

## Towards a new food labelling system for sustainable food production and healthy responsible consumption: The Med Index Checklist

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### ABSTRACT

By 2024, the European Commission will examine a new sustainable labeling framework. Here we describe the development of a new food product labeling system, named Mediterranean Index (Med Index), aimed at promoting adherence to the Mediterranean diet (healthy and sustainable nutritional pattern) by stimulating citizens to practice physical activity consistent with the energy intake of meals and encouraging producers to make healthier and more sustainable food products. It is characterized by the possibility of integrating 27 criteria addressing the issue of sustainable food production processes in the frame of three pillars: nutritional, environmental, and social sustainability. It is conceived as a holistic front-of-pack (FOP) label, complete and applicable by food producers as it is based on measurable criteria, widely shared by stakeholders, but usually adopted on an individual basis.

*“Things are united by invisible bonds. You can't pick a flower without upsetting a star”*

Galileo Galilei

### 1. Introduction

Over the last decades, the frantic way of life in a fast technological society, demographic changes, the organization of work, and increasingly vast and varied offers on the market, have contributed to changing food purchasing choices. The double requirement on food purchasing consists of quickly and well-chosen products. The amount of information shown on food labels is often in contrast with the time devoted to choosing and the possibility of comparing foods belonging to the same product category (Egnell et al., 2018). The industrialization and globalization of the agri-food sector have strongly influenced the diet composition in Western countries. Refined and hyper-processed foods with higher calories and rich in ingredients of animal origin are more and more available. The changes in dietary regimens triggered in the last

century, favored by European economic growth after the end of the Second World War, led to a change also in food production and consumption models that have determined important impacts on citizens' and planetary health, known as the “diet, health, and environment trilemma” (Tilman and Clark, 2014). A “trilemma” is a difficult choice between three options, each of which is (or seems) unacceptable or unfavorable. Today, after the Greta Tumberg revolution has increased the awareness of people towards environmental issues and as a consequence of the COVID-19 pandemic, which has highlighted the fragility of human health (Hsu et al., 2020; Mozaffarian et al., 2021), it is necessary to develop tools (i.e., the food labelling information) that can modify both production and food consumption models to solve the trilemma.

Very often the problem of a healthy diet has just been limited to the nutritional and health aspects, without adequately integrating the concepts of environmental and social sustainability. In this sense, an example is the World Health Organization (WHO) recommendation, which considers the front-of-pack (FOP) labelling as a form of

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supplementary nutrition information. FOP serves as an important policy implementation tool to promote healthy diets by facilitating the consumers' understanding of the food's nutritional values to make healthier food choices and induce improved reformulation by the food industry. The disaggregated approach is the result of recommendations made before the world pandemic events of the last three years, so probably they can be considered inadequate or obsolete. The development of FOP labelling models has been accompanied in recent years by proposals for ethical and environmental labelling of food; anyway, despite the great interest of the European Commission, inside the Farm to Fork strategy, with a deadline set at 2024, no one has yet developed labelling proposals that integrate the three pillars of the sustainability of food systems: nutritional, environmental, and social aspects of food products. The "Farm to Fork" strategy aiming to address the challenges of producing and consuming food in a fair and sustainable way, reducing the environmental and climate impact of the food produce, ensuring food security and citizens' health through access to sufficient, nutritious, sustainable food, while generating fairer economic returns for every-one involved in the supply chain. It is a holistic approach to the transition to sustainable food systems by providing measures and targets for each step of the food chain, from production to processing, distribution to consumption (European Commission Communication, 2020).

The Food and Agriculture Organization (FAO) defined "Sustainable Diets" as diets with low environmental impact that contribute to food and nutritional security and a healthy life for present and future generations. This type of diet has to improve protection and respects for biodiversity and ecosystems, has to be culturally acceptable, economically fair, accessible, affordable, nutritionally adequate, safe and healthy, and has to allow the optimization of natural and human resources (FAO, 2019).

One of the main barriers that limits adherence to safe and sustainable diets, such as the Mediterranean Diet, is the ability that consumers may have, upon purchase, to consciously assess whether a food is healthy, if it has been produced with respect for the environment and if it contributes to ensuring social sustainability in the production, distribution and sales area.

To overcome this barrier, as previously said, the European Commission, among the objectives of the "From Farm to Fork" strategy, envisage, by 2024, to examine new ways to create a sustainable labelling framework that covers, in synergy with other relevant initiatives, the nutritional, climate, environmental, and social aspects of food products. This review is aimed at defining a new food product labelling system – provisionally named Med Index – able to include the dimension of sustainability (Clodoveo M.L.; Tarsitano E., Sabbà E., Gesualdo L., Corbo F., 2021) and promote the adherence to the Mediterranean diet, a well-recognized healthy and sustainable nutritional model, along with the practice of physical activity (consistent with the energy intake of meals). This newly conceived labelling system is aimed at promoting adherence to healthy and sustainable nutritional pattern that have been already recognized for Mediterranean diet in medical literature, but that can be achieved by assuming foods produced in any part of the world if the same nutritional and healthy properties of Mediterranean Diet are granted. At the same time, Med Index is expected to encourage the producers to make healthier and more sustainable food products. Through the Med Index project, we aimed to develop an evidence-based holistic FOP label, complete from a nutritional point of view and applicable by food producers because based on measurable criteria, in line with the objectives of the European strategy "From Farm To Fork".

### 1.1. The importance to promote the citizens adherence to the Mediterranean diet

The Mediterranean diet guarantees health benefits because it involves a high consumption of cereals, fruit, vegetables and legumes, and at the same time it is a sustainable diet model as the production of these foods requires the use of natural resources (soil, water) and less

intensive greenhouse gas emissions compared to Western dietary models in which the consumption of meat and animal fats, less healthy and less sustainable products, prevails.

