Sustainable Food Consumption in Arab Countries

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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 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 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 an average of 4360 kg of CO₂ for feeding (material flow attributable to the production of food 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 of 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, CO₂ 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) produces 170 kg of CO₂ every year, 50 percent of which come from storage, 27 percent from transport and 23 percent from cooking. For processed products, processing and packaging have 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 CO₂, 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.
FOOD SUSTAINABLE FOOD CONSUMPTION IN ARAB COUNTRIES

TABLE 1
CLASSIFICATION OF ARAB COUNTRIES ACCORDING TO NUTRITION TRANSITION

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
<th>Countries</th>
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| Countries in advanced nutrition transition | • high levels of overweight and obesity  
• moderate levels of undernutrition and micronutrient deficiencies  
• 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

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 2
GLOBAL AND REGIONAL PER CAPITA ENERGY CONSUMPTION OF FOOD (KCAL/CAPITA/DAY)

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<td>World</td>
<td>2,358</td>
<td>2,435</td>
<td>2,655</td>
<td>2,803</td>
<td>2,940</td>
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<tr>
<td>Near East and North Africa</td>
<td>2,290</td>
<td>2,591</td>
<td>2,953</td>
<td>3,006</td>
<td>3,090</td>
<td>3,170</td>
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</table>

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).
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. 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 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;

### Table 3: National Per Capita Energy Supply (KCAL/Capita/Day)

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Source: FAOstat (2015) and authors’ calculations
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 “diaita”, 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 can, 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.


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)

%  

<table>
<thead>
<tr>
<th></th>
<th>Cereal products</th>
<th>Vegetable oils</th>
<th>Meat and products</th>
<th>Milk and products</th>
<th>Fruits and vegetables</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lebanon 65-67</td>
<td>21</td>
<td>9</td>
<td>29</td>
<td>16</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Lebanon 79-81</td>
<td>27</td>
<td>8</td>
<td>11</td>
<td>11</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Lebanon 00-02</td>
<td>33</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Egypt 69-71</td>
<td>66</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Egypt 01-03</td>
<td>64</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Jordan 69-71</td>
<td>57</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Jordan 01-03</td>
<td>51</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>17</td>
<td>6</td>
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<tr>
<td>Kuwait 69-71</td>
<td>43</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Kuwait 01-03</td>
<td>40</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Saudi Arabia 69-71</td>
<td>61</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>0</td>
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<tr>
<td>Saudi Arabia 01-03</td>
<td>49</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

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
FOOD SUSTAINABLE FOOD CONSUMPTION IN ARAB COUNTRIES

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 overarching 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  \hspace{1cm} \textbf{WATER SAVINGS FROM REDUCED RED MEAT INTAKE IN ARAB COUNTRIES (billion m$^3$/country/year)*}

