

Developing a methodological approach for assessing the sustainability of diets: The Mediterranean diet as a case study

SANDRO DERNINI^{1,3}, ALEXANDRE MEYBECK¹, BARBARA BURLINGAME¹, VINCENT GITZ¹,
COSIMO LACIRIGNOLA², PHILIPP DEBS², ROBERTO CAPONE², HAMID EL BILAL²

Jel Classification: Q18, O13

1. Introduction

Food consumption is variably influenced by a range of factors including food availability, food accessibility and personal food choice. These in turn may be influenced by geography, demography, disposable income, socio-economic status, urbanization, globalization, religion, culture, marketing, and consumer attitude (Kearney, 2010).

Food consumption and production patterns and trends are among the most important drivers of environmental pressures. With rising income and urbanisation dietary patterns are shifting, with pronounced regional and cultural differences, towards consumption patterns higher in animal products, which require more energy, water and land resources (Gerbens-Leenes and Nonhebel, 2005, Lundqvist *et al.*, 2008; Vanham *et al.*, 2013).

The role of eating patterns as important drivers for building sustainable agricultural and food systems has often been neglected by research and policy (Guyomard *et al.*, 2011). Many studies showed that the achievement of substantial reductions in agro-food-related greenhouse gas

Abstract

The concept of sustainable diets has been proposed to characterize dietary patterns and assess their sustainability in different agro-ecological zones. This paper describes the work conducted since 2010 to develop a methodological approach to be used for assessing the sustainability of dietary patterns. It identifies four main areas to be considered and provides a first list of indicators or families of indicators to be used and tested. The Mediterranean diet, scientifically well-characterized as a healthy dietary pattern, appreciated for its lower environmental impact and acknowledged as a cultural heritage, is used here as a model to assess sustainability of diets and food consumption patterns in the Mediterranean area. The methodological approach described here will be further refined and tested to be used to assess sustainability of diets and food consumption patterns in different contexts.

Keywords: sustainability, diet, food consumption, Mediterranean diet, indicators.

Résumé

Le concept de régimes alimentaires durables a été proposé pour caractériser les modèles alimentaires et évaluer leur durabilité dans différentes zones agro-écologiques. L'article décrit le travail mené depuis 2010 pour développer une approche méthodologique en vue d'évaluer la durabilité des modèles alimentaires. On identifie quatre domaines principaux à prendre en considération et on fournit une première liste d'indicateurs ou familles d'indicateurs à utiliser et tester. La diète méditerranéenne, scientifiquement bien caractérisée comme régime alimentaire sain, appréciée pour son faible impact environnemental et reconnue comme patrimoine culturel, a été utilisée comme modèle pour évaluer la durabilité des régimes et des modes de consommation alimentaires dans la région méditerranéenne. L'approche méthodologique décrite ici sera affinée et testée davantage pour être utilisée afin d'évaluer la durabilité des régimes et des modes de consommation alimentaires dans différents contextes.

Mots-clés: durabilité, régime alimentaire, consommation alimentaire, diète méditerranéenne, indicateurs.

(GHG) emissions to mitigate climate change must be addressed, not only by how we produce and distribute our food but also by what we eat (Marlow *et al.*, 2009; Garnett, 2013; Macdiarmid *et al.*, 2012; Vieux *et al.*, 2012). Recommendations for lowering energy inputs and GHG emissions from household food consumption include diets with less meat and dairy products, more in-season vegetables and more locally produced and fresh foods (Carlsson-Kanayama and Gonzalez, 2009). There is a growing body of evidence of the non-sustainability of current dietary trends (EC/JRC, 2009; S-DC, 2011; INRA/CIRAD, 2011; Guyomard *et al.*, 2011) that together with a growing evidence of the cost of diets on the environment, society and public

health nutrition (Haines *et al.*, 2009; O'Kane, 2012) has further raised the attention on the need for a shift towards more sustainable food consumption and production. The word "sustainability" itself requires further clarification and some caution in the use as it covers not only environmental issues but also economic, social, cultural issues (Lang and Barling, 2013), and public health issues (FAO/Bioversity, 2012).

In the early 1980s, the notion of "sustainable diets" was proposed to recommend diets which would be healthier for the environment as well as for consumers (Gussow and Clancy, 1986). With food globalization and the increased industrialization of agricultural systems, and with little attention paid to the sustainability of agro-food ecosystems,

¹ Food and Agriculture Organization of United Nations, Rome, Italy.