The Mediterranean Diet is considered one of the healthiest dietary patterns, which reduces the risk of non-communicable diseases (metabolic syndrome, type 2 diabetes, cardiovascular diseases, some neurodegenerative diseases, and cancers). It is also the best-known dietary pattern in the world because is supported by:

- the studies of Ancel Keys, who in 1945 measured and disseminated its health effects, theorizing its principles (Tracy, 2019) (Fig. 1..);
- the world-famous pyramid representation, which graphically highlights the food groups to be consumed daily, weekly, or less frequently (Bach-Faig et al., 2011);
- the development of an index or score to evaluate Mediterranean Diet Pattern adherence, which allowed the study of its effects on health (Trichopoulou et al., 1995);
- the recognition by UNESCO (United Nations Educational, Scientific and Cultural Organization) of the Mediterranean Diet as a heritage of unanimity (UNESCO Mediterranean Diet, 2010).

These four reasons have been instrumental in spreading its basic principles all over the world.

Many people in Europe are conscious that the Mediterranean Diet is healthy because it includes meals based on fresh, minimally processed, local, and seasonal foodstuffs, with a balance between energy-dense and nutrient-dense foods. It is rich in plant foods (cereals, fruits, vegetables, legumes, tree nuts, seeds, and olives), with olive oil as the principal source of added fat, along with high to moderate intakes of fish and seafood, moderate consumption of eggs, poultry and dairy products (cheese and yogurt), low consumption of red meat and a moderate intake of wine during meals. However, there has been its progressive abandonment (Zuddeen et al., 2018), to the advantage of less healthy eating styles. The causes are to be found in the greater supply of food products far from the traditional model, in the increased mobility of people, and the "speeding up" of daily activities.

This always has more determined a widespread habit to consume meals away from home, reducing the time dedicated to preparation and lunch, with a consequent increase in consumption of quick and often nutritionally unbalanced meals (Lăcătușu et al., 2019) that can favor overweight and obesity, risk factors for many chronic non-communicable diseases, with a significant impact on social and health expenditure.

The discrepancy between what citizens know about the benefits of the Mediterranean diet and recent eating habits that contradict acquired knowledge can find a useful awareness tool in a holistic labelling model such as the Med Index. In this paper, we describe the research activity exploited for the development of this new food product labelling system, conceived as a holistic front-of-pack (FOP) label, based on the assessment (presence or absence) of 27 well clearly defined measurable criteria (9 for each of the 3 pillars considered: nutritional, environmental and social aspects) depending on the availability of mandatory or voluntary certifications held by companies and detailed in the back of the package. (e.g. blockchain, DOP, organic, renewable energy certification, ethical certifications, health claims etc.). The idea is that the Index value as resulted from the checklist of the 27 assessed criteria needs to be immediately visible to the consumer through a label of different colours on the front of the package (where blue corresponds to the best result). The aim is not to generate a burden of work or add complexity to the companies that want to use this newly proposed Index, but to provide them with a validated checklist. Therefore, Med Index does not replace but "aggregates" and "summarizes" a series of information that is often fragmented and not immediately visible in order to allow informed, rapid and efficient purchasing choices that respond to the specific needs of different consumers, who may be interested only in the nutritional aspects or in all the dimensions of the sustainability.

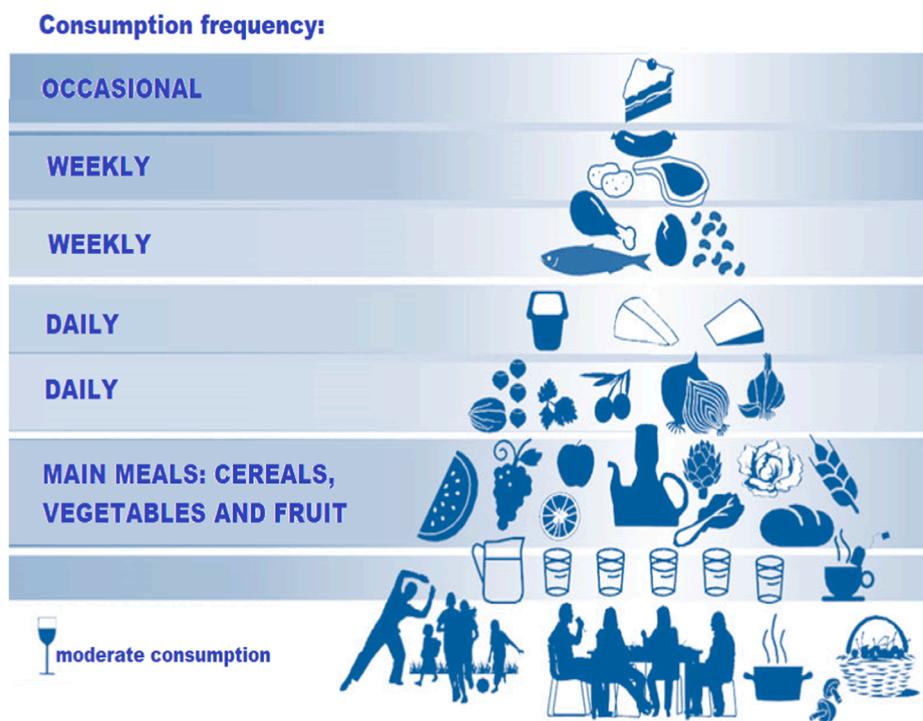


Fig. 1. Mediterranean Diet Pyramid (The image is freely inspired by the New Mediterranean Diet Pyramid (Bach-Faig et al., 2011).