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Availability * (1000 MT/year)</th>
<th>Total Population* (1000s)</th>
<th>Per capita Availability (kg/capita/year)</th>
<th>Recommended Per capita Intake** (kg/capita/year)</th>
<th>Water Footprint of Red Meat *** (m$^3$/kg)</th>
<th>Per capita Water Saved from Red Meat Reduction (m$^3$/capita/year)</th>
<th>Total Water Saved from Red Meat Reduction - 2015 (m$^3$/country/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>329.69</td>
<td>36,414.29</td>
<td>9.1</td>
<td>5.2</td>
<td>15.5</td>
<td>3,220</td>
<td>2,427,235,077</td>
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<td>Bahrain</td>
<td>34.32</td>
<td>1,234.00</td>
<td>27.8</td>
<td>5.2</td>
<td>15.5</td>
<td>-</td>
<td>476,564,790</td>
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<td>Comoros</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.2</td>
<td>15.5</td>
<td>-</td>
<td>N/A</td>
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<tr>
<td>Djibouti</td>
<td>20.19</td>
<td>906.00</td>
<td>22.3</td>
<td>5.2</td>
<td>15.5</td>
<td>2,526</td>
<td>238,241,950</td>
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<td>Egypt</td>
<td>1020.13</td>
<td>80,410.00</td>
<td>12.7</td>
<td>5.2</td>
<td>15.5</td>
<td>3,557</td>
<td>9,829,450,112</td>
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<td>Iraq</td>
<td>65.82</td>
<td>33,226.00</td>
<td>14.5</td>
<td>5.2</td>
<td>15.5</td>
<td>3,471</td>
<td>516,698,581</td>
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<td>Jordan</td>
<td>115.86</td>
<td>6,249.00</td>
<td>18.5</td>
<td>5.2</td>
<td>15.5</td>
<td>3,149</td>
<td>1,590,079,196</td>
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<td>Kuwait</td>
<td>58.15</td>
<td>4,009.59</td>
<td>14.5</td>
<td>5.2</td>
<td>15.5</td>
<td>3,181</td>
<td>458,491,537</td>
</tr>
<tr>
<td>Lebanon</td>
<td>54.63</td>
<td>4,942.44</td>
<td>11.1</td>
<td>5.2</td>
<td>15.5</td>
<td>3,181</td>
<td>458,491,537</td>
</tr>
<tr>
<td>Libya</td>
<td>187.46</td>
<td>6,423.00</td>
<td>29.2</td>
<td>5.2</td>
<td>15.5</td>
<td>3,211</td>
<td>2,348,557,374</td>
</tr>
<tr>
<td>Mauritania</td>
<td>232.61</td>
<td>3,296.96</td>
<td>70.6</td>
<td>5.2</td>
<td>15.5</td>
<td>2,791</td>
<td>4,133,142,591</td>
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<tr>
<td>Morocco</td>
<td>361.35</td>
<td>32,245.00</td>
<td>11.2</td>
<td>5.2</td>
<td>15.5</td>
<td>3,334</td>
<td>3,161,191,946</td>
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<tr>
<td>Oman</td>
<td>43.81</td>
<td>3,295.00</td>
<td>13.3</td>
<td>5.2</td>
<td>15.5</td>
<td>-</td>
<td>521,745,614</td>
</tr>
<tr>
<td>Palestine</td>
<td>32.74</td>
<td>4,231.08</td>
<td>7.7</td>
<td>5.2</td>
<td>15.5</td>
<td>2,032</td>
<td>178,944,216</td>
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<td>Qatar</td>
<td>42.03</td>
<td>1,732.72</td>
<td>24.3</td>
<td>5.2</td>
<td>15.5</td>
<td>-</td>
<td>694,301,005</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>234.44</td>
<td>28,376.36</td>
<td>8.3</td>
<td>5.2</td>
<td>15.5</td>
<td>3,122</td>
<td>1,418,887,088</td>
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<td>Somalia</td>
<td>198.25</td>
<td>13,039.80</td>
<td>15.2</td>
<td>5.2</td>
<td>15.5</td>
<td>1,696</td>
<td>1,724,615,689</td>
</tr>
<tr>
<td>Sudan</td>
<td>1922.34</td>
<td>33,975.59</td>
<td>56.6</td>
<td>5.2</td>
<td>15.5</td>
<td>2,346</td>
<td>31,547,590,087</td>
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<td>Syria</td>
<td>271.03</td>
<td>25,083.71</td>
<td>10.8</td>
<td>5.2</td>
<td>15.5</td>
<td>3,106</td>
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<td>Tunisia</td>
<td>126.59</td>
<td>10,673.60</td>
<td>11.9</td>
<td>5.2</td>
<td>15.5</td>
<td>3,362</td>
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<tr>
<td>UAE</td>
<td>496.65</td>
<td>8,400.00</td>
<td>59.1</td>
<td>5.2</td>
<td>15.5</td>
<td>3,215</td>
<td>8,004,922,725</td>
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<tr>
<td>Yemen</td>
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<td>23,830.00</td>
<td>4.4</td>
<td>5.2</td>
<td>15.5</td>
<td>2,185</td>
<td>327,464,172</td>
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<td>Arab Countries</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>70,252,788,832</td>
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</tbody>
</table>

Source: Authors’ calculations, based on AOAD (2012)**, and Afshin et al. (2015)**, BCFN (2012)***, and UN (2013)

Units are as follows - MT: metric tons; m$^3$: 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.
FOOD SUSTAINABLE FOOD CONSUMPTION IN ARAB COUNTRIES

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.

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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.
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 m³/kg or 15,500 liters/kg), followed by other protein-rich foods, such as cheese, fish, eggs, and dairy products (2-5 m³/kg), whereas starch-based products, fruits, and vegetables require the least amount of water per kg consumed (<1 m³/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
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).

**BOX: THE ENVIRONMENTAL SUSTAINABILITY OF FISH CONSUMPTION**

The environmental sustainability of fish consumption can be assessed by examining the production and consumption patterns within Arab countries. This is crucial as the consumption of fish resources demonstrates the tension between food availability and environmental sustainability. 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**

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*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 (1,000 m³/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
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.

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.

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.

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)

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

APPENDIX III

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

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.

2. Be active.
3. Limit intake of fats and oils.
4. Limit intake of sugars, especially sweetend 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.
12. Choose poultry and lean meat.
13. Drink lots of clean water.
14. Eat clean and safe food.

REFERENCES


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.
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 Plan1. 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 m³/year/capita in Palestine and 2505 m³/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...
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

<table>
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Source: Authors’ elaboration based on data from Mekonnen and Hoekstra, 2011a. n.a.: No available data.
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 Mm³ to 62,157 Mm³ 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 m³/capita/year) while the highest was recorded in Bosnia and Herzegovina (1,849.7 m³/capita/year), closely followed by Italy (1,848.3 m³/capita/year). Intermediate Water Footprints were recorded in Turkey (1,291.6 m³/capita/year) and Morocco (1,644.9 m³/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. 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](image-url)
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 these 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.](image-url)
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
of oil per year (Lundqvist et al., 2008; Hall et al., 2009). Globally, the blue WF of food wastage is about 250 km³ (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 km³ 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) m³/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.

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Note