² Mediterranean Agronomic Institute of Bari (MAI-B), International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), Valenzano (Bari), Italy.

³ Forum on Mediterranean Food Cultures, Rome, Italy.

the sustainable diet concept was abandoned for many years.

Recently, the interest in sustainable diets has again been raised and, in 2010, through a technical workshop, an on-line consultation and an international scientific symposium, organized by FAO, in collaboration with Bioversity International, a common scientific position was reached on the definition of “sustainable diets”, taking into consideration the complexity of the sustainability concept applied to diets: “*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*” (FAO/Bioversity, 2012).

2. The Mediterranean diet as a sustainable diets' case study

The Mediterranean diet has been scientifically well-characterized as a healthy dietary pattern. It has also been analyzed in various studies and appreciated for its lower environmental impact (Duchin, 2005; Baroni *et al.*, 2007; EC/JRC, 2009). For these characteristics and because it concerns a vast number of countries, the Mediterranean diet, recognized by UNESCO as an intangible cultural heritage of humanity, has been selected by FAO as its first case study to develop a methodological approach for assessing the sustainability of diets in different agro-ecological zones (FAO/Bioversity, 2012; Lacirignola *et al.*, 2012).

The importance of the Mediterranean diet as an example of a sustainable diet lies not only in its specific foods and nutrients, but also in the methods used to characterize and analyze it and the philosophy of sustainability that is at its core as a lifestyle pattern (Burlingame and Dernini, 2011).

Since the pioneering *Seven Countries Study*, conducted by Ancel Keys, that established the association of the traditional Mediterranean dietary pattern with a markedly reduced incidence of coronary heart disease mortality (Keys, 1980), the Mediterranean diet has been widely studied and reported to be a model of healthy eating. Greater adherence to the Mediterranean diet has been associated with significant nutrition and health benefits (Willett *et al.*, 1995; Menotti *et al.*, 1999; Serra-Majem *et al.*, 2006; Sofi *et al.*, 2008; Maillot *et al.*, 2011, Estruch *et al.*, 2013). Indeed, numerous recent studies confirmed that good adherence to the traditional Mediterranean

Diet is systematically associated with a markedly reduced risk of cardio-vascular events and mortality (Buckland *et al.*, 2008; Trichopoulou *et al.*, 2009; Martínez-González *et al.*, 2009) and with a lower incidence of the metabolic syndrome (Kastorini *et al.*, 2011; Kesse-Guyot *et al.*, 2012). High intake of foods typical of the traditional Mediterranean dietary pattern –*e.g.*, fruit, vegetables, whole grains, olive oil and fish – were also associated with a reduced risk of developing various types of cancers (Bosetti *et al.*, 2009; Vernele *et al.*, 2010).

Despite its benefits, the Mediterranean diet is undergoing an erosion process, which poses important threats to its preservation and transmission as an intangible cultural heritage to future generations (Dernini, 2011). Many countries in the Mediterranean area are drifting away from the Mediterranean diet healthy pattern and current Mediterranean food consumption patterns show a decline in their adherence to the Mediterranean diet (IOTF, 2005; Alexandratos, 2006; Garcia-Closas *et al.*, 2006; Belahsen, Rguibi, 2006; da Silva *et al.*, 2009; Vareiro *et al.*, 2009).

The Mediterranean area is passing through a “*nutritional transition*” in which, in the Southern and Eastern Mediterranean countries, problems of under-nutrition coexist with overweight, obesity and food-related chronic diseases (Table 1).

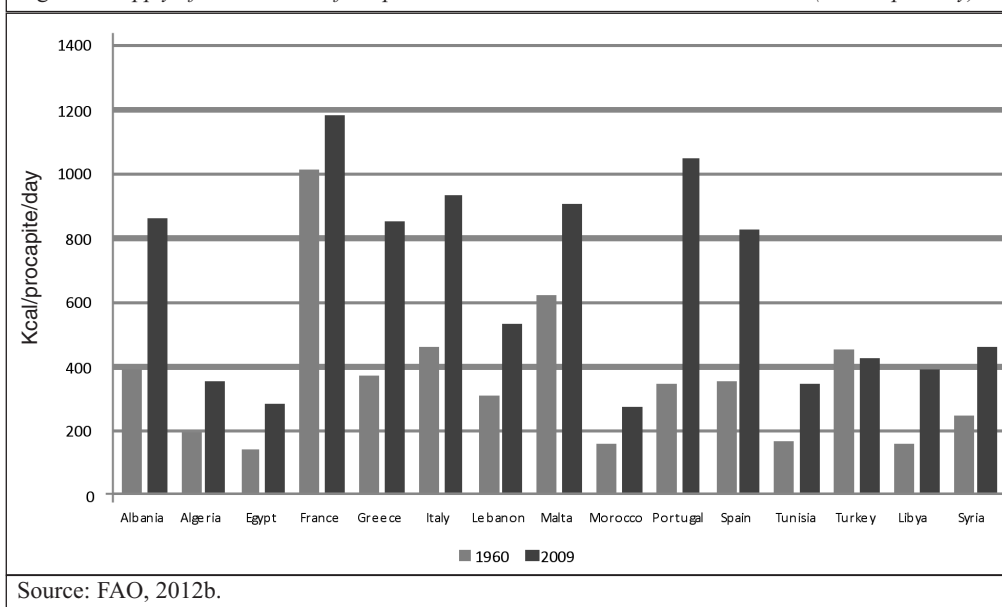
The decline of the adherence to the MD entails two major concerns: an increase in the consumption of lipids (*e.g.* meat, dairy products, etc.) (Figure 1) and a decrease in the consumption of complex carbohydrates (*e.g.* cereals and legumes) (Maillot *et al.*, 2011).

Changes of diets and consumption patterns in the Mediterranean region are the result of population growth (Plan Bleu, 2012), globalisation (Florensa and Aragall, 2012; González Turmo, 2012; Padilla, 2008) and urbanization (Florensa and Aragall, 2012). According to UNEP/MAP (2005), the Mediterranean agricultural and rural

Specification	Overweight 2011 (%) (WHO, 2011)	Obesity 2011 (%) (WHO, 2011)	Undernourishment 2010-2012 (%) (FAO, WFP and IFAD; 2012)
Albania	54.4	21.3	-
Algeria	45.5	16.0	<5
Egypt	67.9	33.1	<5
Iraq	62.3	27.0	26.0
Israel	60.9	26.2	-
Jordan	64.1	30.0	<5
Lebanon	61.8	27.4	<5
Libya	61.9	27.8	<5
Morocco	46.8	16.4	5.5
Syria	61.2	27.1	<5
Tunisia	53.7	22.3	<5
Turkey	61.9	27.8	<5

Source: CIHEAM-Bari's elaboration using data from WHO 2011 and FAO-WFP-IFAD 2012.

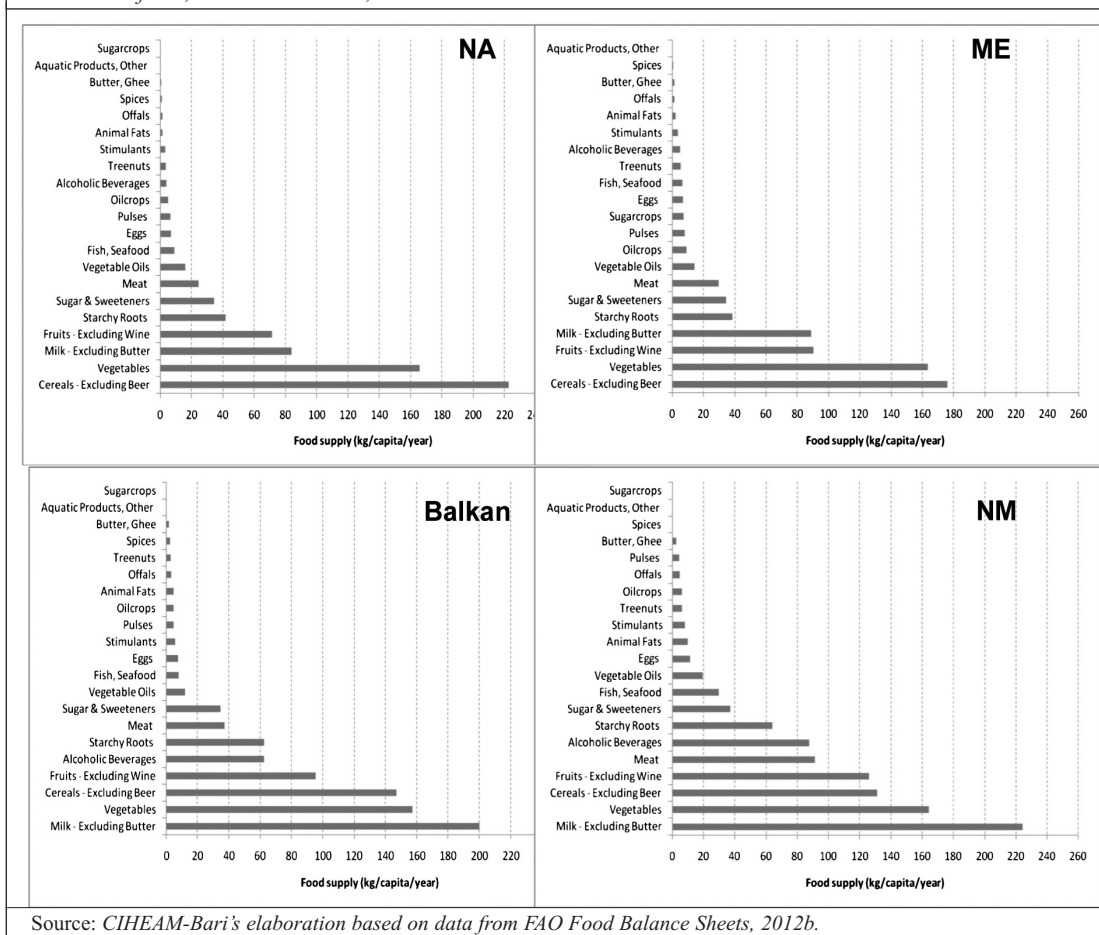
Figure 1. Supply of animal-based food products in selected Mediterranean countries (Kcal/capita/day)



Source: FAO, 2012b.

models, including the Mediterranean dietary model, are under increasing threat from the predominance of imported consumption patterns (Figure 2).

Figure 2 - Composition of the food supply in the Mediterranean region
NA: North Africa; ME: Middle East; NM: Northern Mediterranean.

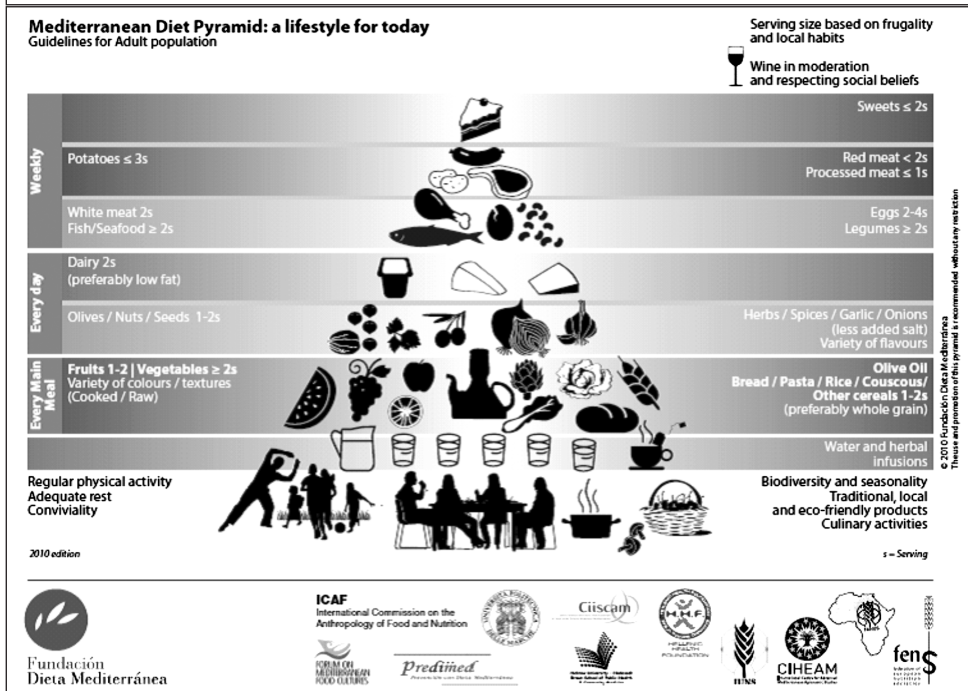


Source: CIHEAM-Bari's elaboration based on data from FAO Food Balance Sheets, 2012b.

Taking into consideration the erosion of the healthy Mediterranean diet pattern all around the Mediterranean area, in 2009 and 2010, a new revised Mediterranean diet pyramid was developed through a participative process (Bach-Faig *et al.*, 2011; Dernini *et al.*, 2012) (Figure 3). The concepts of seasonality, fresh and locally grown products, culinary activities, biodiversity, traditional, local and eco-friendly products, of variety of colours for fruit and vegetables were introduced along with main meals, conviviality and physical activity. The concept of frugality and moderation was emphasized because of the major public health challenge of overweight and obesity.

This revised Mediterranean Diet pyramid was conceived as a simplified main frame in order to be adapted to the different country specific variations related to the various geographical, socio-economic and cultural contexts of the contemporary Mediterranean lifestyle. It was aimed at better popularizing its applicability for present daily lifestyle, without leaving out the different cultural and religious traditions and different national identities present in the Mediterranean area. Main foods included in the common food basket are: an abundance of olive oil and olives, fruit, vegetables, cereals (mostly unrefined), legumes, nuts and fish, moderate amounts of dairy products (preferably cheese and yoghurt) and low quantities of meat and meat products. Wine in moderation was considered acceptable when it does not contradict religious or social norms.

The Mediterranean diet, through its new revised pyramidal repre-

Figure 3 - *The new Mediterranean diet pyramid.*

(Bach-Faig *et al.*, 2011).

sensation, shows that it not only offers considerable health benefits but also respects the environment.

3. A methodological approach for assessing the sustainability of diets in the Mediterranean area

The definition of sustainable diets agreed upon in 2010 (FAO/Bioversity, 2012) provided a starting point to identify the main thematic areas to be considered in order to assess the sustainability of diets. To the three dimensions of sustainability, economic, social and environmental, were added nutrition and health as the very objective of a sustainable diet, and also culture, key to characterize diets and their relations with food, society, economy and environment. Four main thematic areas were accordingly identified: 1) nutrition and health; 2) environment (including agro-biodiversity); 3) economy; and 4) society and culture (FAO, 2010). Through a participatory process, conducted in 2011 and 2012 by CIHEAM MAI-Bari and FAO, in collaboration with ENEA, CNR, INRAN, CIISCAM, Bioversity International, WWF-Italy, within these four main thematic areas, a first list of potential sustainability indicators was compiled (Table 2) and the following steps were identified to develop a methodological approach for assessing the sustainability of diets in the Mediterranean area (Lacirignola *et al.*, 2012):

- Identify priority sustainability challenges, within the four proposed thematic areas (nutrition and health; environment including agro-biodiversity; economy; society and culture);
- Identify the most appropriate indicators and available da-

ta resources to monitor the identified sustainability priority challenges.

For nutrition and health indicators

- Choose Mediterranean countries to apply the revised Mediterranean diet (MD) pyramid (Bach-Faig *et al.*, 2011), to be adapted to each country, as a comparison framework for current country food consumption patterns;
- Assess food consumption patterns in selected countries by using available food consumption surveys and food balance sheets/supply utilization accounts;
- Calculate country-specific consumption patterns and trends, in terms of dietary energy, protein, fat, and selected micronutrients;
- Assess these consumption patterns for their adherence to the revised MD pyramid (Bach-Faig *et al.*, 2011);
- Calculate a value/score using the data gathered for each indicator;
- Combine all scores into a scale and analyse trends over relevant time series. Assess from this set of indicators/scores the relationship between current dietary patterns, adherence to the MD pattern and the sustainability of food consumption and production at country level;
- Changes/trends will indicate whether a country is moving towards, or away from, nutrition and health sustainability.

For environmental, socio-cultural and economic indicators

- Identify for each selected country where the food comes from (locally produced and/or imported) by using recent and historic agricultural statistical databases (*e.g.*, FAO-STAT and CountrySTAT);
- Calculate a value/score using the data gathered for each indicator;
- Combine all scores into a scale and analyse trends in the sustainability of the diet over time. Assess from this set of indicators/scores the relationship between current dietary patterns, adherence to the MD pattern and sustainability of food consumption and production at country level. This set of scores/indicators provides a framework for assessing the relationship between the MD, sustainable diets and sustainable development;
- Changes in national-level indicators will indicate whether a country is moving towards, or away from, environmental, socio-cultural and economic sustainability.

For all diet sustainability dimensions

- Assess the overall (nutrition and health; environmental; economic; socio-cultural) sustainability of diet and food consumption patterns in each Mediterranean country;
- Develop a framework for country-based guidelines and

policy interventions for improving the sustainability of the Mediterranean diets.

The framework for the development of the guidelines for improving the sustainability of diets and food consumption patterns in the Mediterranean area will provide, among others, the following information: a simple operational definition of sustainable diets; for each indicator used to measure progress, the thematic and geographic scope; the rationale for the use of the indicator; the method of computation; sources of data; references, including relevant international databases; periodicity of measurements; gender and geographic disaggregation issues, when relevant; limitations of the indicator; national and international agencies involved in the collection, compilation or dissemination of the data, and when available targets and benchmarks. The intention is not to provide an exhaustive amount of information for each item, but to provide a reference point and guidance for country teams and national stakeholders.

3.1. Identification of the challenges for the sustainability of diets and food consumption patterns in the Mediterranean area

Recent reports, with trends and projections for the Mediterranean area (e.g. UNEP/MAP/Plan Bleu, 2011, 2008; FAO, 2012a) were taken into consideration to identify priority challenges for the sustainability of diets and food consumption patterns in the Mediterranean. They concern all the above mentioned thematic areas and include, but are not limited to:

- Nutrition and health: malnutrition and degree of adherence to the Mediterranean diet pattern;
- Economy: population growth, urbanization, food prices, and food losses and waste;
- Environment: water scarcity, climate change and biodiversity loss;
- Socio-cultural factors: homogenization of lifestyles and erosion of the Mediterranean diet cultural heritage.

3.1.1. Nutrition and health: malnutrition and decline of the adherence to the Mediterranean diet pattern

Recent surveys are pointing out that many countries in the Mediterranean area are drifting away from the Mediterranean diet healthy pattern and current Mediterranean food consumption patterns show a decline in their adherence to the Mediterranean diet (IOTF, 2005; Alexandratos, 2006; Garcia-Closas *et al.*, 2006; Belahsen and Rguibi, 2006; da Silva *et al.*, 2009; Vareiro *et al.*, 2009). The Mediterranean area could be described as passing through a “nutritional transition” in which problems of under-nutrition coexist with overweight, obesity and food-related chronic diseases (WHO, 2011; CIHEAM, 2008).

3.1.2. Economy: population growth, urbanization, food prices, and food losses and waste

Population growth in the Mediterranean Basin is marked

by a widening gap between the northern and southern shores: in the North, the growth rate is levelling off and the population is ageing, whereas the population in the South is increasing rapidly and steadily. Today, 25% of the Mediterranean population is under 15 years of age and 25% of the 15 to 24-year olds are unemployed (Plan Bleu, 2012). For the Mediterranean area, the globalisation of the economic field is introducing changes in the distribution and availability of food products (imports, commercial innovation, transformation of retail sales) while changes in lifestyles and food habits are simultaneously being introduced as a result of this transition from tradition to modernity (Florensa and Aragall, 2012).

Within the globalization process, the pressure from the agro-food market has forced the abandonment of some crops, long established livestock farming techniques and traditional crafts. It has imposed new networks and sales systems, and modified consumption habits. This impact entails losses in the knowledge and practices that have contributed historically to the identity of the Mediterranean peoples and have configured a rich and complex food universe in the Mediterranean area (González Turmo, 2012).

Price increase and volatility has a strong impact on the poor and on food importing countries, especially where diets are less diversified. It also risks modifying diets, especially of the poorest as they tend to shift to cheaper, less preferred, and, often, poorer quality foods (HLPE, 2011).

The distribution of food losses and waste along the food chain vary between regions. Relatively speaking, losses in the first part of the food chain, which are due to poor harvesting techniques, lack of transport and poor storage in combination with climate conditions, are more important in developing countries (Lundqvist *et al.*, 2008), where 40% of food losses occur at the post-harvest and processing level while in industrialised countries more than 40% of the losses occur at the retail and consumer level, i.e. food is wasted (FAO, 2011). Reducing in the entire Mediterranean area the amount of food wasted throughout the food chain (*i.e.* from farm to fork) would help improve food security and nutrition (FAO, 2011).

3.1.3. Environment: water scarcity, climate change and biodiversity loss

Water scarcity is the most critical development problem in the Mediterranean area and the single most important factor in limiting agricultural growth (UNEP/MAP/Plan Bleu, 2008). According to the 4th IPCC report (IPCC, 2007), the Mediterranean is one of the regions of the world in which global warming will impact the more environment and human activities (UNEP/MAP/Plan Bleu, 2008). Climate change is likely to affect agriculture and food security in the Region primarily through changes in temperature, precipitation, extreme climatic events and sea level rise (Skuras, Psaltopoulos, 2012). The main pressures on these ecosystems and their biodiversity come

Table 2 - Proposed indicators for assessing the sustainability of the Mediterranean food consumption patterns.

Thematic area	Proposed indicators
A. Nutrition and health	A1. Diet-related morbidity/mortality A2. Fruit and vegetable consumption/intake A3. Vegetable/animal protein consumption ratio A4. Dietary energy supply/intakes A5. Dietary diversity score A6. Dietary energy density score A7. Nutrient density/quality score A8. Food biodiversity composition and consumption A9. Nutritional anthropometry A10. Physical activity prevalence
B. Environment	B1. Water footprint B2. Carbon footprint B3. Nitrogen footprint B4. Biodiversity
C. Economy	C1. Food consumer price index (FCPI): cereals, fruit, vegetables, fish and meat C2. Cost of living index (COLI) related to food expenditures: cereals, fruit, vegetables, fish and meat C3. Distribution of household expenditure per groups: food C4. Food self-sufficiency: cereals, fruit and vegetables C5. Intermediate consumption in the agricultural sector: nitrogen fertilizers C6. Food losses and waste
D. Society and culture	D1. Proportion of meals consumed outside home D2. Proportion of already prepared meals D3. Consumption of traditional products (e.g. proportion of product under PDO or similar recognized traditional foods) D4. Proportion of mass media initiatives dedicated to the knowledge of food background cultural value
Source: Lacirignola <i>et al.</i> , 2012.	

from tourism, urban development in coastal areas, over-fishing, intensive farming and irrigation, and the abandonment of traditional agricultural practices (Numa and Troya, 2011).

The rich biodiversity of the Mediterranean terrestrial and marine flora and fauna, including many endemic species, is currently threatened by standardization of cultivation practices, monoculture, over-exploitation of natural resources, mechanization, and changes in lifestyles. Furthermore, indigenous knowledge on how to recognize, cultivate and use these local crops is also being lost at unprecedented rate. The genetic diversity of food crops and animal breeds is diminishing rapidly (Plan Bleu, 2012).

3.1.4 Socio-cultural factors: homogenization of lifestyles and erosion of the Mediterranean diet cultural heritage

Changes in intergenerational relations and gender relations, the role of women in society and interrelations with the rest of the world (tourism and migrations) are having main effects on Mediterranean lifestyles with a trend to the westernization of food consumption patterns in the Mediterranean area. These changes are influenced to a large extent by: urbanization, organization of working time,

growing participation of women in economic life, fewer household members, fewer generations living together, *desocialization*, collective environment (Padilla, 2008).

3.2. Identification of potential indicators

To select the most effective indicators, the following criteria were considered: 1. *Relevant to the question being asked i.e.* the indicator should be the best indicator currently available to answer the question; 2. *Understandable i.e.* clear, simple and unambiguous; 3. *Graphically representable*; 4. *Readily interpretable i.e.* clear which direction the indicator should develop to lead to greater sustainability; 5. *Relevant in most Mediterranean countries i.e.* not restricted to an issue which is limited to a few countries; 6. *Monitorable i.e.* based on data that is readily available, or could be made available at reasonable cost-benefit ratio and with regularity within the time frame of policy cycle (*i.e.* updated each year and within maximum four year time delay); 7. *Reliable and consistent i.e.* data collection and analysis methodologies should preferably be consistent

from country to country and at the very least be consistent within a given country from year to year; 8. *Representative i.e.* can be taken to represent current food consumption and production trends (Watson *et al.*, 2010).

In the identification process of the sustainability indicators, consideration was given to the set of indicators provided by the UK Department for Environment, Food and Rural Affairs for enabling and encouraging people to eat a healthy, sustainable diet (DEFRA, 2009). Using the above mentioned criteria as well as the wide range of diverging criteria (UN, 2007), a preliminary list of indicators for assessing the sustainability of Mediterranean dietary patterns was proposed (Table 2).

4. Conclusions

The assessment of the sustainability of dietary patterns is a critical development issue to counteract the emerging triple burden of undernutrition, overnutrition and micronutrient deficiencies in the Mediterranean region, particularly in Southern and Eastern countries. The abandonment of the healthy Mediterranean diet pattern and the emergence of new lifestyles associated with socioeconomic changes pose important threats for this intangible heritage as well as for the sustainability of Mediterranean food systems.

The Mediterranean diet results from a highly diversified heritage, which makes diverse in various countries. Food traditions vary from country to country in the Mediterranean area and as a consequence it is necessary to take into consideration different local realities with specific environmental, economic, social and cultural traits.

Diets are at the intersection of extremely diverse scientific disciplines. They are both the result and the driver of food systems. As such they have to be looked at simultaneously from diverse points of view. This requires huge amount of data, agreed methodologies and analytical tools, some of which do not currently exist in Mediterranean area. It requires also looking at dietary patterns not only from a nutritional point of view but also from environmental, economic, social and cultural perspectives, within a food system approach, to be further identified and developed.

The methodological approach presented in this paper requires to be tested and further refined in a group of selected Mediterranean countries. By considering together the various sustainability dimensions and their complex interactions, in the context of the Mediterranean area under investigation, it will also require to work together across disciplines to develop and strengthen studies of diets and food consumption patterns.

The multidisciplinary methodological approach described in this paper aims to facilitate dialogue among members of the scientific community on the sustainability of the diets in the Mediterranean area. The development of the priority 5 “*Food consumption patterns: diet, environment, society, economy and health*” of the Feeding Knowledge project (www.feedingknowledge.net) within the frame of 2015 Milan Universal Exposition, provides a great opportunity for a “Euro-Med pilot sustainability laboratory” to enhance the transition towards more sustainable food systems in the Mediterranean area. Such a transition requires a further development of holistic approaches within different spheres and arenas of agriculture, nutrition, health, economy, environment, biodiversity, climate change, society, culture, and lifestyle.

The methodological approach outlined in this paper aims to be useful to design policies for cross-sectoral policy instruments allowing the improvement of the sustainability of the diets and food systems in the Mediterranean area, which represents an important area of reflection and action for governments and international organisations concerned about socio-economic and environmental impacts of unsustainable agro-food practices (CIHEAM, 2012).

This methodological approach will be also useful for a similar work to characterize sustainable diets in other agro-ecological zones and among different cultural groups around the world, including the most vulnerable in terms of food security and nutrition.

Acknowledgments

This paper is the outcome of a collaborative effort between the Sustainable Food Systems Program, Department of Agriculture and Consumer Protection of FAO, supported

by the Government of Switzerland, the Nutrition Division of FAO, and the Department of Sustainable Agriculture, Food and Rural Development of CIHEAM-Mediterranean Agronomic Institute of Bari.

The following experts are acknowledged for their significant contribution towards the development of guidelines for the sustainability of diets in the Mediterranean area:

- Angela Polito, Aida Turrini, Federica Intorre, Giuseppe Maiani, Ex INRAN/CRA; Lorenzo M. Donini, Alessandro Pinto, Annamaria Giusti and Valeria del Balzo, CII-SCAM/Sapienza University of Rome, for the identification of nutrition and health indicators;
- Massimo Iannetta, ENEA, for the identification of environmental indicators;
- Eva Alessi; WWF-Italy, for the identification of environmental indicators;
- Giulio Malorgio, University of Bologna, for support in the identification of the economic indicators;
- Mauro Gamboni and Silvana Moscatelli, CNR, for the identification of the socio-cultural indicators.

Also, the following experts are acknowledged for their contribution to the brainstorming process that has accompanied the drafting of this document: Denis Lairon, University Aix-Marseille; Pasquale Steduto, FAO; Elliot Berry, Hebrew University-Hadassah Medical School; Lluís Serra-Majem, University of Las Palmas de Gran Canaria, Spain; F. Xavier Medina; Universitat Oberta de Catalunya (UOC); International Commission on the Anthropology of Food and Nutrition (ICAF)-Europe; Antonia Trichopoulou, Hellenic Health Foundation; WHO Collaborating Centre for Nutrition, Department of Hygiene and Epidemiology, University of Athens; and Federico Mattei, Bioversity International.

Authors would like to thank all those whose names may be not mentioned above and that have contributed in a way or another to the present work.

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