### 1.2. The EU research efforts on Mediterranean diet

The Mediterranean Diet is a lifestyle focused on elements of the Mediterranean culture which includes healthy behaviours, personal and social habits. A Mediterranean lifestyle includes regular physical activity. The Mediterranean Diet affects longevity, as well as preventing the risk of some chronic diseases and cardiovascular diseases. Due to these evidence, during the last twenty years, European Commission spent efforts and money to support scientific research on the effect of the Mediterranean Diet on citizens' health. These precedents corroborate the belief that a labelling model such as the Med Index is perfectly in line with the actions of the past and the ambitions of the future approved in the European context.

A cohort study (23,349 men and women), published in the British Medical Journal, funded in part by the EU's 'Europe against Cancer' programme, shows that a number of food groups in the Mediterranean diet play a much more significant role than others in improving people's well-being and helping them live longer. The researchers, coordinated by Dimitrios Trichopoulos of the Harvard School of Public Health in the US (Castelló et al., 2022), evaluated the contribution of the nine widely accepted components of the Mediterranean diet (high intake of vegetables, fruits and nuts, legumes, fish and seafood, and cereals; low intake of meat and meat products and dairy products; high ratio of monounsaturated to saturated lipids; and moderate intake of ethanol), verifying an inverse association of this diet with all-cause mortality (14 % lower overall mortality).

A team of researchers supported by the EU-funded PREDIMED PLUS (a multicentre, nutritional intervention randomised clinical trial carried out in Spain from 2003 to 2011) project verified that an intervention with two Mediterranean diets, one rich in extra virgin olive oil and the other in nuts, compared to a low fat diet, can impact genes and improve health by means DNA for the correct expression of genes in the body's cells. This diet patterns help in the fight against several conditions, especially cardiovascular disease (Estruch et al., 2018).

The CREDITS4HEALT (a parallel-group, multicentre, randomised controlled community-based trial) is a social innovation and health promotion project, supported by EU, aimed at testing a preventive

healthcare system with the objectives to improve, by means people empowerment, the adoption of healthy dietary styles and enhance the level of physical activity. Promoting the Mediterranean Diet and the physical activity the project encourages citizens to be actively involved in maintaining and improving their health status, being responsible for their well-being, and committing themselves knowingly to an active lifestyle and a healthy diet. The main results obtained consist in an improvement in the participants' adherence to the Mediterranean diet making them more conscious of being able to get the benefits of a healthier diet and are therefore more motivated to change their eating behavior and their level of physical activity, factors associated with a substantial reduction in the risk of occurrence of chronic degenerative diseases and cardiovascular risk (Laiou et al., 2020).

Mediterranean Diet has beneficial and preventive role in the onset of diseases associated with increased level of inflammation. The EU project, NU-AGE, aimed to improve health and quality of life in the EU ageing population by counteracting *inflammageing* through a whole approach based on Mediterranean Diet. The project had the objective to fill in the lack of knowledge on how the whole diet (and thus the integration of different nutrients) can impact on and counteract age-related decline. The first outcomes obtained in the project indicate that those volunteers who were most adherent to the Mediterranean Diet, decreased the plasma levels of C-reactive protein, one of the main inflammatory markers that represented the primary outcome of the NU-AGE intervention and improve their lipid profile. Also, the gut microbiota diversity is preserved in volunteers following the Mediterranean Diet (Santoro et al., 2014; Berendsen et al., 2018; Ghosh et al., 2020).

### 1.3. Mediterranean diet is more than a nutrient combination: The interconnection between the well-being and ecosystems

Among the strengths of the Mediterranean diet, there is a sustainable production and consumption model for the environment and communities and the capability of adapting to different geographical, socio-economic, and cultural contexts (Barros and Delgado, 2022). The health, longevity, and well-being of the population, as well as the conditions and status of environmental resources, socio-economic

development, culture, and social stability, are influenced by food as well as its way of production (Table 1).

An effective demonstration of the sustainability of the Mediterranean Diet is the development of the “Environmental pyramid” (Ruini et al., 2015), which was created by evaluating the environmental impact of the foods that are part of the Mediterranean food pyramid. The values of the corresponding Ecological Footprint have been associated with food (i.e., the ecologically productive surface necessary to generate the resources used for production). A similar result was obtained from the estimate of the Carbon Footprint of food (the amount of greenhouse gases emitted

into the atmosphere). The result obtained, starting from a survey of the international scientific literature, is an inverted pyramid, with, at the top, the foods with the greatest environmental impact and, at the bottom, those with the lowest impact. By placing the two pyramids (the Mediterranean and Environmental ones) side by side (Fig. 2), it is possible to favor balanced, healthy, and sustainable diet models, and to encourage the adoption of eating habits that are healthy for humans and respect for the planet, reducing the impact of food choices on the environment and climate change. It is possible to note that the foods for which a higher consumption is recommended (fruit and vegetables), generally determine the least environmental impact. Conversely, the foods for which a reduced consumption is recommended (meat) are also those that have the greatest impact on the environment.

Agro-food systems are characterized by social, economic, and environmental factors influencing the sustainability of natural or artificial ecosystems (e.g., agroecosystems or urban ecosystems) and consequently have an impact on the health of citizens (Marchetti et al., 2020).

The Mediterranean Diet, in addition to the positive effects on the health of the population, represents a model of sustainable nutrition which, with its typical products, becomes an expression of history and culture (Vaquero et al., 2004) whose rediscovery represents an important opportunity to avoid homologation eating habits, safeguarding food biodiversity.

The use of the Mediterranean Diet not only improves the health conditions of the population but as already mentioned, is proposed as a model of sustainable nutrition, and in the context of the production framework, with its typical products it becomes an expression of the history and culture of which rediscovery represents an important opportunity to escape the standardization of eating habits, thus safeguarding food biodiversity.

Contrary to popular belief, the Mediterranean diet is not limited to southern European countries (Colao et al. 2022) but represents a broad set of food traditions that encompass many elements included in dietary models from northern Europe such as:

- the Atlantic diet (Northwestern region of the Iberian Peninsula and North of Portugal) (Krznařić et al., 2021), mainly based on the consumption of fish, meat, dairy products, vegetables and legumes, potatoes, and whole wheat bread; all these food classes are included in the Mediterranean diet pyramid;

- the Nordic diet (Denmark, Norway, Sweden, Finland, Greenland, and Iceland), based on local and seasonal foods with nutritional recommendations similar to the Mediterranean pattern (excepting the use of rapeseed/canola oil is used instead of extra virgin olive oil) and now orienting toward environmental protection and sustainability (Ainsworth et al., 2000).

The EU Green Deal, in particular the Biodiversity and Farm to Fork strategies, sets out measures and goals aimed at restoring a sense of coherence within its environmental and health policies (Fayet et al., 2022). In line with the Green Deal, the transition to more sustainable and healthy eating patterns requires a paradigm shift not only in consumer behavior but also in food production. This approach constitutes an opportunity for innovation and development that must be seized, also about the promotion of food models such as that of the Mediterranean diet. This change can have significant effects on the environment, availability of safe and quality food in sufficient quantity for all, and sustainability and resilience of food systems, even in the face of sudden crises such as the current one due to the COVID-19 pandemic (Mardones et al., 2020).

The global pandemic has revealed the fragility (Clapp and Moseley, 2020) at the world level of the current model of production and consumption, based mainly on globalization, poor management of natural resources, relocation of production, frequent disconnection with territories and communities for the achievement of objectives short-range, highlighting an approach to development based on the idea of unlimited growth to the detriment of the quality of life and the natural and social capital of communities in a context of growing environmental

**Table 1**  
Elements of sustainability of Mediterranean Diet.

Elements Of Sustainability Of Mediterranean Diet		
Nutritional sustainability	Diet-related morbidity/mortality	(Castelló et al., 2022; Estruch et al., 2018; Laiou et al., 2020; Santoro et al., 2014; Berendsen et al., 2018; Ghosh et al., 2020)
	Fruit and vegetable consumption/intake	(Rosi et al., 2019; Portugal-Nunes et al., 2021)
	Animal protein consumption ratio	(Donini et al., 2018)
	Average dietary energy adequacy	(Otsuka et al., 2021; Cano-Ibáñez et al., 2020)
	Dietary energy density score	(Real et al., 2020)
	Dietary diversity score	(Eme et al., 2019)
	Nutrient density	(Röös et al., 2018)
	Food biodiversity composition and consumption	(Crupi et al., 2018; Crupi et al., 2010)
	Physical activity/physical inactivity prevalence	(Buscemi, 2021; Annunziata et al., 2019)
	Adherence to Mediterranean dietary pattern	(Buscemi, 2021)
	Rate of local/regional foods and seasonality	(Annunziata et al., 2019)
	Rate of eco-friendly food production and/or consumption	(Crupi et al., 2018; Trajkovska Petkoska and Trajkovska-Broach, 2021)
	Environmental sustainability	Ecosystems' equilibrium
Water footprint		(Yardimci and Demirer, 2021; Xavier Medina, 2019)
Carbon footprint		(Coats et al., 2020; Martinez et al., 2019)
Nitrogen footprint		(Martinez et al., 2019; Serra-Majem et al., 2020)
Biodiversity		(Belgacem et al., 2021; Truzzi et al., 2020; Suárez-Gómez and Costa, 2021)
Social and economic sustainability	Animal welfare	(Belgacem et al., 2021; Medina-Albaladejo and Calatayud, 2021)
	Food consumer price index: cereals, fruit, vegetables, fish, and meat	(Donini et al., 2018)
	Cost of living index related to food expenditures: cereals, fruit, vegetables, fish, and meat	(Donini et al., 2018; Sarlio, 2018; Bajan et al., 2021)
	Food self-sufficiency: cereals, fruit, and vegetables	(Aboussaleh et al., 2020)
	Food losses and waste	(Blas et al., 2019; Medina, 2021)
	Conviviality	(Crupi et al., 2018; Diolintzi et al., 2019; Renzella et al., 2018)
	Gastronomic home preparation of meals	(Cavicchi and Santini, 2019)
Consumption of traditional products (e.g., the proportion of products under PDO or similar recognized traditional foods)	(Guiné et al., 2018; Arabia, 2018)	

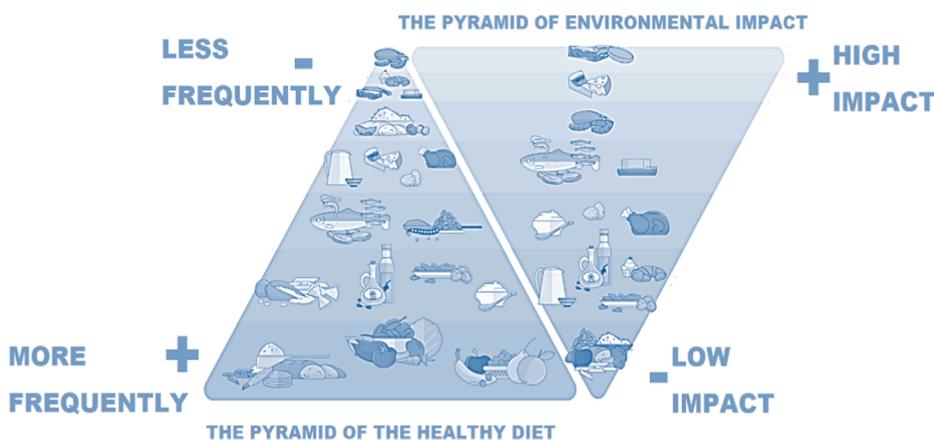


Fig. 2. The Double Food Pyramid, created by the Barilla Center for Food & Nutrition and Food Tank with the patronage of the Italian National Commission for UNESCO, is a graphic model that fully and clearly explains the relationship between food and the environment; the two food pyramids, that of the Mediterranean diet with the top facing up and the environmental one upside down, allow us to understand how much a balanced diet can promote good health, longevity, and well-being while reducing the environmental impact.

impact (Rivera et al., 2018).

1.4. FOP labelling development to encourage healthy lifestyles and ecological choices

The current European Food information to consumers defines obligation to provide nutrition information applies since 13 December 2016 (Ballke and Kietz, 2020) In particular; this Regulation provides a clearer and harmonized presentation of allergens together with certain nutrition information for the majority of prepacked processed foods.

In line with the Green Deal, the Farm to Fork, and Biodiversity strategies, a food label must quickly report either the features on the “what” is a food product or on the “how”, “when” and “where” it was produced (Sarkis et al., 2020), providing comprehensive information on the three pillars of sustainability: nutritional, environmental, and social-economic (Ranjbari et al., 2021). Developing innovative food labelling systems can allow combining different objectives:

1. providing the consumer with clear and immediate additional information to guide them in making healthier food choices (Lazzarini et al., 2018);
2. helping the consumer to make meaningful comparisons between products and understand the wider implications of the food they buy

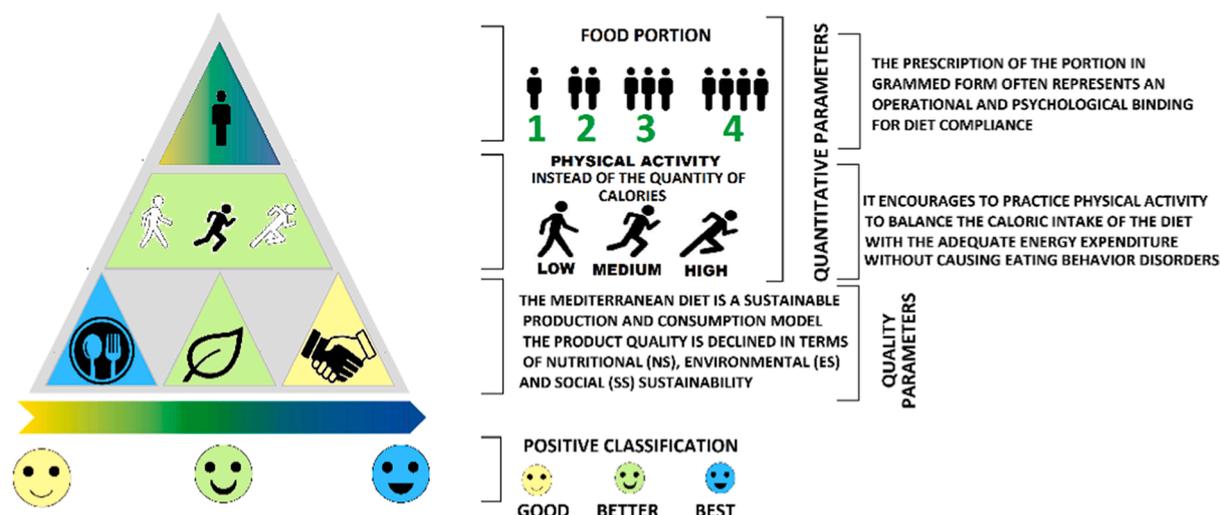
(Petrescu et al., 2020);

3. raising skills in the industry to assess products and design communications on their greenhouse gas emission, environmental, economic, and health profile (Niloofer et al., 2021);

4. encouraging Food Business Operators to develop and, where possible, reformulate food products that can be considered healthier solutions (Garst et al., 2017).

The Med Index is based on the scientific evidence that the Mediterranean Diet is a sustainable and effective dietary model as mentioned above. The purpose of the Med Index is to guide the consumer toward healthy food choices that improve life expectancy and quality of life by reducing health expenditure by means the compliance with Mediterranean diet guidelines.

Inspired by the need to reverse the consumption trend that has determined, in recent decades, a deviation of European citizens from adhering to a Mediterranean and sustainable diet model, we have developed a new labelling model called Med Index, in view of the expiry of the 2024 which envisages, in the Farm to Fork strategy, the examination by the European Commission of holistic labelling models that combine all the elements of sustainability. The Med Index (Fig. 3) is a quick and immediate system to recognize healthy food products and incentivize producers towards better products and sustainable



THE **MED-INDEX** IS A NUTRITIONAL LABELING SYSTEM THAT

- CONTRIBUTES TO EDUCATE CONSUMERS BY PROPOSING A HEALTHY AND SUSTAINABLE DIET MODEL AND
- ENCOURAGES PRODUCERS TO IMPROVE PRODUCTS AND PROCESSES
- IN COHERENCE WITH THE EUROPEAN "GREEN DEAL", "FARM TO FORK" AND "BIODIVERSITY" STRATEGIES

Fig. 3. The Med Index.

processes.

It has the triangular shape of the pyramid, a symbol of a healthy diet; the indication of the number of standard portions (Almiron-Roig et al., 2013) is reported on the apex, graphically instead of in grams to be inclusive towards all consumers, even those who may not understand and use the numerical information to improve awareness in the choice, in particular those with poor nutritional literacy and education or members of minority ethnic groups. The definition of “standard portion” is based on the IV revision of Dietary Reference Values of Nutrients and Energy for the Italian population (LARN) and corresponds to the quantity of food, that is recognized as a unit of reference both by the operators of the nutritional sector and consumers, consistent with the food tradition and of reasonable size, by the consumer’s expectation.

In the central band, the caloric intake is expressed as the intensity of the recommended physical activity to achieve through lifestyle a balance between consumed and ingested calories. The intensity of physical activity, measured with metabolic equivalents (MET), is classified into three levels: low (MET < 3; e.g., walking on level ground at 2.7 km/h, walking slowly, or walking at 4 km/h), medium (MET = 3–6; e.g., cycling, very light effort, walking at 5.5 km/h, or cycling at < 16 km/h), high (MET > 6; e.g., jogging or gymnastics such as push-ups, abdominals, etc.). There are no absolute or percentage numerical terms because, in the absence of skills (also a function of age, income, and level of education) they do not take on a meaning and contribute to positively changing eating choices and behaviors; on the contrary, they could hurt people with eating disorders (anorexia, bulimia, etc.). The last bar of the pyramid encompasses the three sustainability criteria (nutritional, environmental, and social, in line with the 2030 sustainability agenda and the objectives with those of the Green Deal, in particular the Farm to Fork and Biodiversity strategies. They inform consumers, providing either on whether food is good or bad for health or the food choice can be both nutritious and sustainable. Finally, it is remarkable the use of a positive color code (yellow for good, green for better, and light blue for best). The color of each dimension of sustainability is based on measurable criteria based on certifiable processes often already implemented by companies and presented fragmentarily on labels.

The use of the Med-Index can effectively create the conditions for Mediterranean food chains (farmers, processors, retailers, restaurants, and businesses) to produce and distribute healthier and more sustainable foods.

Fig. 4 shows the extreme cases of the Med Index color combinations. Table 2 summarizes the followed criteria to attribute a color to each

specific field of sustainability. A detailed description of the sustainability criteria will be conducted highlighting the benefits in terms of the health of citizens, communities, and the planet.

## 2. Nutritional sustainability

### 2.1. The product is in the traditional basket of products of the Mediterranean diet

The products of the basket of the Mediterranean diet are of vegetable and animal origin, ingredients and foods typical of the tradition (bread, pasta, cheeses, yogurt, kefir, vegetable, and fish preserves, etc.) and gastronomic culture of the countries of the Mediterranean area, which represent the result of agro- local bio-systems and the transfer of trans-generational know-how. The Med Index helps citizens to recognize healthy Mediterranean foods; moreover, if combined with the Mediterranean Food Pyramid, which indicates the frequency of consumption of each class of food, it allows to obtain a quantitatively and qualitatively balanced diet. The Med Index together with an educational campaign (Piscopo, 2009) (indispensable for the consumer understanding and judging nutritional information) can be, in a comprehensive nutrition policy package, a crucial measure to promote healthier food choices, modifying emerging eating habits, fighting obesity, and concurring to improve cardiovascular and cancer prevention in Europe.

### 2.2. The Mediterranean product respects the biodiversity of food

The Mediterranean product respects the biodiversity of food. Biodiversity is the basis of all the mechanisms that regulate the relationships between living beings, so as to ensure the balance of different ecosystems to the point that, if one species were to be missing, all the others would be affected. The protection of biodiversity is one of the recognized benefits of the Mediterranean Diet. Protecting biodiversity is of fundamental importance for achieving a sustainable future and is in line with the EU’s biodiversity strategy for 2030 pursuing some objectives:

- a. enhancing the local and typical products of a territory;
- b. protecting the environment;
- c. promoting the spread of organic farming;
- d. respecting the sustainability criteria in agriculture (Sánchez-Bravo et al., 2021);
- e. limiting sources of pollution.

Although there are over 6 thousand types of plants cultivated for

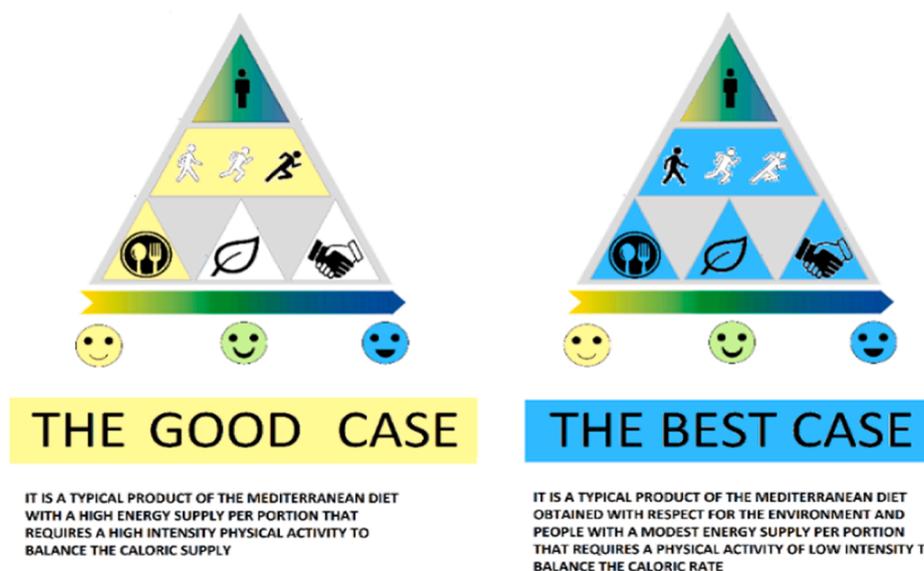


Fig. 4. The extreme cases of the Med Index color combinations.

**Table 2**

List of the criteria needed to attribute a color to each specific dimension of sustainability: nutritional, environmental, and social sustainability.

Criteria	Measurable parameter
<b>Nutritional Sustainability</b>	<p>1. The product is part of the traditional basket of products of the Mediterranean diet The Mediterranean product respects the biodiversity of food The Mediterranean product respects the seasonal availability</p> <p>2. The Mediterranean product has a balanced ratio of macronutrients The Mediterranean product has a nutritional claim The Mediterranean product is recognized by a certification of origin</p> <p>3. The Mediterranean product contains prebiotics The Mediterranean product contains probiotics The Mediterranean product has a health claim</p> <p>4. Nutrition declaration Commission Regulation (EU) No 432/2012 of 16 May 2012 European Database of PDO PGI TSG Products Commission Regulation (EU) No 432/2012 of 16 May 2012</p>
<b>Environmental Sustainability</b>	<p>1. It is a local food product certified by the traceability system The production process of the agri-food product takes place in full compliance with environmental and animal welfare regulations It is a zero-residue product (no pesticides and no antibiotics residues) from conventional farming systems</p> <p>2. It is a food product that comes from organic farming systems The food product comes from eco-friendly management of all waste throughout the entire production cycle The company has implemented a circular economic model production system.</p> <p>3. The production process uses renewable energies The product has an environmental sustainability certification relating to the carbon footprint The product has an environmental sustainability certification relating to the water footprint</p> <p>1. e.g., BlockChain e.g., Ethical certification e.g., Zero Residue - CCPB certification</p> <p>2. e.g. Organic certification e.g. Eco-Label e.g. BS 8001 certification</p> <p>3. e.g., 100 % Certified Green Energy e.g., ISO 14,067 e.g., UNI EN ISO 14,046</p>
<b>Social Sustainability</b>	<p>1. The production process is conducted in full respect of the labor regulations the income deriving from the product is equally divided among the players in the supply</p> <p>1. e.g., Ethical certification e.g., Ethical certification e.g., Ethical certification</p>

**Table 2 (continued)**

Criteria	Measurable parameter
chain the production systems protect the Mediterranean landscape and its identity role	Social Balance Report
2. the producer implements food education actions The producer invests in R&D aimed to support people's well-being and quality of life The producer measures the impacts of the production process on society (social report, SLCA, etc.)	
3. The producer takes positive action to promote gender equity The producer takes positive action to reduce inequality between generations The producer implements positive actions to create new jobs and reduce the forced migration of human capital that deplete the territory	Gender Balance Report Social Balance Report

food purposes, in the surveys carried out since 2014, the number of species that make a significant contribution to production globally would be <200. Food products that derive from production systems based on the cultivation of varieties of ancient plants or raise animals of species that are at risk of extinction, and that come from farms that have restored native ecosystems on saved agricultural land or integrated pockets of natural habitat in agricultural land, giving up monocultures, have a beneficial effect also on the nutritional level because the loss of biodiversity does not only harm the environment but also to the health of the man who suffers from not very varied diet than can provide adequate nutrition. In Europe a biodiversity database is developing in order to allow to calculate the effects on biodiversity for a large number of food products. This initiative will help citizen to choose foods and ingredients with a positive or low negative impact on biodiversity, finding biodiversity hotspots in the production chain, consumer information, etc. So, the criterion of biodiversity of food is increasingly measurable and verifiable. The Med Index recognizes and rewards producers who invest in the protection of biodiversity.

**2.3. The Mediterranean product respects the seasonal availability**

A correct and healthy diet needs to follow the seasonality of the products (Spence, 2021).

The United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) (Vargas et al., 2021) suggested two definitions of seasonal food:

- Global Seasonality: food is produced during the natural growing/production period for the country or region where it is produced, but it is not necessarily consumed where it is produced.

- Local Seasonality: food is produced outdoors without high-energy use climate modification or storage and being consumed in geographic proximity to the production.

Both settings, food is produced outdoors in its natural season without additional energy, thus not creating additional greenhouse gas emissions. This approach has economic and ecologic benefits. The former deals with the lower cost of seasonal products, especially if available at Km 0 (Local Seasonality), than non-seasonal ones, which generally come

from faraway places (so that the import cost greatly affects their price) or are grown in greenhouses (with lower supply of nutrients than the same products obtained from classic cultivation). Seasonal fruit and vegetable, especially at Km 0, take very little time to reach the tables, so they are fresher, tastier, and retain a much higher quantity of vitamins and bioactive molecules than off-season or imported products. Respecting seasonality is a useful strategy for varying the diet. Seasonality, global or local, is a verifiable criterion from the traceability data. The Med Index recognizes and rewards producers who produce and sell seasonal products.

#### 2.4. The Mediterranean product has a balanced ratio of macronutrients and micronutrients

The foods consumed daily are made up of molecules with an energetic, plastic, and regulatory function, which control cellular activities based on the correct functioning of the human body. Each substance we assume from food performs a specific function that translates, in terms of health, into a condition of the psycho-physical well-being of the individual. The right distribution of nutrients is fundamental to reducing the risk of the onset of diseases related to overweight and obesity or the damage caused by excessive calorie restriction. Nutritional adequacy is the comparison between the nutrient requirement and the intake of a certain individual or population. The Mediterranean products, if made of “local seasonal food”, are characterized by a balanced ratio of macronutrients and micronutrients. Moreover, the Mediterranean diet is characterized by a widespread knowledge among citizens of the frequency of consumption of the different classes of foods, which contributes to adherence to a varied dietary regime. The Med Index can be considered a tool able to recognize and combine foods with balanced ratio of macronutrients and micronutrients, that contains fewer sugars, salt, and saturated fats, and more fiber from whole ingredients. Moreover, the Mediterranean diet is characterized by a widespread knowledge among citizens of the frequency of consumption of the different classes of foods, which contributes to adherence to a varied dietary regime.

#### 2.5. The Mediterranean product has a nutritional claim

The nutritional claim is the indication that states, suggests, or implies that a food has particular beneficial nutritional properties, referring to the energy content it brings, or not, and to the nutrients or other substances it contains, or not. The “nutrition claims” are nutritional claims governed, in Europe, by regulation (EC) no. 1924/06 (Vicentini et al., 2016).

The purpose of the regulation and nutrition claims is to protect consumers' health and make them more aware of their choices through correct information. The European regulation also specifies the use and function of nutrition claims, to protect consumers from the ambiguous application of messages. For example, nutrition and health claims cannot:

- a. be false, ambiguous, or misleading;
- b. give rise to doubts about the safety and/or nutritional adequacy of other foods;
- c. encourage or tolerate excessive consumption of an item;
- d. affirm, suggest or imply that a balanced and varied diet does not provide adequate amounts of all nutrients;
- e. refer to changes in body functions that could arouse or exploit fears in the consumer.

The Med Index recognizes and rewards producers who choose raw materials and processes useful for claiming a nutritional claim on the label.

#### 2.6. The Mediterranean product is recognized by a certification of origin

Geographical Indications (GI) products identify a deep link with a

territory (Clodoveo et al., 2021): Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) are trademarks assigned by the European Union to those foods with unique and unmistakable characteristics that depend exclusively (Bellassen et al., 2022), or mainly, on the area in which they are produced. As part of the Mediterranean Diet, GI certified products offer various peculiarities including:

- a. trust, as they are products regulated by EU laws;
- b. traceability, since the products come from a defined geographical area;
- c. link with the territory with inimitable geological, agronomic, and climatic characteristics, since the products are obtained through traditional methods.

The presence of a geographical indications is a verifiable criterion. The Med Index recognizes the value of GIs in terms of quality and richness of intangible contents of the product (Mozaffarian et al., 2021) and rewards producers who choose product specification by subjecting themselves to periodic checks by third-party certification bodies.

#### 2.7. The Mediterranean product contains prebiotics

Mediterranean Diet includes many natural sources of prebiotics like legumes, beans, starchy fruits and cereals. Prebiotics are non-digestible oligosaccharides that, present in food, positively influence the growth and activity of one or a limited number of beneficial bacteria present in the colon (Seal et al., 2021). Prebiotics perform numerous beneficial functions:

- a. decrease in fecal pH with acidification of the intestinal contents;
- b. trophism of the mucosa and cell proliferation;
- c. increase of minerals bioavailability.
- d. hypocholesterolemic action.

The fermentation of prebiotics by the intestinal microflora generates lactic acid and short-chain carboxylic acids which create favorable acidic conditions for the growth of symbionts (*Bifidobacteria* and *Lactobacillus Acidophilus*) and are hostile for the development of pathogenic microorganisms. Consequently, there is a decrease in the “enemy” flora and its toxic metabolites, which, when present in excessive concentrations, favor inflammation of the mucosa and alter its permeability with negative repercussions on the health of the whole organism. These include ammonia (toxic to the brain), biogenic amines (highly toxic), nitrosamines (hepato-carcinogenic), and secondary bile acids (potent promoters of colon cancer) (Wu et al., 2021).

The short-chain fatty acids (Ashaolu et al., 2021) have also protective functions against inflammatory bowel diseases. They are excellent nourishment for the cells of the colon mucosa and help to improve trophism and effectiveness. Butyric acid, in particular, can reduce the proliferation of pathogens and prevent the development of colon cancer. Fructo-oligosaccharides improve the bioavailability of isoflavones present in legumes (having protective effects against various types of cancer, such as breast and prostate cancer) (Essa et al., 2021). All this translates into a better absorption of nutrients at the expense of toxic components. Prebiotics indirectly facilitate the absorption of water and some minerals in ionized form, in particular  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ . Prebiotics are useful in reducing the plasma concentration of cholesterol and, to a lesser extent, triglycerides (Korcz et al., 2018). In nature, oligosaccharides are present in numerous edible plants such as chicory, artichoke, onion, leek, garlic, asparagus, wheat, bananas, oats, and soy (Kaur et al., 2021). The presence of a prebiotic is a verifiable criterion certified by a claim approved by EFSA on the label (i.e. “Native chicory inulin, Barley grain fibre, Beta-glucans from oats and barley, etc.). The presence of Med Index recognizes and rewards producers who choose raw materials and processes useful for enriching the food product of prebiotics.

#### 2.8. The Mediterranean product contains probiotics

Mediterranean Diet includes many natural sources of prebiotics like

yogurt, kefir, freshly fermented cheese, fermented pickles, pickled vegetables, fermented olives, apple cider vinegar. The concept of probiotics (Ni et al., 2021; Goyal et al., 2020) (from the Greek: “pro-bios” in favor of life) was born in 1908 when the Nobel laureate Elie Metchnikoff put forward the hypothesis that the longevity of Bulgarian farmers was linked to the high consumption of fermented milk. In 1965 Lilly and Stillwell first used the term probiotics to describe “substances secreted by one organism, capable of stimulating the growth of another”.

To define a bacterium as a probiotic:

- a. it must normally be present in our intestine;
- b. it must resist the digestive action of gastric juice, intestinal enzymes, and bile salts;
- c. it must not give immune or otherwise harmful reactions;
- d. it must be able to adhere to intestinal cells and colonize them;
- e. it must have a beneficial effect on human health, thanks to the antagonism towards pathogenic microorganisms and the production of antimicrobial substances.

The presence of a probiotic is a verifiable criterion certified by a claim approved by EFSA on the label (i.e. Live yoghurt cultures). Med Index recognizes and rewards producers who choose raw materials and processes useful for enriching probiotics’ food products.

### 2.9. The Mediterranean product has a health claim

Framed by the regulations, at the European level (Khedkar et al., 2017; