither led to the development of other sectors, nor made up for the low diversification of the economic fabric. Sidi-Bouzid suffers from rural depopulation due to job seeking in urban areas, at a time when the area is going through a farm labour recruitment crisis. The agricultural sector, which employs more than 40 percent of the active population of Sidi-Bouzid, faces a crisis caused by the overexploitation of hydro-agricultural resources and rangelands, which shows the limits of Sidi-Bouzid's rural development. It has been made worse by climatic uncertainties that indicate a probable 7mm decrease in annual rainfall and a 1°C temperature rise by 2020.

The changes realised at the level of production structures have generated a certain disintegration of rural society, moving from a homogeneous system of pastoral producers with low productivity and self-produced diet to a mixed agro-pastoral system with higher productivity but a market-dependent diet.

Several responses to the challenges of structural change regarding globalization have been observed, the most striking of which were irrigation, pluriactivity, size decrease of herds and market-based diet.

To identify and study the different components of this system, an integrated assessment must be realised by analysing the behaviour of farming households at the level of the three significant issues at stake.

The first relates to the farming household's monetary income, which includes farm and off-farm incomes; the second relates to family labour (including that of women). The third issue represents the household's consumption, which includes self-consumption and other means of food supply. Based on this approach, farming households in Sidi-Bouzid can be classified as follows:

- **Producers - consumers households:** associated with the extensive dominant rainfed production system, they show high levels of self-consumption and their source of income is sheep farming. Highly exposed to climatic and market vagaries and most affected by the deterioration of rangelands, the contribution of family labour on the farm is more significant during rainy

years, forcing members of the household to look for additional income during dry periods when agricultural income comes exclusively from livestock (products and decapitalization).

- **Producers - consumers - traders households:** associated with semi-intensive production systems, their source of income is irrigated market gardening. Less exposed to climatic vagaries thanks to their access to water through surface wells and irrigated public perimeters for the most part. They are most vulnerable to market vagaries and to the overexploitation of water. The contribution of family labour on the farm is more frequent but with a significant recourse to hired labour. These households produce for the market while showing a considerable share of self-consumption and strong crop diversity.

- **Producers-traders households:** associated with an intensive production system, they are hardly faced with climatic vagaries and their source of income is irrigated fruit arboriculture. Their production systems rely on permanent and seasonal hired labour and on the market, with an opening onto international markets. Mostly from other provinces than Sidi-Bouzid, these producers, whose access to natural and financial resources has been encouraged by the state and they are considered as entrepreneurs rather than farmers. They are marginal, but based in zones with strong natural potential (water and soil). They require a significant mobilization of hydro-agricultural and financial resources.

These three models of rural households coexist within one single territory. We consider a set of solutions that must be defined and targeted for each model, via monitoring of resource use for trader-farming households, development of an industrial agribusiness fabric for rainfed crops of trader-consumer households, and promotion of crops diversity for irrigating households.

Other transverse or national solutions can also be envisaged, like promotion of the consumption of nutritionally "efficient" products, creation of farm work service cooperatives.

After the revolution, the authorities showed an increased interest in food-production sustainability. The state, which has always maintained an active profile must:

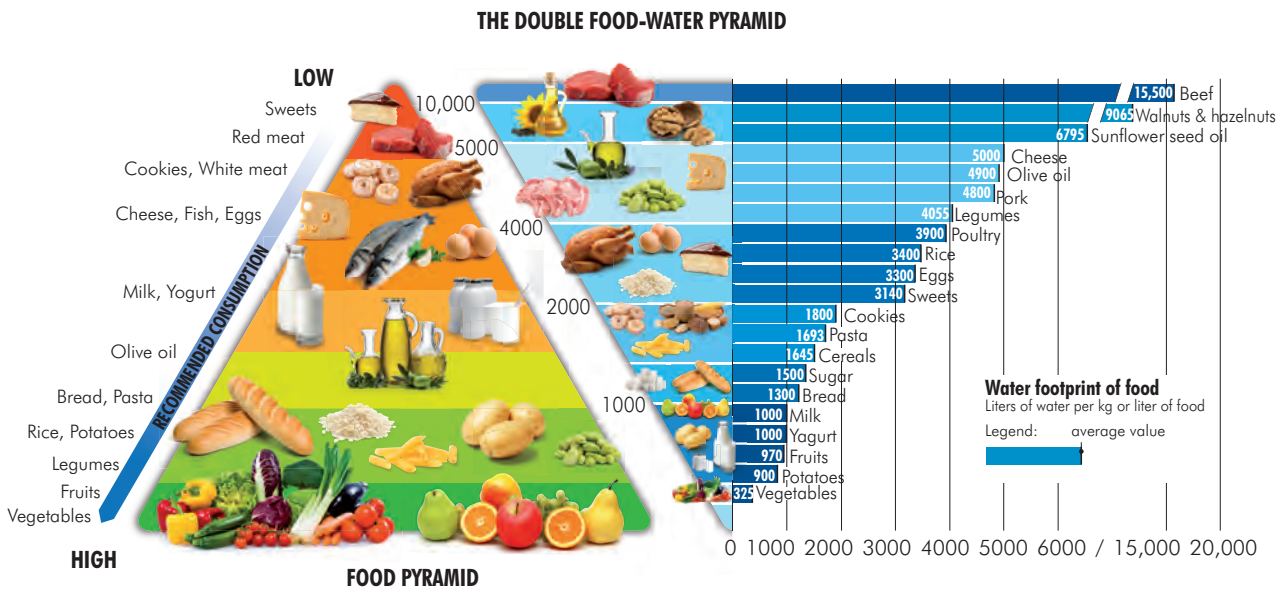
- Consider actors' diversity in Sidi-Bouzid where

the first and second systems out of the three systems as describe above (family-based) have a significant geographical importance, and the second and third systems have a significant economic position (most productive systems).

- Design reforms connecting the various actors within the different sectors. Just like the three achievement goals, three types of indicators will serve as a simulation base for each "farm-household" system: production indicators like household work productivity, self-consumption value, and farm performance. Consumption indicators like food diversity, which we consider as a way to approach the overall diet quality, caloric input, and the quantity consumed per "recommended" product. Finally, natural resources use indicators such as agricultural water consumption, soil water conservation and soil erosion which are key issues in dryland areas.

Dr. Ahmed Ferchiou, Researcher, CIHEAM-IAMM and UMR-Moisa, Dr. Florence Jacquet, Research Director, INRA-Montpellier and UMR-Moisa, Dr. Hatem Belhouchette, Instructor and Researcher, CIHEAM-IAM-Montpellier and UMR-System.

FIGURE 2 **THE DOUBLE FOOD-WATER PYRAMID: MIRRORING FOOD CONSUMPTION WITH RESPECTIVE WATER FOOTPRINTS**



Source: Antonelli and Greco (2013)

BCFN FOUNDATION © 2014

Considerable research has examined the environmental footprint of various foods with respect to water, land and greenhouse gas emissions, most often within developed country food production systems. In many cases, the evidence suggests that more nutritionally sound diets have a lower environmental impact (Barilla Center for Food and Nutrition, 2010). For example, while most Arab countries consume more than three times the recommended amount of meat, they seem to neglect the fact that meat production requires significantly more water and energy resources to produce than an equivalent volume of grains with similar nutritional value, largely because of the feed volumes needed to raise livestock. Capone et al.(2012) note that "[t]he livestock sector is considered to be one of the major players in the reduction of biodiversity since it is one of the primary drivers of, inter alia, deforestation, land degradation, pollution, climate change, the erosion and sedimentation of coastal areas and the facilitation of alien species invasion" Industrially-produced meat, in particular, tends to have a higher negative environmental impact in terms of elevated greenhouse gas emissions and greater demands on cereal stocks and freshwater reserves than either range-based meat or plant-based products (HLPE, 2011). The High Level Panel of Experts on Food Security and Nutrition (2011) notes that the high environmental costs of animal foods are often not included in the prices paid by consumers, leading to their over-consumption. Recommendations have, therefore, called for reduced meat consumption in favor of a plant-based diet, or for protein sources that can be produced with a lower environmental footprint.

A preliminary calculation illustrates the potential environmental benefit of better adherence to food-based dietary guidelines that recommend lower red meat intake by most Arab countries. Current availability of red meat exceeds the nutritionally recommended level of 5.2 kg/capita/year in all Arab countries (Afshin et al., 2015), with the exception of Iraq and Yemen (AOAD, 2012). By reducing red meat consumption to nutritionally recommended levels (without replacement of that consumption by other foods), Arab countries could enjoy a more nutritious diet and jointly reduce their virtual water footprint by more than 70 billion m^3 per year and thus follow a more sustainable food consumption pattern, as shown in Table 4. Calculations could be made to determine the

joint nutritional and environmental benefits of reduced meat consumption in terms of greenhouse gas emissions and energy and land use.

The "Double Food-Water Pyramid" in Figure 2 is a useful illustration of the water footprint of various food groups. Red meat accounts for the highest water footprint (15.5 m^3/kg or 15,500 liters/kg), followed by other protein-rich foods, such as cheese, fish, eggs, and dairy products (2-5 m^3/kg), whereas starch-based products, fruits, and vegetables require the least amount of water per kg consumed (<1 m^3/kg). Hence, lowering the consumption of red meat and increasing intake of nutrient-dense foods (fruits, vegetables, and legumes) will result in the double effect of more nutritionally adequate and sustainable food consumption and lower environmental impact evident by reduced water footprint of the recommended foods

Other environmental impacts occur not only at the production level, but also at the level of the consumer (Capone et al., 2012). Notably, high levels of food loss and waste totaling one-third of global food production exacerbate the negative impact on the environment. For example, food loss and waste disposed of in landfills directly occupies land resources and contributes to water pollution, while also consuming natural resources that are no longer available for production (soil, water, energy, and greenhouse gas emissions) (Moomaw et al., 2012). In addition, the disposal of food losses and waste and other organic material represents between 40-70 percent of municipal solid waste in Arab countries which could, in fact, be used as a source of agricultural compost or biogas (El-Sherbiny et al., 2011).

Addressing sustainable food consumption for food security requires a broadening of current thinking, away from a solely economic focus and toward a broader understanding of the value of ecosystems services and the costs of environmental damage, sub-optimal nutritional health, and food waste (UK DEFRA, 2013). For example, nutritionists recommend consuming fish twice per week as a good source of protein to replace red meat, but the environmental impacts of such a recommendation are less clear. Text Box 1 highlights the environmental implications of fish consumption, as an example demonstrating the importance of thinking beyond strictly economic concerns.

B. Food accessibility and sustainable food consumption

Sustainable consumption patterns are influenced by economic access to food in several ways. First, a sustainable and nutritionally adequate food basket must be economically accessible. A perfectly nutritious food basket that has zero net environmental impact is not useful to individuals who cannot afford it or otherwise access it through entitlements programs.

The consumption patterns of some individuals must not prevent the food access of others. In fact, current food consumption trends among certain population groups can have a negative effect on food security by undermining others' access to food and, thus, should be deemed unsustainable. Moomaw et al. (2012) explain that overconsumption of cereals in developed countries for use as animal feed and inefficient biofuels pushes up global prices, which has a negative effect on poorer, developing countries' access to food.

Finally, sustainable consumption must ensure that food producers – whether farmers, fishermen, or workers within the food production supply chain – are fairly compensated for their efforts. That compensation, then, allows producers to access their own food basket. On the other hand, consumption that reinforces economic exploitation is inherently unsustainable.

C. Food utilization and sustainable food consumption

Food utilization is rooted in its nutritional value, safety, and cultural acceptability of food. Recommendations for sustainable consumption should take into consideration the sustainability aspects in addition to the nutritional value of food, given the direct impact of nutrient intake on health outcomes. In addition, the social value of food – contained in knowledge and practices of individuals, households, and social groups – directly informs food consumption patterns. Efforts to increase knowledge of how to select nutritionally recommended and environmentally sustainable foods that return a

BOX: THE ENVIRONMENTAL SUSTAINABILITY OF FISH CONSUMPTION

The demand for and use of fish resources in Arab countries demonstrates the tension between food availability and environmental sustainability.

The Arab world is rich in fish resources, and was a net exporter of fish (by value) in 2012 and 2013. Production comes from wild catch and farm operations, and is dominated by three countries: Egypt, Morocco, and Mauritania (Al-Zadjali, 2013). Al-Zadjali (2013) argues that the fisheries sector could be an important source of high-quality and relatively inexpensive animal protein for the Arab food basket, thereby contributing to food security. Arab countries generally have fish and seafood supply at per capita levels below the global average, with the exceptions of Egypt, Oman, and UAE (see Table).

TABLE **NATIONAL PER CAPITA FISH AND SEAFOOD SUPPLY (KG/CAPITA/YEAR)**

Country	2010	2011	2012	2013
Algeria	3.81	3.94	3.99	3.92
Bahrain	-	-	-	-
Comoros	-	-	-	-
Djibouti	1.20	1.18	-	-
Egypt	22.45	22.13	-	-
Iraq	2.65	3.05	-	-
Jordan	6.66	6.39	-	-
Kuwait	16.04	15.36	-	-
Lebanon	10.37	10.05	-	-
Libya	-	-	-	-
Mauritania	9.70	9.45	-	-
Morocco	13.49	13.32	-	-
Oman	27.77	26.93	24.58	22.43
Palestine	-	-	-	-
Qatar	-	-	-	-
Saudi Arabia	8.25	8.1	-	-
Somalia	-	-	-	-
Sudan	1.79	-	-	-
Syria	-	-	-	-
Tunisia	12.89	12.74	-	-
United Arab Emirates	25.47	24.09	-	-
Yemen	3.03	2.57	2.51	2.46
Arab Countries	**10.93**	**10.82**	-	-
World	**18.78**	**18.93**	-	-

Source: FAOStat, 2015

The contribution of the fisheries sector to food security in the Arab world is limited by its underdevelopment and natural limits, evidenced by overfishing and degradation of fish stocks (Al-Zadjali, 2013). Unfortunately, natural degradation is a global phenomenon in which "75 percent of the world's major marine fish stocks are either depleted, overexploited or being fished to their biological limit to supply this rising consumption" (Moomaw et al., 2012).

Recommendations for Arab countries to eat more fish protein may be in tension with high and rising pressures on global stocks. Although fish consumption is often proposed as a more nutritious and environmentally friendly alternative to red meat consumption, a rapid increase in demand for fish could lead to increasing pressure on wild marine fish stocks that are already dangerously over-exploited. It could also lead to a greater reliance on aquaculture, which can require significant water, feed, and energy inputs that may offer little to no improvement over livestock systems (McMahon, 2014). The environmental implications of greater fish consumption thus require further investigation.

fair economic value to producers seek not only to adjust consumption patterns, but also to improve the long-term availability of food and the accessibility of important actors within the food system.

D. Food stability and sustainable food consumption

Stability applies to food availability, accessibility, and utilization. Accordingly, stability is relevant to food consumption in each of the previous three dimensions. For example, unstable availability of household food production may push households to adopt unsustainable farming practices, as is seen in regions where declining harvests lead to increasing and environmentally unsustainable use of chemical fertilizers. Unstable access to food through income shocks may push households to shift their consumption to less optimal food baskets, with negative implications for their nutritional status and health.

Food security programming in emergency situations that addresses the dimensions of food availability, accessibility, and utilization should consider the nutritional adequacy of the diet and its sustainability. For example, provision of sufficiently diverse food baskets (availability and accessibility) can satisfy nutritional requirements (utilization), particularly if food assistance can be sourced from local communities to support the incomes of local farmers and producers (accessibility). Sourcing from local production may also incur lower environmental costs than importing food products from afar, which may be subject to higher rates of food loss if supply chain systems are inefficient or subject to disruption.

IV. CONCLUSION AND RECOMMENDATIONS

Sustainable food consumption and sustainable diets that are nutritionally adequate may have positive impacts on: public health through reductions in diet-related chronic disease and nutrient deficiencies; environmental sustainability through the mitigation of climate change and reduced depletion of natural resources; economic sustainability through higher employment, trade opportunities, and incomes; and social inequalities through reduced gaps in health and incomes. Other positive impacts may include improved physical well-being, animal welfare, cultural and social diversity, and knowledge sharing (Johnston et al., 2014). Sustainable food consumption and sustainable diets are governed by four major elements or concerns: food consumption and eating patterns, well-being and health, natural resources, and economic forces.

Hence, recommendations for more sustainable food consumption patterns in Arab countries call for adopting a sustainability lens, considering sustainable food consumption and production simultaneously, adopting appropriate public policies to support sustainable food consumption, and revising food-based dietary guidelines to promote sustainable food consumption in Arab countries.

SUSTAINABLE FOOD SYSTEMS: FAO'S PERSPECTIVE

"A food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes" (High Level Panel of Experts on food security and nutrition, 2012). A sustainable food system delivers food security and nutrition in a way that preserves the economic, social and environmental bases for future generations. It is a holistic concept that is consumer-driven, respects the capacities of natural ecosystems, and considers all aspects and phases of food from production to consumption.

The need for sustainable food systems lies in a finite and shrinking natural resource base, a global population estimated to surpass 9 billion by 2050, and the associated growth in demand for sufficient, safe and nutritious food. Sustainable food systems, therefore, connect issues of climate change, biodiversity, water, food and nutrition security, right to food, food distribution and diets.

The issue is especially complex in the Near East and North Africa (NENA) region. Water is the binding constraint for agriculture in the NENA, as internal renewable water resources in most countries fall well below the threshold of water scarcity (1,000m^3/capita/year). Food production needs to make use of scarce natural water and land resources in environmentally, economically, socially and culturally sustainable ways, taking special consideration of the needs of smallholder farmers who hold 85 percent of the agricultural land. There are already indications that the current production systems in the region are approaching their sustainability limits. The region, which already imports at least 50 percent of its food, will continue relying on international markets to feed a population estimated to grow by over 50 percent by 2050.

Being a net food importer closely links the NENA region to the context of global food systems in terms of sustainable consumption. Consumption patterns in the NENA have widely shifted in the past decades, towards more globalized food production and retail systems, yet with less variety in available foods and less diverse diets. Urban populations are projected to reach 70 percent by 2050, and already depend on retail markets for greater consumption of resource-intensive products. Per capita consumption of milk, meat, sugar and fat has increased dramatically over the past three decades. Cereal consumption remains much higher than the world average, despite high import dependency ratios and the limited natural resource base to produce. These shifts underlie a triple burden of malnutrition – nearly 25 percent of the population is obese, yet micronutrient deficiencies persist in both affluent and low income countries, and the number and proportion of chronically under-nourished have increased since

A. Adopt a sustainability lens in recommending food consumption patterns

Food consumption patterns should be made sustainable, and all governments should incorporate sustainability into their policies, programs, and strategic plans addressing food consumption patterns in their countries. There is no common consensus as to what is optimally sustainable food consumption, so an overarching vision of what 'good' might look like across social, environmental, and economic long-term interests – and identifying the trade-offs to achieve sustainable food consumption – should be adopted by all Arab countries. In order to

2000. Policy, education, and information need to be balanced with preserving consumers' choice of healthy and culturally appropriate food.

Despite the challenges, win-win solutions exist through the support of FAO and partners for better environmental, socio-economic, and nutritional outcomes. Taken together, countries are supported in achieving sustainable food systems.

The FAO principles and approaches for sustainable food and agriculture support sustainable crop production intensification to produce more with the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services. The codes and guidelines provided by Good Agricultural Practices enhance food safety and quality, strengthen market opportunities, and preserve natural resources. Climate Smart Agriculture promotes production systems that sustainably increase productivity, promote resilience or adaptation, mitigate the effect of greenhouse gases, and enhance achievement of national food security and development goals.

To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save (FAO Save and Grow)

On the other hand, the Second International Conference on Nutrition put forth a declaration and plan with actionable recommendations for sustainable food systems through a lens of healthy diets and the interlinked issues of production, gender, food chain efficiency, policies and natural resources management. Likewise, work on sustainable diets promotes food choices that are less resource intensive but deliver nutrition of similar or better value, are culturally acceptable, accessible, economically fair and affordable.

Growth of agrifood systems must be inclusive, must target objectives beyond production (including efficiencies along the food chains) and must promote sustainable practices and diets (FAO-UNEP Sustainable Food Systems Programme)

Reducing food losses and waste is often considered a quick-win solution to tackle inefficiencies in food systems, preserve the economic and nutritional value of food, and preserve the natural resources used to produce, distribute and market food. FAO's Global Initiative for Food Loss and Waste Reduction provides strategic support, technical guidance, and a platform for exchange and partnership, and a NENA Regional Strategic Framework supports new and ongoing activities across the region.

FAO.

achieve such sustainable food consumption, governments should also base all policies, programs, and strategic plans addressing food and nutrition security on sustainable consumption patterns. Therefore, sustainable food consumption should be incorporated into the four dimensions of food security: availability, accessibility, utilization, and stability. Governments and ministries should engage in policy dialogue about the direct connection between sustainable diets and food security, allocate sufficient funding for programs in all four dimensions of food security, and be held accountable for achieving positive and sustainable environmental outcomes in the full range of food security programs.

B. Consider sustainable food consumption and production simultaneously

Consumption patterns are directly related to food production systems, as they both determine the types of food produced, and respond to the types of food available on the market. Accordingly, focusing on recommendations regarding what type of food to consume alone will not lead to adopting sustainable diets, nor will it enhance food security if the food supply value chain does not provide better food choices. The Arab region must shift focus from producing or importing enough food in the form of bulk calories to delivering nutritious food that meets human nutritional needs. In Arab countries, programs

and policy interventions to support agriculture and rural development must be designed with an eye toward which type of food should be produced and consumed, its nutritional value, economic accessibility by consumers, and environmental and social sustainability.

C. Adopt public policies that support sustainable food consumption and discourage waste

The close link between sustainable food consumption and food security demands that policymakers in Arab countries act promptly to address current and emerging problems and inefficiencies that are leading to unsustainable food consumption. Policymakers should reduce or eliminate perverse agricultural **subsidies** that encourage unsustainable food production or that adversely affect food security; apply **tax incentives** that make foods with negative nutritional impacts or adverse environmental effects relatively more expensive; launch **public awareness** campaigns on sustainable food consumption; **regulate** marketing and advertising for unhealthy and unsustainably produced foods; **invest in agricultural technologies and infrastructure** to reduce food losses and waste; and support **public procurement** reforms in favor of more sustainable food consumption patterns.

Though government leadership is critical, government action will not be sufficient to bring about sustainable consumption in Arab countries. Action must also be taken by the private sector (including food and agricultural producers and processors), non-governmental actors, civil society, and consumers alike.

D. Revise existing food-based dietary guidelines to promote sustainable consumption in Arab countries

Existing Arab food-based dietary guidelines have traditionally been based on nutritional goals, and have not explicitly focused on either the cost of the recommendation or its environmental sustainability as it relates to agricultural production, processing, and distribution (see Appendix IV). To make current food consumption patterns more sustainable, food-based dietary guidelines can be revisited for their nutritional impact as well as the

sustainability considerations for each guideline. The affordability, environmental footprint, and ethical considerations of all foods should be assessed, and recommendations adjusted accordingly. To date, Arab countries have not yet undertaken such efforts but should take immediate steps to incorporate sustainability considerations into their guidelines. Efforts should be invested in making such recommendations culture-specific and tailored to the traditions, dietary needs, and eating habits of the Arab population.

In conclusion, ongoing joint efforts by the FAO and CIHEAM around the Mediterranean diet may provide a pathway for studying the sustainability of food consumption patterns in Arab countries. Also, Arab countries can consult and build on established methodologies and indicators to assess dietary sustainability, by measuring affordability and environmental footprints of the endorsed guidelines and recommending different food consumption patterns.

APPENDIX I

STAGES OF THE NUTRITION TRANSITION

STAGE 1

- Average diets low in calories and micronutrients
- Food sourced from smallholder and subsistence farms
- Marked by high prevalence of undernutrition and infectious disease

STAGE 2

- Average diet offers adequate access to calories but inadequate diversity or access to micronutrients
- Marked by undernutrition and increasing prevalence of overweight, obesity, and non-communicable diseases

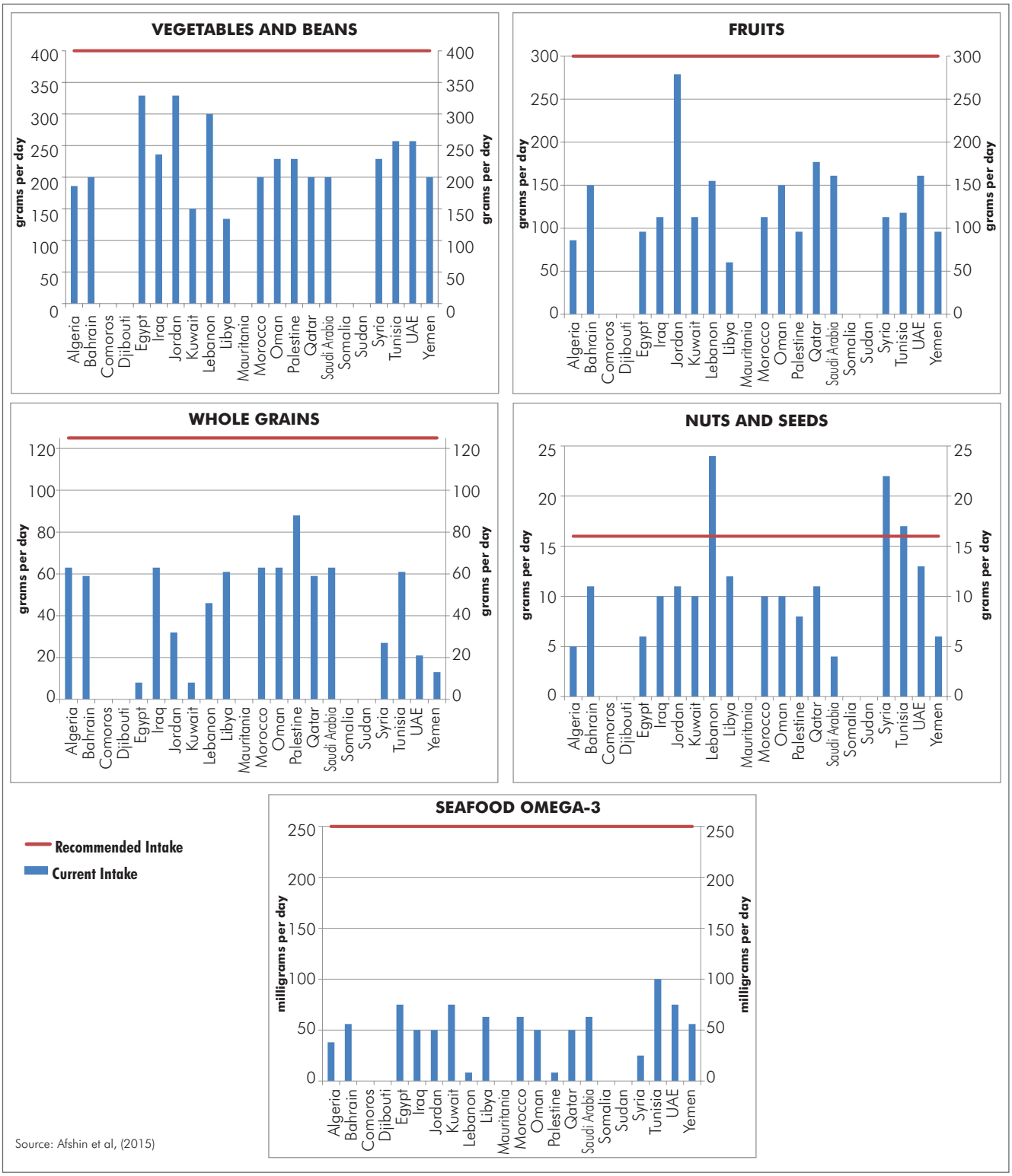
STAGE 3

- Average diet is energy dense and rich in fat, salt, and refined carbohydrates
- Food supply systems are diverse and abundant
- Marked by high prevalence of diet- and lifestyle-related health problems linked to obesity

Source: Popkin, 2000

APPENDIX II

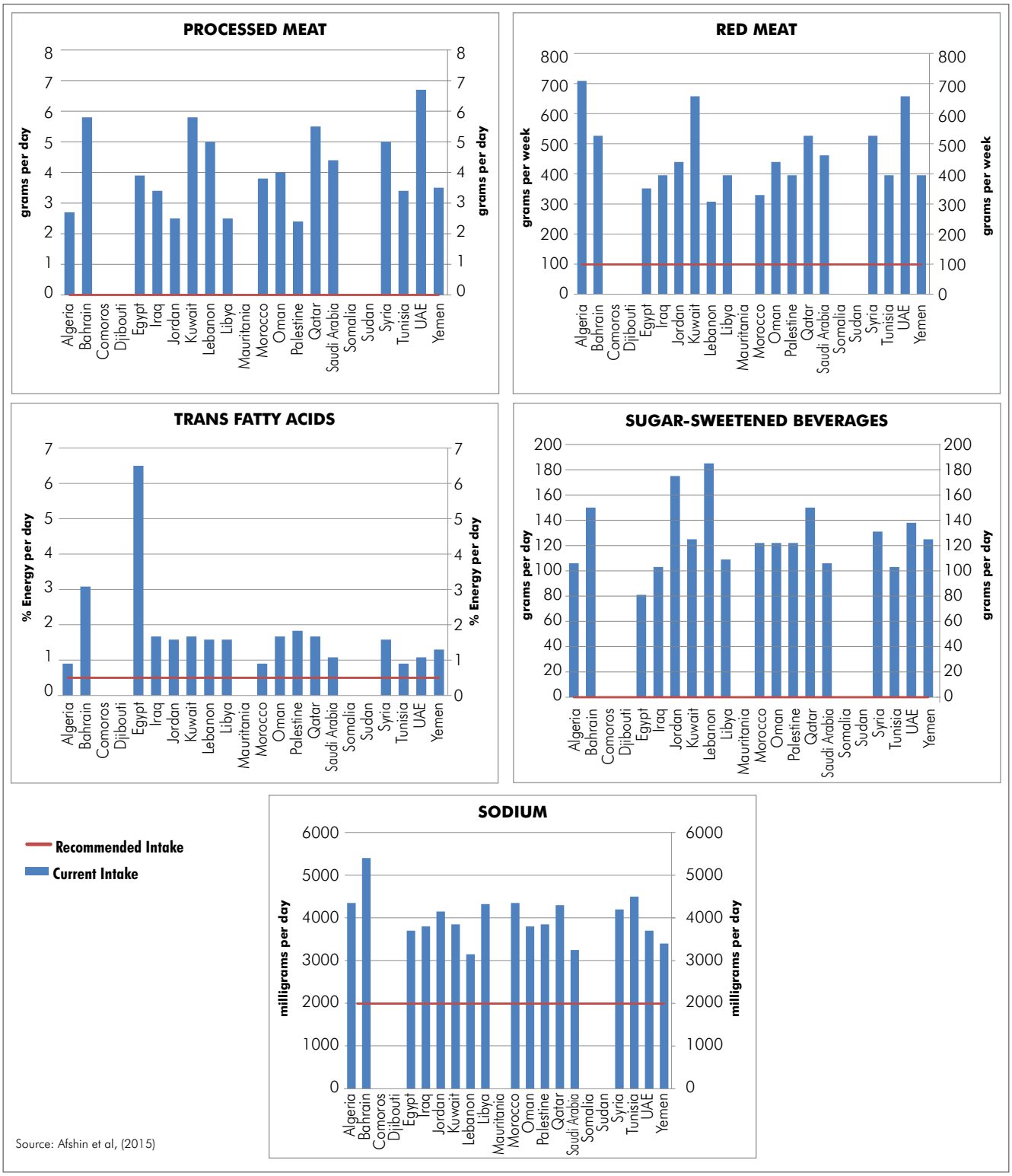
NATIONAL CONSUMPTION AND RECOMMENDED INTAKES OF PROTECTIVE FOOD COMPONENTS IN ARAB COUNTRIES



Source: Afshin et al, (2015)

APPENDIX III

NATIONAL CONSUMPTION AND RECOMMENDED INTAKES OF HARMFUL FOOD COMPONENTS IN ARAB COUNTRIES



Source: Afshin et al, (2015)

APPENDIX IV

GUIDELINES FOR A HEALTHY DIET FOR THE EASTERN MEDITERRANEAN REGION

The WHO Regional Office for the Eastern Mediterranean (2013) has developed user-friendly guidelines for a healthy diet, applicable to the countries of the Eastern Mediterranean. The guidelines are designed to inform overall patterns of eating for the general public, and are food-based rather than nutrient-based so as to improve public understanding and adherence.

1. Maintain a healthy body weight.
2. Be active.
3. Limit intake of fats and oils.
4. Limit intake of sugars, especially sweetened foods and beverages.
5. Limit salt intake.
6. Eat a variety of foods every day.
7. Eat cereals, preferably whole grains as the basis of most meals.
8. Eat more vegetables and fruit every day.
9. Eat legume-based dishes regularly and choose unsalted nuts and seeds.
10. Eat fish at least twice a week.
11. Consume milk/dairy products daily (preferably low fat).
12. Choose poultry and lean meat.
13. Drink lots of clean water.
14. Eat clean and safe food.

REFERENCES

Afshin, A., Micha, R., Khatibzadeh, S., Fahimi, S., Shi, P., Powles, J. and Mozaffarian, D.(2015). "The impact of dietary habits and metabolic risk factors on cardiovascular and diabetes mortality in countries of the Middle East and North Africa in 2010: a comparative risk assessment analysis." British Medical Journal Open, 5:e006385.doi:10.1136/bmjopen-2014-006385.

Ahmed, G., Hamrick, D., Guinn, A., Abdulsamad, A. and Gereffi, G. (2013). Wheat value chains and food security in the Middle East and North Africa region. Duke University Center on Globalization, Governance, and Competitiveness, Durham, NC.

Al-Zadjali, T. (2014). "Developing Fish Resources in the Arab World." In Food Security Challenges and Prospects: 2014 Report of the Arab Forum for Environment and Development. (eds. Sadik, A.K., El-Solh, M. and Saab, N.) Arab Forum for Environment and Development, Beirut.

Antonelli, M. and Greco, F. (2013). The water we eat: what virtual water is and how we consume it. Edizioni Ambiente srl, Milano. http://www.barillacfn.com/PDF/Water-we-eat.pdf [accessed May 12, 2015].

Arab Organization for Agricultural Development (AOAD) (2012). Arab Agricultural Statistics Yearbook, Vol. 32. AOAD, Khartoum.

Barilla Center for Food and Nutrition. (2010). Double pyramid: Healthy food for people, sustainable food for the planet. Barilla Center for Food and Nutrition, Parma. http://www.barillacfn.com/wp-content/uploads/2010/06/pp_doppia_piramide_alimentazione_eng.pdf [accessed May 5, 2015].

Bernstein, M.A., Tucker, K.L., Ryan, N.D., O'Neill, E.F., Clements, K.M., Nelson, M.E., Evans, W.J. and Fiatarone Singh, M.A. (2002). "Higher dietary variety is associated with better nutritional status in frail elderly people." Journal of the American Dietetic Association, 102: 1096–1104.

Breisinger, C., van Rheenen, T., Ringler, C., Pratt, A.N., Minot, N., Aragon, C., Yu, B., Ecker, O. and Zhu, T. (2010). "Food security and economic developing in the Middle East and North Africa: Current state and future perspectives." IFPRI Discussion Paper 00985. International Food Policy Research Institute, Washington, D.C.

Capone, R., Lamaddalena, N., Lamberti, L., Elferchichi, A. and El Bilali, H. (2012). "Food consumption patterns and sustainable natural resources management in the Mediterranean region." Journal of Food Science and Engineering, 2: 437-451.

El-Sherbiny, R., Gaber, A. and Riad, M. (2011). "Waste Management." In Green Economy – Sustainable Transition in a Changing Arab World: 2011 Report of the Arab Forum for Environment and Development. (eds. Abaza, H., Saab, N. and Zeitoon, B.) Arab Forum for Environment and Development, Beirut. http://www.afedonline.org/Report2011/main2011.html[accessed May 5, 2015].

Food and Agriculture Organization (FAO) (2015). FAOStat. http://faostat3.fao.org/home/E [accessed May 5, 2015].

Food and Agriculture Organization (FAO) (2014) FAO Statistical Yearbook 2014: Near East and North Africa Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome.

Food and Agriculture Organization (FAO) (2012). "Sustainable diets and biodiversity: Directions and solutions for policy, research and action." In Proceedings of the International Scientific Symposium on Biodiversity and Sustainable Diets: United Against Hunger. (eds. Burlingame, B. and Dernini, S.) Food and Agriculture Organization, Rome. http://www.fao.org/docrep/016/i3004e/i3004e.pdf [accessed March 19, 2015].

High Level Panel of Experts on Food Security and Nutrition (HLPE) (2011). Price volatility and food security: A report by the High Level Panel of Experts on Food Security and Nutrition. Committee on World Food Security of the Food and Agriculture Organization, Rome. http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE-price-volatility-and-food-security-report-July-2011.pdf.

Hollis, J.H. and Henry, J.K. (2007). "Dietary variety and its effect on food intake of elderly adults." Journal of Human Nutrition and Dietetics, 20: 345–351.

Horwath, C., Kouris-Blazos, A., Savige, G. and Wahlqvist, M.L. (1999). "Eating your way to a successful old age, with special reference to older women." Asia Pacific Journal of Clinical Nutrition, 8: 216–225.

Johnston, J., Fanzo, J. and Cogill, B. (2014). "Understanding sustainable diets: A descriptive analysis of the determinants and processes that influence diets and their impact on health, food security, and environmental sustainability." Advances in Nutrition, 5: 418-429.

McMahon, P. (2014). Feeding Frenzy. Greystone Books, Vancouver.

Meerman, J., Garrett, J. and Wüstefeld, M.(2013). "Development partners and country programming in nutrition and agriculture." SCN News, 40: 10-18.

Micronutrient Initiative. (2009). Investing in the future: A united call to action on vitamin and mineral deficiencies, global report 2009. Micronutrient Initiative, Ottawa. http://www.unitedcalltoaction.org/documents/Investing_in_the_future.pdf.

Moomaw, W., Griffin, T., Kurczak, K. and Lomax, J. (2012). The critical role of global food consumption patterns in achieving sustainable food systems and food for all: A UNEP discussion paper. United Nations Environment Programme, Division of Technology, Industry and Economics, Paris.

Popkin, B. (2000). "Urbanization and the nutrition transition." IFPRI Brief, 7. International Food Policy Research Institute, Washington, D.C.

Sibai, A.M., Nasreddine, L, Mokdad, A.H., Adra, N., Tabet, M. and Hwalla, N.(2010). "Nutrition Transition and Cardiovascular Disease Risk Factors in Middle East and North Africa Countries: Reviewing the Evidence." Annals of Nutrition and Metabolism, 57:193-203.

United Kingdom Department for Environment, Food and Rural Affairs (UK DEFRA) (2013). Sustainable consumption report: Follow-up to the Green Food Project. https://www.gov.uk/government/publications/sustainable-consumption-report-follow-up-to-the-green-food-project [accessed March 18, 2015].

United Nations (UN). (n.d.) "Food security and sustainable agriculture."http://www.un.org/en/sustainablefuture/food.asp[accessed March 13, 2015].

United Nations, Department of Economic and Social Affairs, Population Division (UN) (2013). World Population Prospects: The 2012 Revision, DVD Edition. United Nations, New York.

United Nations, Economic and Social Commission for Western Asia (UN-ESCWA) (2015). Pathways towards food security in the Arab region: An assessment of wheat availability. UN-ESCWA, Beirut. http://www.escwa.un.org/information/publications/edit/upload/E_ESCWA_SDPD_15_1_E.pdf [accessed May 5, 2015].

World Bank and Food and Agriculture Organization of the United Nations (FAO) (2012). The grain chain: Food security and managing wheat imports in Arab countries. The World Bank Group, Washington, D.C.

World Health Organization (WHO) (2015). "Obesity and overweight."http://www.who.int/mediacentre/factsheets/fs311/en/[accessed February 12, 2015].

World Health Organization (WHO) (2011). Regional strategy on nutrition 2010–2019 and plan of action. WHO Regional Office for the Eastern Mediterranean: Cairo.

World Health Organization (WHO) (n.d.). "Global and Regional Food Consumption Patterns and Trends." http://www.who.int/nutrition/topics/3_foodconsumption/en/ [accessed March 13, 2015].

NOTES

1. FAO defines the Near East and North Africa region as including Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

2. According to the World Health Organization (2015), overweight is defined as a body mass index (BMI) greater than or equal to 25 and less than 30; obesity is defined as a BMI greater than or equal to 30.

3. Food supply is used as a rough proxy for food consumption. Total food supply may overstate consumption, as food may be wasted or otherwise not consumed.

4. Since Food Balance Sheets from FAO do not provide supply or availability data for essential protective (whole grains and seafood omega-3 fatty acids) and harmful (trans fatty acids, sugar-sweetened beverages, and sodium) food components, data on the actual intake or consumption of these foods will be reported as published by Afshin et al., 2015.

ANNEX

FOOTPRINT APPROACH OF FOOD CONSUMPTION AND PRODUCTION PATTERNS IN THE MEDITERRANEAN REGION

Alessandro Galli and Cosimo Lacirignola

I. INTRODUCTION

The provision of food is one of the vital services that nature provides to humanity. Conversely, the exploitation of nature to meet humanity's demand for food is among the major causes of environmental degradation. In the Mediterranean region, immediate action is required to address this issue, which is mainly driven by population and consumption growth. Increasing stress on biological and social systems is put by unsustainable consumption patterns. Food consumption patterns are important drivers of environment degradation such as unsustainable water use, declining soil fertility, marine environment degradation, biodiversity loss, climate change, etc.

The Mediterranean region's development cannot be "sustainable" unless the fundamental common goods are protected and improved. Protection of the coast, sea, climate and air quality, soil and biodiversity, water resources, cultural and landscape heritage, and traditional knowledge are the priorities to be focused on. It is very important to break the joints that make economic development reliant on an intensive exploitation of natural resources and to promote changes in consumption and production patterns (UNEP/MAP, 2005). The current food system delivers low cost food at a high cost to the environment (Kickbusch, 2010) and this cost also includes the environmental impacts of food production, distribution and consumption (Ingram, 2011).

To foster and speed up the transition towards more sustainable food consumption patterns, profound changes in both food consumption and food production are necessary. In this context, the Mediterranean region is at the forefront of the sustainable consumption and production (SCP) approach through the work of the Mediterranean Action Plan[1]. Efforts relating to the promotion of sustainable agriculture should be complemented by consumption-related measures. In fact, developing a sustainable food system requires transformative and simultaneous interventions covering all phases of the food chain, from field to fork. It also requires unprecedented, large-scale behaviour change. Sustainability in food systems means addressing coherently and simultaneously the consumptive demand and productive supply elements by fostering smarter and efficient food production systems and diets.

As a very important factor in critical sustainability issues (Reddy et al., 2009), diets affect different issues ¬(social, cultural, agricultural, environmental, nutritional, and economic), which interact with one another. In fact, in the Mediterranean region, many issues (water, biodiversity loss, scarcity, soil erosion, etc.) are linked to food consumption patterns, and they should be addressed as priorities (Lacirignola and Capone, 2009). The current consumption patterns imply high Ecological, Carbon and Water Footprints of consumption – jointly referred to as the "Footprint Family" (Galli et al., 2012) – and unfavourable national virtual water balances.

The objective of this annex is thus to highlight the pressures that current consumption and production patterns in the Mediterranean area place on both the hydrosphere and the biosphere through the use of Water and Ecological Footprints, respectively.

II. WATER FOOTPRINT

A. Water footprint of consumption in Mediterranean and Gulf countries

Data from Mekonnen and Hoekstra (2011a) show that the Water Footprint (WF) of consumption activities varies widely amongst Mediterranean countries. The WF of national consumption ranges between 1055 m^3/year/capita in Palestine and 2505 m^3/year/capita in Portugal. Northern Mediterranean countries (NMC) present a higher WF of consumption compared to Southern and Eastern Mediterranean Countries (SEMC) and the Balkan countries. The share of the external WF of consumption ranged from 7.3 percent to 91.8 percent in Palestine and Malta, respectively.

When we look only at the blue Water Footprint per capita, many Arab countries in Southwest Asia and North Africa appear on top-ten list: the United Arab Emirates

TABLE 1 **WATER FOOTPRINTS OF CONSUMPTION, WF OF AGRICULTURAL PRODUCTS CONSUMPTION AND NET VIRTUAL WATER BALANCE IN MEDITERRANEAN AND GULF COUNTRIES.**

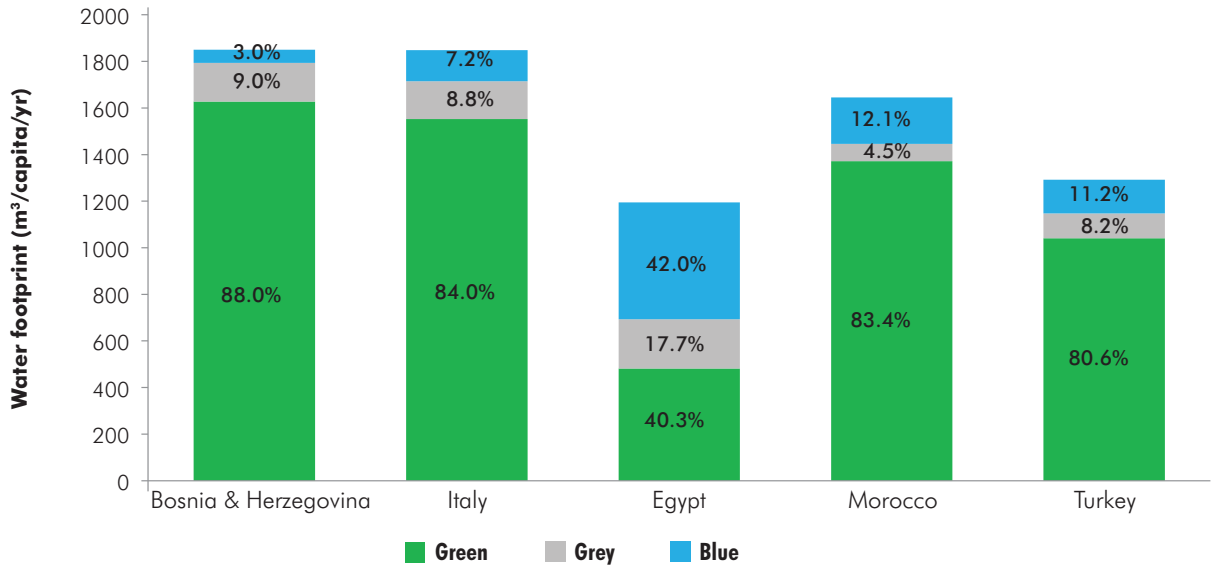
Mediterranean regions	Countries	WF of consumption (m^3/capita/year)	WF of agricultural products consumption (%)	Net virtual water balance (in million m^3/year)
Southern and Eastern Mediterranean countries	Palestine	1,055	93	n.a.
	Egypt	1,341	90	9,051
	Turkey	1,642	92	5,786
	Algeria	1,589	97	17,311
	Morocco	1,725	98	8,337
	Libya	2,038	93	9,559
	Lebanon	2,112	94	4,057
	Syria	2,107	95	-2,267
	Tunisia	2,217	98	-1,666
Balkans	Macedonia	1,348	84	340
	Bosnia and Herzegovina	1,256	95	1,891
	Albania	1,555	86	1,165
	Serbia	2,390	62	-1,780
	Croatia	1,688	93	1,973
	Slovenia	2,012	85	1,415
Northern Mediterranean countries	France	1,786	87	12,822
	Malta	2,216	90	529
	Italy	2,303	89	62,157
	Greece	2,338	91	6,903
	Cyprus	2,385	89	1,173
	Spain	2,461	94	24,203
	Portugal	2,505	94	10,246
Gulf Countries	Saudi Arabia	1,849	92	17,652
	United Arab Emirates	3,136	84	7,627
	Qatar	n.a.	n.a	1,058
	Kuwait	2,072	89	3,036
	Bahrain	n.a.	n.a.	1,124
	Oman	n.a.	n.a.	2,558

Source: Authors' elaboration based on data from Mekonnen and Hoekstra, 2011a. n.a.: No available data

(3rd with 571 m^3/yr), Egypt (4th with 527 m^3/yr), Libya (5th with 511 m^3/yr) and Saudi Arabia (7th with 447 m^3/yr). These values are higher than the global average of blue WF of consumption of 153 m^3/yr per capita (Mekonnen and Hoekstra, 2011b).

Most Mediterranean and Gulf countries depend upon freshwater resources in other countries. Highly water-scarce countries that have a large external water dependency are for example: Malta (dependency 92 percent), Kuwait (90 percent), Jordan (86 percent), United

FIGURE 1 **WATER FOOTPRINTS (GREEN, GREY AND BLUE) OF FOOD SUPPLY IN EGYPT, TURKEY, MOROCCO, ITALY AND BOSNIA AND HERZEGOVINA; 2006.**



Source: Authors' elaboration based on data from Mekonnen and Hoekstra, 2011a

Arab Emirates (76 percent), Yemen (76 percent), Lebanon (73 percent) and Cyprus (71 percent) (Mekonnen and Hoekstra, 2011b).

Most of the WF of consumption in Mediterranean and Gulf countries is due to the consumption of agricultural products. The share of the WF of agricultural products consumption in the total WF of consumption in Mediterranean countries ranges from 61.8 percent (in Serbia) to 97.7 percent (in Tunisia). The average rate is about 91 percent of the total WF of consumption. Values obtained in Gulf countries are similar to those recorded in North African ones.

Only Tunisia, Serbia, and Syria present a negative total net virtual water balance in the Mediterranean area. The other Mediterranean countries present a positive net virtual water balance. The main reason is that most Mediterranean countries are not self-sufficient for many products so they import them, thus importing embodied virtual water. The other Mediterranean countries show water savings ranging from 340 Mm^3 to 62,157 Mm^3 in Macedonia and Italy, respectively. This is due to the fact that the production of agricultural/industrial goods is highly water-efficient in NMC as compared to the other SEMC, i.e. virtual water contents of goods are relatively lower. All Gulf countries are net virtual water importers.

B. Water Footprint of Food Supply in selected Mediterranean countries

Water Footprints (WF) of food supply were calculated for five Mediterranean countries for the year 2006: Bosnia and Herzegovina, Egypt, Italy, Morocco, and Turkey. These countries were selected as representatives of different Mediterranean macro-regions: Italy (Northern Mediterranean), Egypt and Turkey (Eastern Mediterranean), Bosnia and Herzegovina (Balkans) and Morocco (Southern Mediterranean).

The lowest Water Footprint of food supply was recorded in Egypt (1,194.7 m^3/capita/year) while the highest was recorded in Bosnia and Herzegovina (1,849.7 m^3/capita/year), closely followed by Italy (1,848.3 m^3/capita/year). Intermediate Water Footprints were recorded in Turkey (1,291.6 m^3/capita/year) and Morocco (1,644.9 m^3/capita/year).

The share of the three WF components (green, grey and blue water) changes among countries: in all Mediterranean countries except Egypt, the highest contributor to the overall WF is the green water component, followed by grey water in Bosnia and Herzegovina and Italy and by blue water in Morocco and Turkey (Figure 1). The highest share of the blue water component in the total WF was

recorded in Egypt due to the country's noticeable use of surface water in irrigation (Galli, 2015).

Meat products' contribution to the total WF is the highest in Bosnia and Herzegovina and Italy where about a third of the total WF is due to the consumption of meat products. Conversely, the contribution of cereals to the total WF is the highest in Southern and Eastern Mediterranean countries (Egypt, Morocco and Turkey), accounting for more than a third of the virtual water use. The contribution of vegetable oils (e.g. olive oil) to the overall WF is relevant in Italy but not in the other countries. Finally, milk and meat together represent more than half of the total WF of food supply in Bosnia and Herzegovina and Italy (Figure 2).

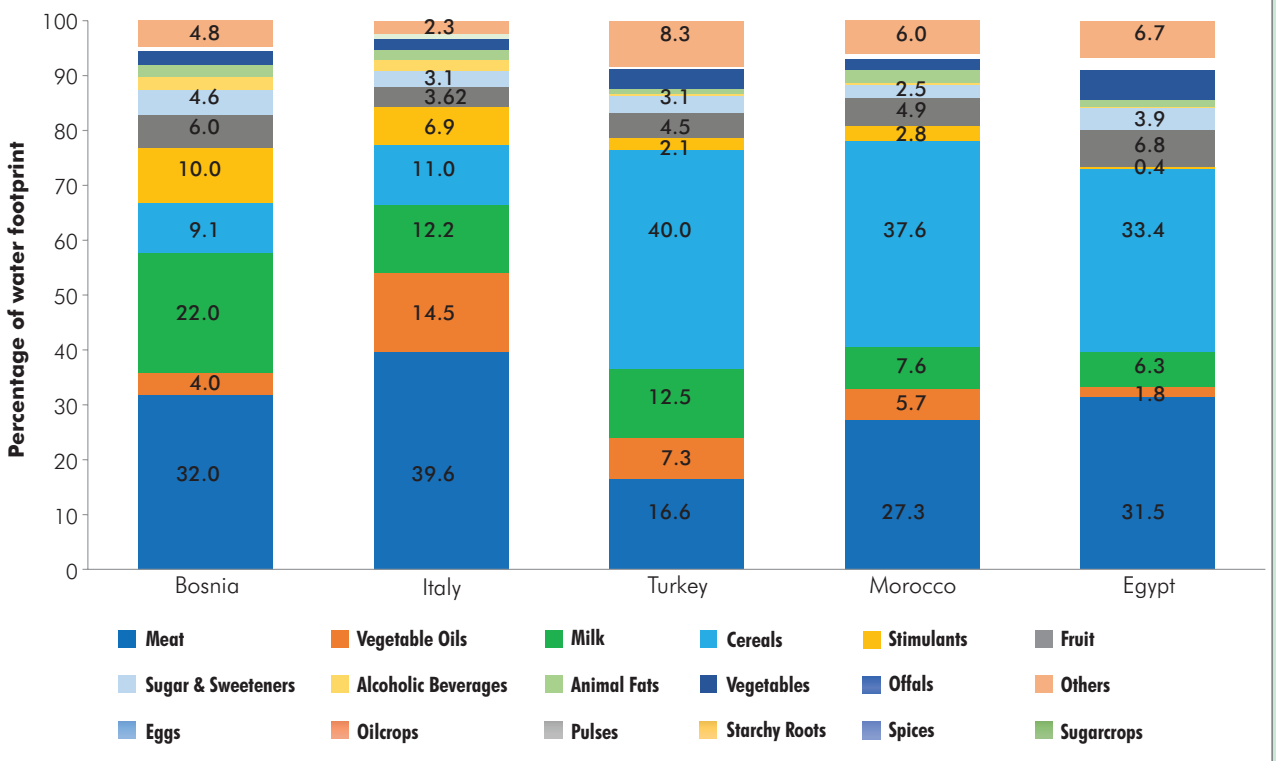
III. ECOLOGICAL FOOTPRINT

A. Ecological Footprint of food consumption

According to Galli et al., (2015), the Ecological Footprint (EF) of an average Mediterranean person in 2010 was approximately 3.0 gha – slightly higher than that of an average world inhabitant (2.7 gha). At the same time, residents in the Mediterranean region had a per capita biocapacity of 1.2 gha, slightly below the world-average of 1.7 gha per person (Borucke et al., 2013). As such, the SCP issue is crucial for the region's environmental and economic success. Moreover, the food sector is the biggest driver of the Ecological Footprint in the Mediterranean region, at about 35 percent of the overall Footprint (see Galli and Halle, 2014).

Among the 14 Mediterranean countries analyzed in detail for the year 2010, France was found to have the highest (4.6 gha) and Morocco the lowest (1.5 gha) per capita ecological footprint in the region. Upon further investigation of the daily consumption activities contributing the most to the overall country's EF, resource demand from food consumption was found to range from as low as 20 percent (in Slovenia) to as high as 70 percent (in Morocco) (see Figure 3). Moreover, countries like France and Morocco, representing different Mediterranean macro-regions and income levels, were

FIGURE 2 **CONTRIBUTION OF FOOD PRODUCT GROUPS TO THE TOTAL WATER FOOTPRINT OF FOOD SUPPLY IN BOSNIA AND HERZEGOVINA, ITALY, TURKEY, MOROCCO, AND EGYPT; 2006**



Source: Authors' elaboration based on data from Mekonnen and Hoekstra, 2011a

found to have about the same per capita resource requirements for food and non-alcoholic beverages (about 0.9 gha per capita), thus indicating that food is a basic need and represents an indispensable share of households' monthly expenses.

FAO estimates that the minimum daily dietary energy requirement is 2500 kcal (FAO/WHO/UNU, 1985). Different countries satisfy those calorie requirements with different types of food, which vary in terms of the share of protein. Protein-intensive food products such as meat and dairy require more resources, in terms of bio-productive land, to produce the same amount of calories as with plant-based food products (Grunewald et al., 2015).

According to Grunewald et al., (2015), Egypt has a considerably high calorie provision (3517 kcal) with a relatively low EF (0.64 gha per capita) due to the low protein diet of its population and the high productivity of its croplands, which reduces its dependence on imported food (this in turn reduces the Carbon Footprint embedded in foodstuff imported through trade). Egypt's EF of food is primarily composed of products with a low EF intensity such as cereals (32 percent of overall food Footprint) and vegetables, fruits and nuts (18 percent) (Figure 4). Similarly, a major share of the food EF comes from cereal consumption in Morocco and Tunisia, which are both characterized by per capita food EF values (0.83 gha for both countries) lower than the regional average (0.90 gha).

Portugal, on the other hand, supplies its residents with a similar amount of calories as Egypt (3518 kcal) but it places a much higher demand on biocapacity with an average per capita food EF of 1.5 gha. This is due to the protein-intensive diet of Portugal's residents, characterized by the consumption of high-trophic-level fishes (44 percent of Food Footprint) and meat products (16 percent). Although an assessment of the Ecological Footprint of food consumption in Gulf countries has not yet been completed, their residents are expected to have a per capita Footprint value closer to Northern Mediterranean countries (NMC) due to the high consumption of protein based products (e.g., average annual meat consumption in Egypt and Morocco is

FIGURE 3 **ECOLOGICAL FOOTPRINT OF CONSUMPTION FOR 14 MEDITERRANEAN COUNTRIES, BY COICOP CATEGORIES, IN 2010.**

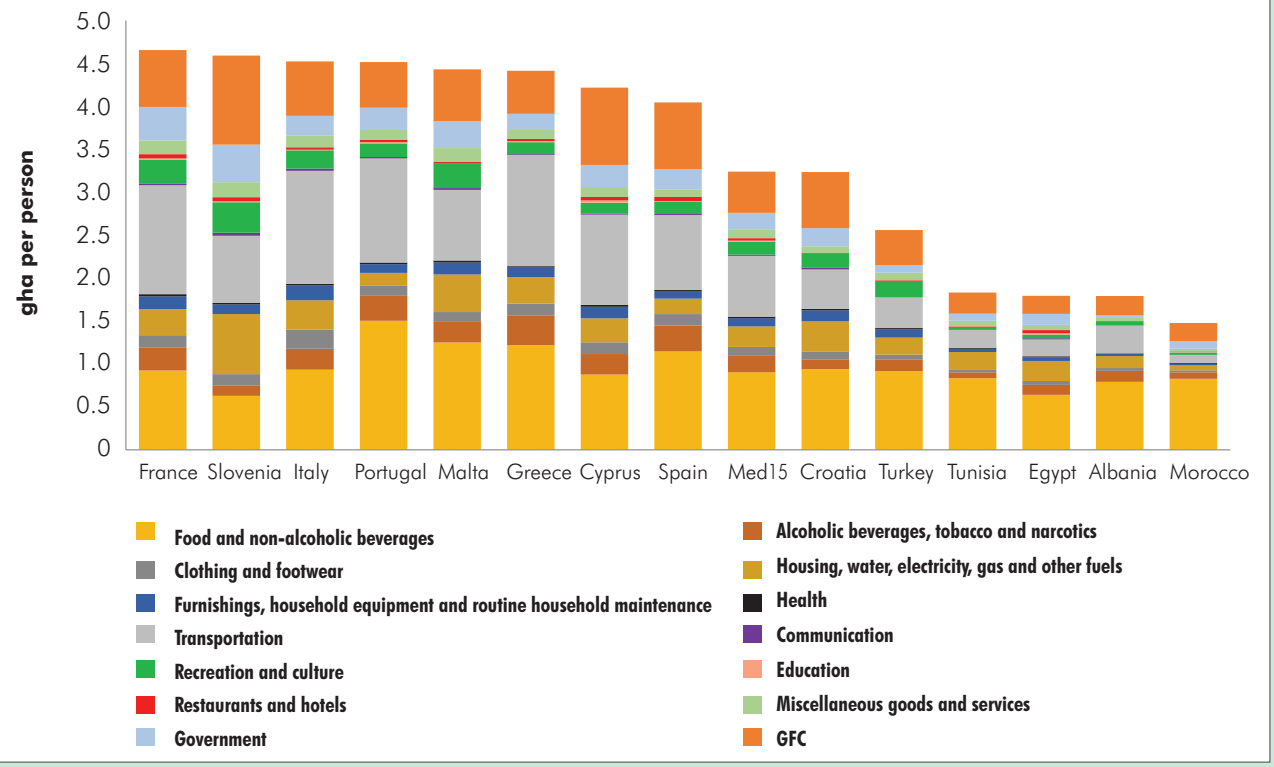
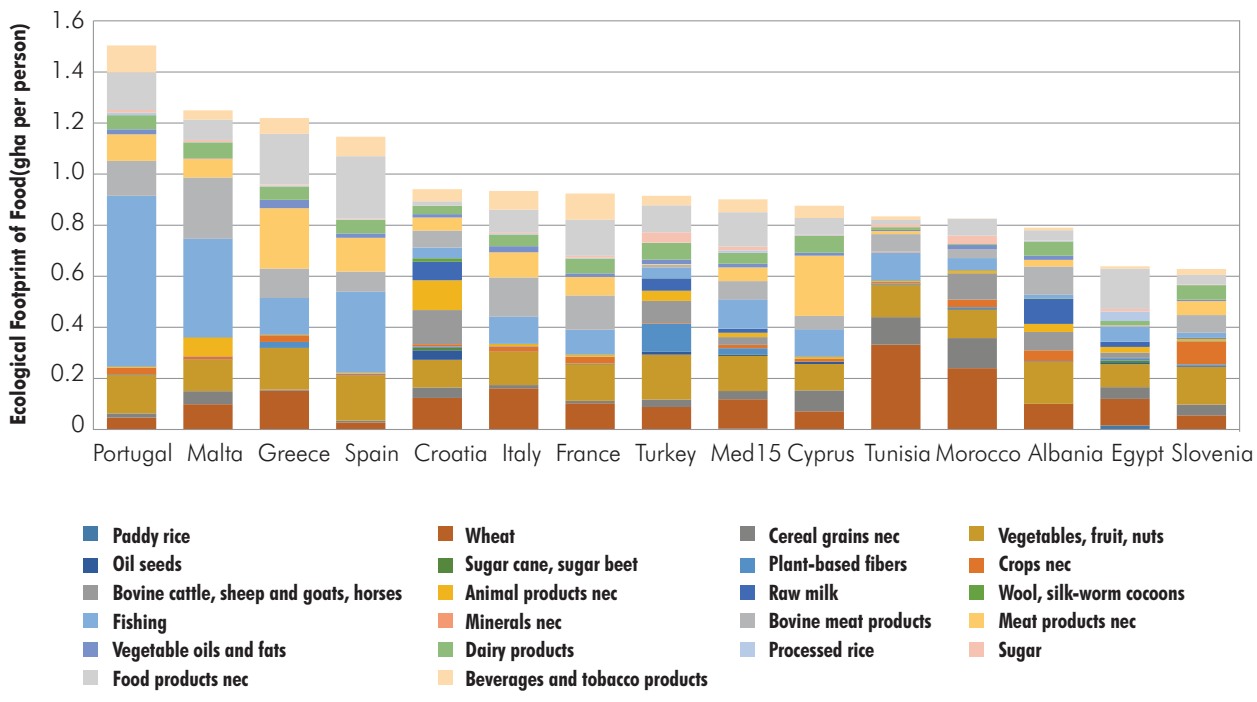


FIGURE 4 ECOLOGICAL FOOTPRINT OF FOOD CONSUMPTION OF 14 MEDITERRANEAN COUNTRIES, IN 2010.



about 25 kg per capita while it is approximately 65 kg per capita in Gulf countries).

Resource needs from food consumption can only be shifted by small amounts and they heavily depend on dietary habits as well as production efficiency. Therefore, providing food security in the future cannot rely solely on efficiency improvements in agricultural production but must also consider reducing food waste and promoting healthier and less resource-intensive diets.

B. Shift away from the Mediterranean diet adds pressure on Ecological Footprint

Comparing the food EF of Mediterranean countries with a selected sample of non-Mediterranean countries also shows that while products typical of the Mediterranean diet (e.g., oil, vegetables and complex carbohydrates such as cereals) have a low Ecological Footprint per calorie provided (see Grunewald et al., 2015), the current food EF in Mediterranean countries is not much lower than in other countries (see Figure 5).

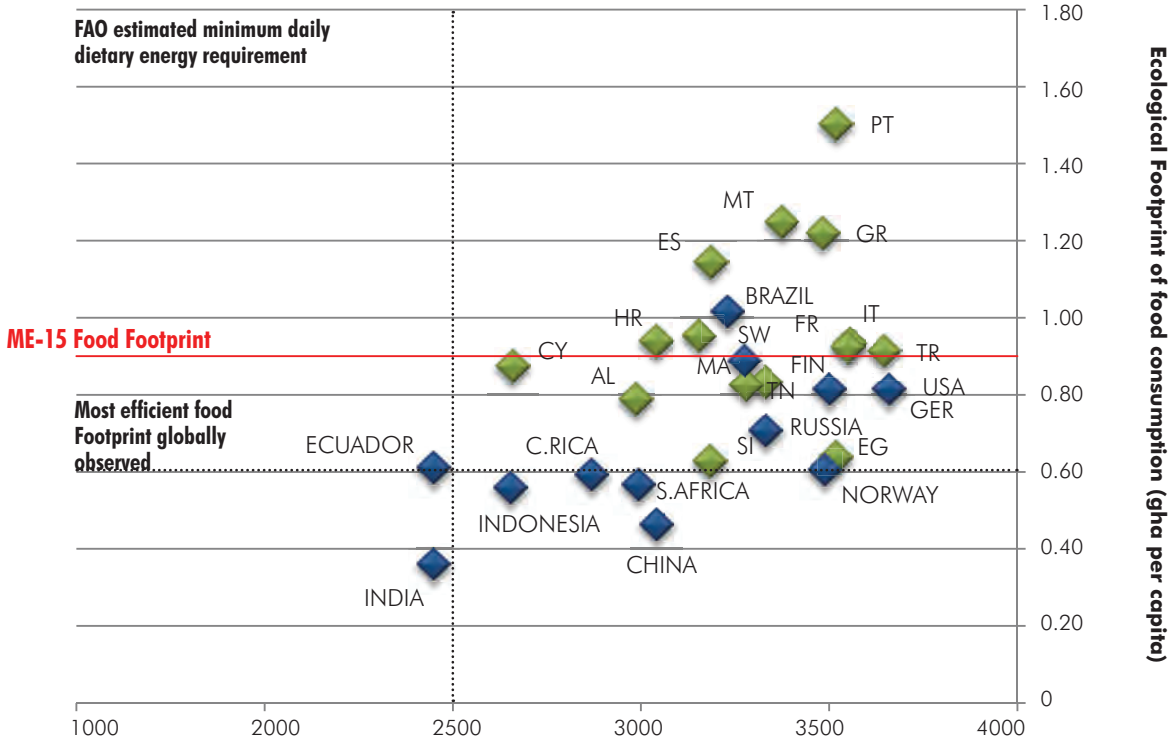
A possible explanation for the relatively high food EF in the Mediterranean is that residents in the region have drifted away from the traditional environmental- and health-friendly Mediterranean diet: protein consumption (milk, meat) has increased significantly, while consumption of products typical of the traditional Mediterranean diet (e.g., oil, cereals and vegetables) has decreased.

Population growth and a shift towards protein-based, energy-rich diets are likely to further increase the global pressure on ecosystems. Future food security will depend on higher production efficiency, reduction of food waste, and promotion of healthier and less resource-intensive diets such as the traditional Mediterranean diet rich in cereals (e.g., wheat) and plant-based food products (e.g., oil, fresh fruits and vegetables). Those pathways can enable the food sector to have a major impact on reaching the sustainable consumption and production targets in the Mediterranean region.

IV. ENVIRONMENTAL IMPLICATIONS OF FOOD LOSSES AND WASTE IN TERMS OF WATER RESOURCE USE

Food loss and waste account for more than 25 percent of the total consumptive use of vulnerable and limited freshwater resources and more than 300 million barrels

FIGURE 5 **ECOLOGICAL FOOTPRINT OF FOOD CONSUMPTION AND DAILY CALORIES PROVISION FOR 15 MEDITERRANEAN COUNTRIES AND SELECTED NON-MEDITERRANEAN COUNTRIES, IN 2010. 2-DIGIT ISO COUNTRY-CODES USED TO INDICATE MEDITERRANEAN COUNTRY NAMES**



of oil per year (Lundqvist et al., 2008; Hall et al., 2009). Globally, the blue WF of food wastage is about 250 km^3 (FAO, 2013a, 2013b). Minimizing waste can reduce water demand; a decrease of about 50 percent in food losses and waste at the global level would save 1,350 km^3 a year (FAO, 2012).

Approximately 90 percent of the WF of consumption in the Mediterranean countries is due to the consumption of agricultural products, with values ranging from 61.8 percent in Serbia to 97.7 percent in Tunisia (Mekonnen and Hoekstra, 2011b). Taking into account the WF of agricultural products consumption (Mekonnen and Hoekstra, 2011b), considering the conservative food losses and waste percentage of 30 percent (Gustavsson et al., 2011) and assuming that the same amount of water is wasted whenever food is lost and/or wasted (WWF Italia, 2013) it can be constituted that from 294 (in Palestine) to 706 (in Portugal) m^3/capita of water are lost or wasted every year by Mediterranean people.

V. CONCLUSIONS

Addressing the challenge of feeding a growing Mediterranean population requires new strategies to ensure food and nutrition security while allowing natural resources conservation. Population increase, industrial development, globalization and urbanization have dramatically affected Mediterranean food production and consumption patterns with impacts on natural ecosystems as well as diets. The present food system is unsustainable and is putting increasing stress on ecosystems and human social systems.

Sustainable food consumption encompasses sustainable diets. Preference should be given to diets that have low environmental impacts while providing the required amount of nutrients (including micronutrients) and energy for a healthy life and a sustainable lifestyle.

The main drivers of resource use as a result of food

consumption are dietary habits on the consumption side and land productivity on the production side. High Water and Ecological Footprint requirements assessed in this annex are driven by dietary habits favouring protein-based diets. Conversely, plant-based diets are less resource intensive in terms of both freshwater use and regenerative capacity appropriation as the Egypt case study has shown.

It is thus important to reduce food wastage throughout the food chain, increase food efficiency and favour cereal- and vegetable-rich diets to make the Mediterranean food system more sustainable. For this reason it is of paramount importance to alert consumers of the environmental implications of their food-related behaviour (e.g. diets, overeating, wasting food). Reduced food losses and waste generation can ease pressure on natural resources and free up water resources and land for other development purposes, societal needs and economic sectors.

Finally, transitioning towards a sustainable food system in the Mediterranean region requires developing integrated, coherent, comprehensive and holistic policies. Policies and actions at all levels require more and better intersectoral research to simultaneously address food security and environmental sustainability. In particular, it is important to assess the environmental sustainability of Mediterranean food consumption patterns by taking into account the multiple pressures humans place on the various compartments of the Earth system through integrated approaches such as the Footprint Family one used here. Moreover, these activities require a shared regional multi-actor governance model in which coordinated actions are needed at all levels (local, national and regional). Sound regional regulatory frameworks can then ensure the scaling-up of local multi-actor partnerships and initiatives to achieve sustainable food consumption at the regional level.

Dr. Alessandro Galli, Director of Mediterranean-MENA Program, Global Footprint Network; Dr. Cosimo Lacirignola Secretary General, International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM).

Collaborating authors: Roberto Capone, Philipp Debs, Hamid El Bilali and Francesco Bottalico, (CIHEAM); Nicole Grunewald, Michel Gressot, Derek Eaton and Katsunori Iha (Global Footprint Network.

References

Borucke, M., Moore, D., Cranston, G., Gracey, K., Iha, K., Larson, J., Lazarus, E., Morales, J.C., Wackernagel, M. and Galli, A. (2013). "Accounting for demand and supply of the Biosphere's regenerative capacity: the National Footprint Accounts' underlying methodology and framework." Ecological Indicators, 24, 518-533.

FAO (2012). Towards the Future We Want: end hunger and make the transition to sustainable agricultural and food systems. Food and Agriculture Organization (FAO), Rome. Available online at: http://www.fao.org/docrep/015/an894e/an894e00.pdf.

FAO (2013a). Food wastage footprint: impacts on natural resources. Available at: http://www.fao.org/docrep/018/i3347e/i3347e.pdf.

FAO (2013b). Food wastage footprint, impacts on natural resource. FAO Rome. Available at: http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_FOOD-43WASTAGE.pdf.

FAO/WHO/UNU (1985). Protein and Energy Requirements. Food and Agriculture Organization, World Health Organization, United Nations University, Rome.

Galli, A., Halle, M., Grunewald, N. (2015). "Physical limits to resource access and utilisation and their economic implications in Mediterranean economies". Environmental Science & Policy, 51, 125-136.

Galli, A. (2015). "On the rationale and policy usefulness of Ecological Footprint Accounting: The case of Morocco". Environmental Science & Policy, 48, 210-224.

Galli, A., Wiedmann, T., Ercin, E., Knoblauch, D., Ewing, B., Giljum, S. (2012). "Integrating ecological, carbon and water footprint into a footprint family of indicators: definition and role in tracking human pressure on the planet". Ecological Indicators, 16, 100–112.

Grunewald, N., Galli, A., Iha, K., Halle, M., and Gressot, M. (2015). "The Ecological Footprint of Mediterranean Diets." In CIHEAM Watch Letter N° 32 "Innovative indicators and initiatives for Food Security in the Mediterranean", 10-17.

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R. and Meybeck, A. (2011). Global food losses and food waste: extent, causes and prevention. FAO, Rome.

Hall, K.D., Guo, J., Dore, M., and Chow, C.C. (2009). The progressive increase of food waste in america and its environmental impact. Laboratory of Biological Modeling, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, Maryland.

Ingram, J.S.I. (2011). From food production to food security: developing interdisciplinary, regional-level research. PhD Thesis, Wageningen University.

Kickbusch, I. (2010). The food system: a prism of present and future challenges for health promotion and sustainable development. Triggering the debate – white paper. Promotion Santé Suisse, Bern.

Lacirignola, C. and Capone, R. (2009). "Mediterranean Diet: Territorial identity and food safety." New Medit, 4 (8): 2-3.

Lundqvist, J., de Fraiture, C. and Molden, D. (2008). Saving water: From field to fork, SIWI Policy Brief. Stockholm International Water Institute, Stockholm, Sweden. Available at: http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf.

Mekonnen, M.M., and Hoekstra, A.Y. (2011a). National water footprint accounts: the green, blue and grey water footprint of production and consumption. Volume 2: Appendices. Value of Water Research Report Series No. 50, United Nations Educational, Scientific and Cultural Organization (UNESCO) - Institute for Water Education (IHE), Delft, The Netherlands.

Mekonnen, M.M., and Hoekstra, A.Y. (2011b). National water footprint accounts: the green, blue and grey water footprint of production and consumption. Volume 1: Main Report. Value of Water Research Report Series No. 50, United Nations Educational, Scientific and Cultural Organization (UNESCO) - Institute for Water Education (IHE), Delft, The Netherlands.

Reddy, Sh., Lang, T., and Dibb, S. (2009). Setting the table - Advice to Government on priority elements of sustainable diets. Sustainable Development Commission, UK.

UNEP/MAP (2005). Mediterranean Strategy for Sustainable Development: a framework for environmental sustainability and shared prosperity. Tenth Meeting of the Mediterranean Commission on Sustainable Development (MCSD), Athens.

WWF Italia (2013). Quanta natura sprechiamo? Le pressioni ambientali degli sprechi alimentari in Italia. WWF Italia Ong-Onlus, Rome.

Note

1. See https://www.switchmed.eu/en/about for further details on SCP activities in the Mediterranean region.

CONTRIBUTORS

In alphabetical order

HUSSEIN ABAZA
Chief of UNEP's Economics and Trade Branch in Geneva, before he retired in 2009. He developed various programmes on Environment and Economics, and has many publications on environmental and integrated assessment, the interface between trade and environment and others. Co-editor of AFED report on Green Economy, 2011.

DR. IBRAHIM ABDEL GELIL
Adjunct professor at the Arabian Gulf University (AGU) in Bahrain. He was the CEO of the Egyptian Environmental Affairs Agency (EEAA), and the chairman of the Egyptian Organization for Energy Planning (OEP). He authored and co-authored around 70 publications on energy and environment. Co-editor of AFED report on Sustainble Energy, 2013.

DR. MOHAMED EL-ASHRY
Senior Fellow at the UN Foundation and former Chairman of REN21. He previously served as CEO & Chairman of the Global Environment Facility (GEF), and Director of the Environment Department at the World Bank. A member of several high-level international commissions, and Deputy Chairman of AFED Board of Trustees.

RACHEL A. BAHN
Director of the Food Security Program and instructor of agribusiness at the American University of Beirut (AUB). Previously she worked as an economist with the U.S. Department of Treasury and the United States Agency for International Development.

DR. BASSAM FATTOUH
Director of the Oxford Institute for Energy Studies and Professor at the School of Oriental and African Studies. He has published articles on the international oil pricing system, OPEC pricing power, security of Middle Eastern oil supplies, and the dynamics of oil prices and oil price differentials.

DR. ALESSANDRO GALLI
Program Director for the mediteranean and MENA at Global Footprint Network. He worked as technical advisor on the Al Basama Al Beeiya (Ecological Footprint) Initiative in the United Arab Emirates with the Emirates Wildlife Society (EWS-WWF) and the Environment Agency–Abu Dhabi (EAD).

DR. NAHLA HWALLA
Dean of the Faculty of Agricultural and Food Sciences and Professor of human nutrition at the American University of Beirut (AUB). Her research focuses on obesity, its prevalence, determinants and dietary manipulation to curb its effects. She has served on various international expert committees, and member of WHO to serve on the WHO Expert Advisory Panel on Nutrition.

LAURA EL-KATIRI
Research Fellow at the Oxford Institute for Energy Studies and Teaching Fellow in the Department of Financial and Management Studies at the School of Oriental African Studies, University of London. Her research focuses on energy and economic policy in the Middle East.

SIBELLE EL LABBAN
Senior Research Assistant at the Faculty of Agricultural and Food Sciences at the American University of Beirut (AUB) with research interests covering food security, early nutrition, and diet-related diseases. She is a Licensed Dietitian in Lebanon.

DR. COSIMO LACIRIGNOLA
Secretary General of International Center for Advanced Mediterranean Agronomic Studies (CIHEAM) in Bari, Italy. He is an agricultural economist, with extensive experience in in the field of scientific and technical cooperation in the Mediterranean. He developed numerous training and research projects which placed him at the heart of high-level regional development diplomacy.

DR. ANNE SAAB
Assistant professor of international law at the Graduate Institute of International and Development Studies in Geneva, Switzerland, where she teaches courses on climate law, patent law, and global food systems. She did research at the London School of Economics (LSE), King's College, and Leiden University. She worked as a policy and legal advisor at the ministries of Agriculture and Foreign Affairs in The Netherlands.

NAJIB SAAB
Secretary General of the Arab Forum for Environment & Development (AFED) and Editor-in-Chief of Al-Bia Wal-Tanmia magazine. An architect by training, he is a 2003 recipient of the UNEP's Global 500 Award and the 2011 laureate of Sheikh Zayed International Prize for Environment. Editor of the series of AFED Annual Reports on the State of Arab Environment.

DR. ABDUL-KARIM SADIK
Senior Economic Adviser at Kuwait Fund for Arab Economic Development for over 25 years, including eight years as Executive Director for Kuwait at the International Fund for Agricultural Development (IFAD), and Adviser to the Executive Director at the World Bank. Co-editor of AFED report on Food Security, 2014.

DR. WALEED KHALIL AL-ZUBARI
Coordinator of the Water Resources Management Program at the Arabian Gulf University in Bahrain. He did his PhD research at Colorado State University in groundwater mathematical modeling. His research interests include water-energy-food nexus and use of dynamic modeling in planning and management of water resources systems. He has published more than 90 research papers.

SUPERVISORY COMMITTEE

Members of AFED Board of Trustees

Dr. Mohamed El-Ashry, Senior Fellow at the United Nations Foundation and former CEO and Chairman, Global Environment Facility – GEF.

Dr. Abdulrahman Al-Awadi, Executive Secretary of the Regional Organization for the Protection of Marine Environment (ROPME) and former Minister of Health in Kuwait.

Dr. Adnan Badran, Chairman of the Board of Trustees of the University of Jordan, Chancellor, Petra University and former Prime Minister of Jordan.

Najib Saab, Secretary General of the Arab Forum for Environment & Development (AFED) and Editor-in-Chief of Al-Bia Wal-Tanmia (Environment & Development) magazine.

PARTICIPANTS IN CONSULTATION MEETINGS AND REVIEWERS DURING THE PREPARATION OF AFED 2015 REPORT:

(In alphabetical order)

Sebastian Abis (CIHEAM), Dr. Yaser Abunnasr (American University of Beirut), Dr. Ali Al Tokhais (Saudi Shura Council), Ingrid Andersson (Corporate Wellbeing), Thomas Andersson (International Organisation for Knowledge Economy and Enterprise Development), Mounir Bou Ghanem (Environment Agency – Abu Dhabi), Hamid El Bilali (CIHEAM), Roberto Capone (CIHEAM), Jaume Fortuny (OBREAL - Observatory of Globalization), Dr. Hafez Ghanem (World Bank), Dr. Shadi Hamadeh (American University of Beirut, AUB), Dr. Steven Stone, (UNEP, Geneva), Dr. Habib El-Habr (UNEP/MAP), Dr. Heba Essam Khalil (Cairo University), Gaetano Leone (UNEP/MAP), Mrs. Roula Majdalani (ESCWA), Mr. Fidele Byringiro (ESCWA), Mr. Cosimo Lacirignola (CIHEAM), Mr. Abdessalam Ould Ahmed (FAO), Enrique de Villamore Martín (SCP/RAC), Dr. Thani Zioudi, (Ministry of Foreign Affairs, UAE)

ACRONYMS AND ABBREVIATIONS

10YFP	Ten Year Framework of Programmes on Sustainable Consumption and Production
AAAID	Arab Authority for Agricultural Investment and Development
ABSP	Agricultural Biotechnology Support Programme
AC	Air-Conditioning
AC	Alternating Current
ACSAD	Arabic Centre for the Studies of Arid Zones and Drylands
ACU	Arab Custom Union
ADA	Arriyadh Development Authority (Riyadh)
ADCO	Abu Dhabi Company for Onshore Oil Operations
ADEREE	The National Agency for Energy Efficiency and the Development of Renewable Energy
ADFD	Abu Dhabi Fund for Development
ADR	Alternative Disputes Resolution
ADWEA	Abu Dhabi Water & Electricity Authority
AED	United Arab Emirates Dirham
AEPC	African Environmental Protection Commission
AEPS	Arctic Environmental Protection Strategy
AEWA	African-Eurasian Waterbird Agreement
AFED	Arab Forum for Environment and Development
AFESD	Arab Fund for Economic and Social Development
AG	Associated Gas
AGDP	Agricultural Gross Domestic Product
AGERI	Agricultural Genetic Engineering Institute
AGP	Arab Gas Pipeline
AGU	Arabian Gulf University
AHD	Aswan High Dam
AHDR	Arab Human Development Report
AIA	Advance Informed Agreement
AIDS	Acquired Immunodeficiency Syndrome
AIECGC	Arab Investment and Export Credit Guarantee Corporation
AKTC	Aga Khan Trust for Culture
Al	Aluminum
ALBA	Aluminium Bahrain
ALECSO	Arab League Educational, Cultural, and Scientific Organization
ALMEE	Lebanese Association for Energy Saving & Environment
ALOA	Association for Lebanese Organic Agriculture
AMCEN	African Ministerial Conference on the Environment
AMF	Arab Monetary Fund
AMU	Arab Maghreb Union
ANME	National Agency for Energy Management
AoA	Agreement on Agriculture (WTO Uruguay Round)
AOAD	Arab Organization for Agricultural Development
AP	Advanced Passive reactor
AP	Additional Protocol

API	Arab Planning Institute
APR	Advanced Power Reactor
APRUE	National Agency for the Promotion and Rationalization of Use of Energy
AREE	Aqaba Residence Energy Efficiency
ARWR	Actual Renewable Water Resources
ASABE	American Society of Agricultural and Biological Engineers
ASDRR	Arab Strategy for Disaster Risk Reduction
ASR	Aquifer Storage and Recovery
AU	African Union
AUB	American University of Beirut
AUM	American University of Madaba (Jordan)
AVL	Automatic Vehicle Location
AWA	Arab Water Academy
AWC	Arab Water Council
AWCUA	Arab Water Countries Utilities Association
b/d	Barrels per Day
BADEA	Arab Bank for Economic Development in Africa
BAU	Business as Usual
Bbl	Oil Barrel
BCH	Biosafety Clearing House
Bcm	Billion cubic meters
BCWUA	Branch Canal Water User Association
BDB	Beyond Design Basis
BDL	Central Bank of Lebanon
BGR	German Geological Survey
BMP	Best Management Practices
BMZ	German Federal Ministry of Economic Cooperation and Development
BNEF	Bloomberg New Energy Finance
BOD	Biological Oxygen Demand
boe	Barrels of Oil Equivalent
BOO	Build-Own-Operate
BOOT	Build Own Operate Transfer
BOT	Build Operate Transfer
BP	British Petroleum
BREEAM	Building Research Establishment Environmental Assessment Method
BRO	Brackish Water Reverse Osmosis
BRS	ARZ Building Rating System
BU	Boston University
C&D	Construction and Demolition
C&I	Commercial and Industrial
CA	Conservation Agriculture
CAB	Centre for Agriculture and Biosciences
CAGR	Compound Annual Growth Rate
CAIP	Cairo Air Improvement Project
CAMP	Coastal Area Management Project
CAMRE	Council of Arab Ministers Responsible for the Environment
CAN	Competent National Authority
CAPEX	Capital Expenditures
CBC	Community-Based Conservation
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
CBSE	Center for the Study of the Built Environment (Jordan)
CCA	Climate Change Adaptation
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Sequestration
CCS	Carbon Capture and Storage
CCS CO_2	Capture and Storage

CD	Compact Disk
CDM	Clean Development Mechanism
CDRs	Certified Emissions Reductions
CEDARE	Centre for Environment and Development for the Arab Region and Europe
CEDRO	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
CEIT	Countries with Economies in Transition
CEO	Chief Executive Officer
CEP	Coefficient of Performance
CERES	Coalition for Environmentally Responsible Economics
CERs	Credits
CFA	Cooperative Framework Agreement
CFC	Chloro-Fluoro-Carbon
CFL	Compact Fluorescent Light
CFL	Compact Fluorescent Lamp
CGE	Computable General Equilibrium
CGIAR	Consultative Group on International Agricultural Research
CH4	Methane
CHN	Centre Hospitalier du Nord -Lebanon
CHP	Combined Heat and Power
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CIRAD	Agricultural Research for Development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIWM	Chartered Institution of Wastes Management
CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
CLO	Compost-Like-Output
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CM	Carbon Management
CMI	Community Marketing, Inc.
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CNA	Competent National Authority
CNCA	Public Agricultural Bank
CNG (CNS)	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
$CO_{2e/eq}$	CO_2 equivalent
COD	Chemical Oxygen Demand
COP	Conference of the Parties
CPB	Cartagena Protocol on Biosafety
CPC	Calcined Petroleum Coke
CRS	Center for Remote Sensing
CSA	City Strategic Agenda
CSD	UN Commission on Sustainable Development
CSEM	Centre Suisse d'Electronique et de Microtechnique
CSP	Concentrated Solar Power
CSR	Corporate Social Responsibility
CTAB	Technical Center of Organic Agriculture
cum	Cubic meters
CZIMP	Coastal Zone Integrated Management Plan
DALYs	Disability-Adjusted Life Years
DBFO	Design Build Finance Operate
DBO	Design-Build-Operate
DC	Direct current
DED	Dubai Economic Department
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DEM	Digital Elevation Model
DESA	Department of Economic and Social Affairs
DEWA	Dubai Electricity and Water Authority

DFID	UK Department for International Development
DHW	Domestic Hot Water
DII	DESERTEC Industrial Initiative
DMN	Moroccan National Meteorological Office
DNE	Daily News Egypt
DOE	United States Department of Energy
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSIRE	Database of State Incentives for Renewables & Efficiency
DTC	Dubai Transport Corporation
DTCM	Dubai Department for Tourism and Commerce Marketing
DTIE	UNEP Division of Technology, Industry, and Economics
DTO	Dublin Transportation Office
DUBAL	Dubai Aluminum Company Limited
E3G	Third Generation Environmentalism
EAD	Environment Agency AbuDhabi
ECA	Economic Commission for Africa
ECAs	Energy Conversion Agreements
ECE	Economic Commission for Europe
ED	Electrodialysis
EDCO	Electricity Distribution Company
EDF	Environmental Defense Fund
EDL	Electricité du Liban
EDM	Al- BiaWal-Tanmia - Environment & Development magazine
EE	Energy Efficiency
EEAA	Egyptian Environmental Affairs Agency
EEHC	Egyptian Electricity Holding Company
EF	Ecological Footprint
EGBC	Egyptian Green Building Council
EGPC	Egyptian General Petroleum Corporation
EGS	Environmental Goods and Services
EIA	Energy Information Administration
EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative
EMA	Europe, the Middle East, and Africa
EMAL	Emirates Aluminium Company Limited
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ENEC	Emirates Nuclear Energy Corporation
ENPI	European Neighborhood and Partnership Instrument
ENSO	El Niño-Southern Oscillation
EOR	Enhanced Oil Recovery
EPA	US Environmental Protection Agency
EPC	Engineering Procurement and Construction
EPD	European Patent Office
EPDRB	Environmental Program for the Danube River Basin
EPI	Environment Performance Index
EPSA	Exploration and Production Sharing Agreement
ESAUN	Department of Economic and Social Affairs
ESBM	Ecosystem-Based Management
ESCOs	Energy Service Companies
ESCWA	United Nations Economic and Social Commission for Western Asia
ESDU	Environment and Sustainable Development Unit
ESI	Environment Sustainability Index
ESMAP	World Bank Energy Sector Management Assistance Program
ETM	Enhanced Thematic Mapper
EU	European Union

EU ETS	European Union Emission Trading System
EVI	Environmental Vulnerability Index
EWRA	Egyptian Water Regulatory Agency
EWS	Emirates Wildlife Society
FACE	Free Air Carbon Enrichment
FANR	The Federal Authority for Nuclear Regulation (UAE)
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FEMIP	Facility for Euro-Mediterranean Investment and Partnership
FFEM	French Fund for Global Environment
FiBL	Research Institute of Organic Agriculture
FIFA	Fédération Internationale de Football Association
FIT	Feed-in-Tariff
FOEME	Friends of the Earth Middle East
FSP	Food Security Program
FSU	Former Soviet Union
F-T	Fischer-Tropsch process
FTIAB	Packaging and Newspaper Collection Service (Sweden)
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
GAM	Greater Amman Municipality
GAPs	Good Agricultural Practices
GAS	Guarani Aquifer System
GATT	General Agreement on Tariffs and Trade
GBC	Green Building Council
GBIF	Global Biodiversity Information Facility
GCC	Gulf Cooperation Council
GCM	General Circulation Model
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GE	General Electric
GECF	Gas Exporting Countries Forum
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GEO	Global Environment Outlook
GERD	Gross Domestic Expenditure on Research and Development
GFEI	Global Fuel Economy Initiative
GFU	Global Facilitation Unit for Underutilized Species
Gha	Global hectare
GHGs	Greenhouse Gases
GIPB	Global Partnership Initiative for Plant Breeding Capacity Building
GIS	Geographical Information Systems
GIWA	Global International Waters Assessment
GJ	GigaJoule
GLASOD	Global Assessment of Soil Degradation
GLCA	Global Leadership for Climate Action
GM	Genetically Modified
GME	Gazoduc Maghreb Europe
GMEF	Global Ministerial Environment Forum
GMO	Genetically Modified Organism
GMP	Green Moroccan Plan
GNI	Gross National Income
GNP	Gross National Product
GPC	Green petroleum Coke
GPS	Global Positioning System
GPRS	Green Pyramid Rating System
GRI	Global Reporting Initiative

GRID	Global Resource Information Database
GSDP	General Secretariat for Development planning-Qatar
GSI IISD	Global Subsidies Initiative
GSLAS	General Secretariat of League of Arab States
GSR	Global Status Report
Gt	Gigaton
GTZ	German Technical Cooperation (Gesellschaft für Technische Zusamm)
GVC	Civil Volunteers' Group (Italy)
GW	Gigawatt
GW	Greywater
GW_e	Gigawatt electrical
GWI	Global Water Intelligence
GWP	Global Warming Potential
GWP	Global Water Partnership
GW_{th}	Gigawatt-thermal
ha	Hectares
HACCP	Hazardous Analysis and Critical Control Points
HDI	Human Development Index
HFA	Hyogo Framework for Action
HFCs	Hydrofluorocarbons
HFO	Heavy Fuel Oil
HIV	Human Immunodeficiency Virus
HLW	High Level Waste
HNWI	High Net Worth Individuals
HVAC	Heating, Ventilation, and Air-Conditioning
I/M	Inspection and Maintenance
IAASTD	International Assessment of Agricultural Knowledge Science and Technology for Development
IAEA	International Atomic Energy Agency
IAS	Irrigation Advisory Service
IC	Irrigation Council
ICAM	Integrated Coastal Area Management
ICARDA	International Center for Agricultural Research in Dry Areas
ICBA	International Center for Biosaline Agriculture
ICC	International Chamber of Commerce
ICGEB	International Center for Genetic Engineering and Biotechnology
ICLDC	Imperial College London Diabetes Centre
ICM	Integrated Coastal Management
ICPDR	International Commission for the Protection of the Danube River
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IDA	International Desalination Association
IDB	Islamic Development Bank
IDECO	Irbid District Electricity Company
IDRC	International Development Research Center
IDSC	Information and Decision Support Center
IEA	International Energy Agency
IEADSM	International Energy Agency Demand-side Management
IEEE	Institute of Electrical and Electronic Engineers
IFA	International Fertilizer Industry Association
IFAD	International Fund for Agricultural Development
IFOAM	International Federation of Organic Agriculture Movements
IFPRI	International Food Policy Research Institute
IGCC	Integrated Gasifier Combined Cycle
IHP	International Hydrology Program
IIED	International Institute for Environment and Development
IIIEE	Lund University International Institute for Industrial Environmental Economics
IIIP	Integrated Irrigation Improvement Project

IIP	Irrigation Improvement Project
IISD	International Institute for Sustainable Development
ILO	International Labour Organization
ILW	Intermediate Level waste
IMC	Istituto Mediterraneo Di Certificazione
IMF	International Monetary Fund
IMO	International Maritime Organization
InWEnt	Capacity Building International-Germany
IO	Input-Output
IOC	International Oil Companies
IPCC	Intergovernmental Panel on Climate Change
IPF	Intergovernmental Panel on Forests
IPM	Integrated Pest Management
IPP	Independent Power Producer
IPR	Intellectual Property Rights
IPTRID	International Program for Technology and Research in Irrigation and Drainage
IRENA	International Renewable Energy Agency
IRESEN	Institut de Recherche en Energie Solaire et en Energies Nouvelles
IRR	Internal Rate Of Return
ISCC	Integrated Solar Combined Cycle
ISESCO	Islamic Educational, Scientific, and Cultural Organization
ISIC	UN International Standard Industrial Classification
ISO	International Organization for Standardization
ISWM	Integrated Solid Waste Management
ITC	Integrated Tourism Centers
ITC	International Trade Center
ITSAM	Integrated Transport System in the Arab Mashreq
IUCN	International Union for Conservation of Nature
IUCN	World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
IWMI	International Water Management Institute
IWPP	Independent Water And Power Producer
IWRB	International Waterfowl and Wetlands Research Bureau
IWRM	Integrated Water Resources Management
JAEC	Jordan Atomic Energy Commission
JBAW	Jordan Business Alliance on Water
JCEDARE	Joint Committee on Environment and Development in the Arab Region
JD	Jordanian Dinar
JEPCO	Jordan Electric Power Company
JI	Joint Implementation
JMWI	Jordan Ministry for Water and Irrigation
JNRC	Jordan Nuclear Regulatory Commission
JVA	Jordan Valley Authority
KA-CARE	King Abdullah City for Atomic and Renewable Energy
KACST	King Abdulaziz City for Science and Technology
KAUST	King Abdullah University of Science and Technology
KEPCO	Korea Electric Power Corporation
KFAED	Kuwait Fund for Arab Economic Development
KFUPM	King Fahd University of Petroleum and Minerals
KfW	German Development Bank
KISR	Kuwait Institute for Scientific Research
KSA	Kingdom of Saudi Arabia
KW	Kilowatt
kWh	Kilowatt-hour
LADA	Land Degradation Assessment of Drylands
LAS	League of Arab States
LATA	Lebanese Appropriate Technology Association
LAU	Lebanese American University

LBNL	Lawrence Berkeley National Laboratory
LCC	Life Cycle Costing
LCEC	Lebanese Center for Energy Conservation
LCOE	Levelized Costs of Electricity
LDCs	Least Developed Countries
LED	Light-Emitted Diode
LEED	Leadership in Environmental Design
LEMA	Suez Lyonnaise des Eaux, Montgomery Watson and Arabtech Jardaneh
LEU	Low-enriched Uranium
LGBC	Lebanon Green Building Council
LLW	Low Level Waste
LMBAs	Land and Marine Based Activities
LMEs	Large Marine Ecosystems
LMG	Like Minded Group
LMO	Living Modified Organism
LNG	Liquefied Natural Gas
LowCVP	Low Carbon Vehicle Partnership
LPG	Liquefied Petroleum Gas
LRA	Litani River Authority
LV	Low Voltage
MAAR	Syrian Ministry of Agriculture and Agrarian Reform
MAD	Moroccan Dirham
MALR	Ministry of Agriculture and Land Reclamation
MAP	UNEP Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MASEN	Moroccan Agency for Solar Electricity
mb/d	million barrels per day
MBT	Mechanical-biological treatment
MCM	Million Cubic Meters
MD	Membrane Distillation
MDGs	Millennium Development Goals
MEA	Multilateral Environmental Agreement
MECTAT	Middle East Centre for the Transfer of Appropriate Technology
MED	Multiple-Effect Distillation
MED WWR WG	Mediterranean Wastewater Reuse Working Group
MED-ENEC	Energy Efficiency in the Construction Sector in the Mediterranean
MEES	Middle East Economic Survey
MEMAC	Marine Emergency Mutual Aid Centre
MENA	Middle East and North Africa
MEPS	Minimum Energy Performance Standards
METAP	UNEP Mediterranean Environmental Technical Assistance Program
MEW	Lebanese Ministry of Energy and Water
MGD	Million Gallon per Day
MHT	Mechanical Heat Treatment
MICE	Meetings, Incentives, Conferences, And Events
MJ	Mega Joule
MIST	Masdar Institute of Science and Technology
MMBTU	One Million British Thermal Units
MMCP	Making the Most of Commodities Programme
MNA	Multinational Approaches
MOQ	Maersk Oil Qatar
MOU	Memorandum of Understanding
MOX	Mixed-Oxide
MPA	Marine Protected Area
MPAP	Multi-Stakeholder Policy Formulation and Action Planning
MSF	Multi-Stage Flash
MSF	Multi-Stakeholder Forum

MSP	Mediterranean Solar Plan
MSW	Municipal Solid Waste
Mt	Metric tons
MT	Million ton
Mt	Megatons
$MtCO_2$	Million tons of CO_2
Mtoe	Million tons of oil equivalent
MTPY	Metric Tons Per Year
MV	Medium Voltage
MW	Megawatt
MW_h	Megawatt-hour
MW_p	Megawatt-peak
MWRI	Ministry of Water Resources and Irrigation
MW_{th}	Megawatt-thermal
N_2O	Nitrous Oxide
NAMA	Nationally Appropriate Mitigation Actions
NARI	National Agricultural Research Institutes
NARES	National Agricultural Research and Extension Systems
NASA	National Aeronautics and Space Administration
NBC	National Biosafety Committee
NBDF	Nile Basin Discourse Forum
NBF	National Biosafety Framework
NBI	Nile Basin Initiative
NBM	Nile Basin Management
NC	National Communication
NCSR	Lebanese National Council of Scientific Research
ND	Neighborhood Development
NDW	Moroccan National Drought Watch
NEA	Nuclear Energy Agency
NEAP	National Environmental Action Plan
NEEAP	National Energy Efficiency Action Plan
NEEP	National Energy Efficiency Program
NEEREA	National Energy Efficiency and Renewable Energy Action (Lebanon)
NERC	National Energy Research Centre
NF	Nano-Filtration
NFC	Nile Forecast Center
NFP	National Focal Point
NGCCs	Natural-Gas-Fired Combined Cycles
NGO	Non-Governmental Organization
NGV	Natural Gas Vehicles
NGWA	Northern Governorates Water Authority (Jordan)
NIF	Neighborhood Investment Facility
NMC	Northern Mediterranean countries
NOAA	National Oceanic and Atmospheric Administration
NOC	National Oil Company
NOEC	Net Oil Exporting Countries
NOGA	National Oil and Gas Authority (Bahrain)
NOIC	Net Oil Importing Countries
NORDEN	Nordic Council of Ministers
NOx	Nitrogen Oxides
NPK	Nitrogen, Phosphates and Potash
NPP	Nuclear Power Plant
NPP	Net Primary Productivity
NPPA	Nuclear Power Plant Authority
NPT	Non-Proliferation treaty of nuclear weapons
NRC	National Research Council
NREL	National Renewable Energy Laboratory

NRW	Non-Revenue Water
NSAS	Nubian Sandstone Aquifer System
NSR	North-South Railway project
NUS	Neglected and underutilized species
NWRC	National Water Research Center (Egypt)
NWSAS	North Western Sahara Aquifer System
O&M	Operation and Maintenance
OAPEC	Organization of Arab Petroleum Exporting Countries
OAU	Organization for African Unity
ODA	Official Development Assistance
ODS	Ozone-Depleting Substance
OECD	Organization for Economic Co-operation and Development
OFID	OPEC Fund for International Development
OIES	Oxford Institute for Energy Studies
OME	Observatoire Méditerranéen de l'Energie
OMW	Olive Mills Wastewater
ONA	Omnium Nord-Africain
ONE	National Electricity Office
ONEP	National Office of Potable Water
OPEC	Organization of Petroleum Exporting Countries
OPEX	Operational Expenditures
OSS	Sahara and Sahel Observatory (Observatoire du Sahara et du Sahel)
PACD	Plan of Action to Combat Desertification
PARC	Pan Arab Research Centre
PC	Personal Computer
PCB	Polychlorinated Biphenyls
PCFPI	Per Capita Food Production Index
PCFV	Partnership for Clean Fuels and Vehicles
PEA	Palestinian Energy and Natural Resources Authority
PERG	Global Rural Electrification Program
PERSGA	Protection of the Environment of the Red Sea and Gulf of Aden
PFCs	Perfluorocarbons
PICs	Pacific Island Countries
PIM	Participatory Irrigation Management
PJ	Peta Joule
PM	Particulate Matter
PMU	Program Management Unit
PNA	Palestinian National Authority
PNEEI	Tunisian National Program of Irrigation Water Conservation
POPs	Persistent Organic Pollutants
PPA	Power Purchase Agreement
PPIAF	Public-Private Infrastructure Advisory Facility
PPM	Parts Per Million
PPM	Process and Production Methods
PPP	Public-Private Partnership
PPP	Purchasing Power Parity
PPP	Public-Private Partnership
PRM	Persons with Reduced Mobility
PRY	Potential Researcher Year
PTSs	Persistent Toxic Substances
PV	Photovoltaic
PWA	Palestinian Water Authority
QNFSP	Qatar National Food Security Programme
QP	Qatar Petroleum
QSAS	Qatar Sustainable Assessment System
R&D	Research and Development
RA	Risk Assessment

RADEEMA	Régie autonome de distribution de l'eau et de l'électricité de Marrakech
RBO	River Basin Organization
RBP	Restrictive Business Practices
RCM	Regional Circulation Model
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RDF	Refuse Derived Fuel
RE	Renewable Energy
REC	Renewable Energy Credits
REMPEC	Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea
REN21	Renewable Energy Policy Network for the 21st Century
Rep	Republic
RM	Risk Management
RO	Reverse Osmosis
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
RPS	Renewable Portfolio Standard
RSA	ROPME Sea Area
RSC	Royal Society of Chemistry (UK)
RSCN	Royal Society for the Conservation of Nature
RSGA	Red Sea and Gulf of Aden
RUAF	Resource Centers Network on Urban Agriculture and Food Security
S&T	Science and Technology
SAIC	Science Applications International Corporation
SAP	Strategic Action Program
SASO	Saudi Standards, Quality and Metrology Organization
SCP	Sustainable Consumption and Production
SCPI	Sustainable Crop Production Intensification
SCP/RAC	Regional Activity Centre for Sustainable Consumption and Production
SD	Sustainable Development
SEA	Strategic Environmental Assessment
SEEC	Saudi Energy Efficiency Centre
SEMC	Southern and Eastern Mediterranean Countries
SFD	Saudi Fund for Development
SHS	Solar Home System
SIR	Shuttle Imaging Radar
SIWI	Stockholm International Water Institute
SL	Syrian Pound
SLR	Sea Level Rise
SME	Small and Medium-Size Enterprises
SMS	Short Messaging Service
SoE	State of the Environment
SONEDE	Société Nationale d'Exploitation et de Distribution des Eaux
SOx	Sulfur Oxides
SPD	Sozialdemokratische Partei Deutschlands
SPM	Suspended Particulate Matter
SRES	Special Report on Emission Scenarios
SRTM	Shuttle Radar Topography Mission
SSA	Sub-Saharan Africa
SSR	Self-Sufficiency Ratio
SWCC	Saline Water Conversion Corporation
SWH	Solar Water Heating
SWRO	Seawater Reverse Osmosis
T&D	Transmission and Distribution
TAC	Technical Advisory Committee
TAR	Third Assessment Report
Tcm	Trillion cubic meters
TDM	Transportation Demand Management

TDS	Total Dissolved Solids
TES	Thermal Energy Storage
TFP	Total Factor Productivity
TIES	The International Ecotourism Society
TII	Thermal Insulation Implementation
Toe	Tons of Oil Equivalent
TPES	Total Primary Energy Supply
TRAFFIC	Trade Records Analysis for Flora and Fauna in International Commerce
TRI	Toxics Release Inventory
TRIPs	Trade-Related Aspects of International Property Rights
TRMM	Tropical Rainfall Measuring Mission
tU	tones of Uranium
TWh	Terawatt-hour
UA	Urban Agriculture
UAE	United Arab Emirates
UCLA	University of California at Los Angeles
UCS	Union of Concerned Scientists
UF	Ultrafiltration
UfM	Union for the Mediterranean
UHCPV	Ultra-High Concentration Photovoltaic
UHI	Urban Heat Island
UIS	UNESCO Institute for Statistics
UK	United Kingdom
UMA	Union du Maghreb Arabe (Arab Maghreb Union)
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
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
UNESCO-ROSTAS	UNESCO Regional Office for Science and Technology for the Arab States
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
UNIDO	United Nations Industrial Development Organization
UNISDR	United Nations International Strategy for Disaster Reduction
UNWTO	United Nations World Tourism Organization
UPC	Abu Dhabi Urban Planning Council
UPI	United Press International
USA	United States of America
USAID	United States Agency for International Development
USCCSP	United States Climate Change Science Program
USEK	Université Saint-Esprit De Kaslik
USEPA	United States Environmental Protection Agency
USJ	Saint Joseph University
USPTO	United States Patent and Trademark Office
UV	Ultraviolet (A and B)
VAT	Value-Added Tax
VC	Vapor Compression
VCM	Volatile Combustible Matter

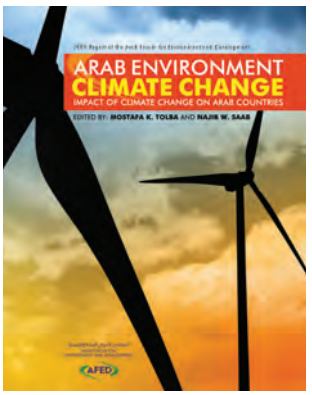
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
VRS	Vapor Recovery System
WACC	Weighted Average Cost of Capital
WaDImena	Water Demand Initiative for the Middle East and North Africa
WAJ	Water Authority of Jordan
WALIR	Water Law and Indigenous Rights
WANA	West Asia and North Africa Region
WB	West Bank
WBCSD	World Business Council for Sustainable Development
WBGU	German Advisory Council on Global Change
WCD	World Commission on Dams
WCED	World Commission on Environment and Development
WCMC	UNEP World Conservation Monitoring Center
WCP	World Climate Programme
WCS	World Conservation Strategy
WDM	Water Demand Management
WDPA	World Database on Protected Areas
WEEE	Waste of Electronic and Electrical Equipment
WEF	World Economic Forum
WEI	Water Exploitation Index
WETC	Wind Energy Technology Centre
WF	Water Footprint
WFN	Water Footprint Network
WFP	World Food Programme
WGP-AS	Water Governance Program in the Arab States
WHO	World Health Organization
WIPP	Waste Isolation Pilot Plant
WMO	World Meteorological Organization
WNA	World Nuclear Association
Wp	Watt-peak
WRI	World Resources Institute
WSSCC	Water Supply and Sanitation Collaborative Council
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WTTC	World Travel and Tourism Council
WUA	Water User Association
WUE	WUE Water Use Efficiency
WWAP	World Water Assessment Program
WWC	World Water Council
WWF	World Wide Fund for Nature
WWF	World Water Forum
WWI	First World War
WWII	Second World War
YASAD	Yemenite Association for Sustainable Agriculture and Development
YR	Year

State of Arab Environment Series
AFED Annual Reports

Arab Environment: Future Challenges

2008 Report of the Arab Forum for Environment and Development

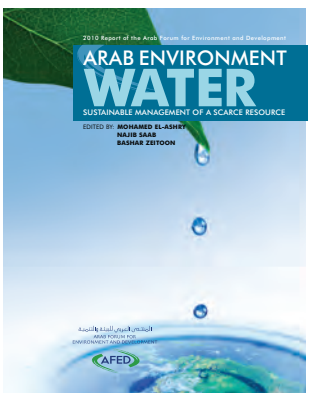
For the first time, a comprehensive independent expert report on Arab environment is released for public debate.
Entitled *Arab Environment: Future Challenges*, this ground-breaking report has been commissioned by Arab Forum for Environment and Development (AFED), and written by some of the most prominent Arab experts, including authors, researchers and reviewers. Beyond appraising the state of the environment, based on the most recent data, the policy-oriented report also evaluates the progress towards the realization of sustainable development targets, assesses current policies and examines Arab contribution to global environmental endeavors. Ultimately, the report proposes alternative policies and remedial action.



Arab Environment: Climate Change

2009 Report of the Arab Forum for Environment and Development

Impact of Climate Change on the Arab Countries is the second of a series of annual reports produced by the Arab Forum for Environment and Development (AFED). The report has been designed to provide information to governments, business, academia and the public about the impact of climate change on the Arab countries, and encourage concrete action to face the challenge. The report analyzes the Arab response to the urgent need for adaptation measures, and uses the latest research findings to describe the vulnerabilities of natural and human systems in the Arab world to climate change and the impacts on different sectors. In an attempt to help shape adequate policies, the report discusses options for a post-Kyoto regime and outlines the state of international negotiations in this regard.



Arab Environment: Water

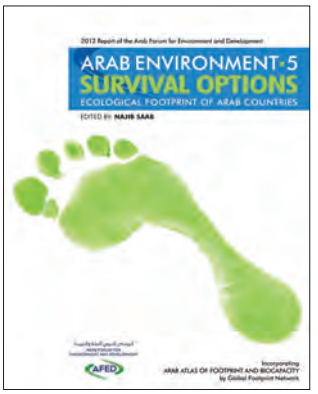
2010 Report of the Arab Forum for Environment and Development

Water: Sustainable Management of a Scarce Resource is the third of a series of annual reports produced by the Arab Forum for Environment and Development (AFED). It follows the publication of two reports, Arab Environment: Future Challenges in 2008 and Impact of Climate Change on Arab countries in 2009. The 2010 report is designed to contribute to the discourse on the sustainable management of water resources in the arab world and provides critical understanding of water in the region without being overly technical or academic in nature. The unifying theme is presenting reforms in policies and management to develop a sustainable water sector in Arab countries. Case studies, with stories of successes and failures, are highlighted to disseminate learning. This report contributes to the ongoing dialogue on the future of water and catalyzes institutional reforms, leading to determined action for sustainable water policies in Arab countries.

Arab Environment: Green Economy

2011 Report of the Arab Forum for Environment and Development

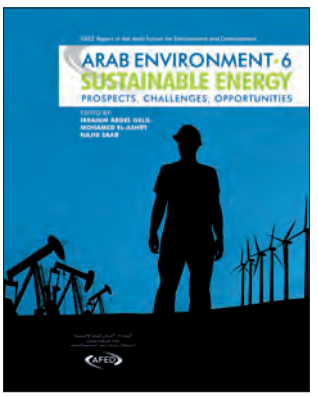
Green Economy: Sustainable Transition in a Changing Arab World is the fourth of a series of annual reports on the state of Arab environment, produced by the Arab Forum for Environment and Development (AFED). This report on options of green economy in Arab countries represents the first phase of the AFED green economy initiative. Over one hundred experts have contributed to the report, and discussed its drafts in a series of consultation meetings. The report is intended to motivate and assist governments and businesses in making a transition to the green economy.
It articulates enabling public policies, business models, green investment opportunities, innovative approaches, and case studies, and addresses eight sectors: agriculture, water, energy, industry, cities and buildings, transportation, tourism, and waste management.



Arab Environment: Survival Options

2012 Report of the Arab Forum for Environment and Development

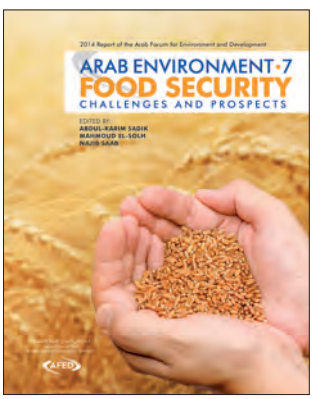
Survival Options - Ecological Footprint of Arab Countries is the fifth in the series of annual reports produced by the Arab Forum for Environment and Development (AFED) on the state of the Arab environment. It examines sustainability choices in Arab countries, based on a survey of people's demand of natural capital and available supply. The report discusses potential paths to sustainability based on ecological constraints. As a basis for the analysis, AFED has commissioned the Global Footprint Network, the world leader in this field, to produce an Arab Ecological Footprint and Biocapacity Atlas using the most recent data available. The Atlas covers the 22 members of the League of Arab States, as region, sub-regions and individual countries. The analysis focuses on the challenges posed by the state of food security, water and energy, while considering main drivers such as population and patterns of production and consumption. Ultimately, it prescribes regional cooperation and sound management of resources as the main options for survival in a region characterized by stark variations in ecological footprint, natural resources and income.



Arab Environment: Sustainable Energy

2013 Report of the Arab Forum for Environment and Development

Sustainable Energy is the sixth in the series of annual reports produced by the Arab Forum for Environment and Development (AFED) on the state of Arab environment. The report highlights the need for more efficient management of the energy sector, in view of enhancing its contribution to sustainable development in the Arab region. The AFED 2013 report aims at: presenting a situational analysis of the current state of energy in the Arab region, shedding light on major challenges, discussing different policy options and, ultimately, recommending alternative courses of action to help facilitate the transition to a sustainable energy future. To achieve its goals, the AFED 2013 report addresses the following issues: oil and beyond, natural gas as a transition fuel to cleaner energy, renewable energy prospects, the nuclear option, energy efficiency, the energy-water-food nexus, mitigation options of climate change, resilience of the energy sector to climate risk, and the role of the private sector in financing sustainable energy.



Arab Environment: Food Security

2014 Report of the Arab Forum for Environment and Development

Food Security is the seventh in the series of annual reports on the state of Arab environment, produced by the Arab Forum for Environment and Development (AFED). The report highlights the need for more efficient management of the agriculture and water sectors, in view of enhancing the prospects of food security. *Food security* is of great concern to Arab countries. They have been pursuing a target of higher food self-sufficiency rate, but achieving this goal remained beyond reach. While they have limited cultivable land and scarce water resources, they did not use their agricultural endowments in an effective and efficient manner. Lack of appropriate agricultural policies and practices led to diminishing the bio-capacity of the resources to regenerate their services and threatened agricultural sustainability. AFED hopes that its report on Food Security will help Arab countries adopt the right policies and commit to long-term investments, allowing them to secure a sustainable supply of food to meet ever-growing needs.

www.afedonline.org
info@afedonline.org

Notes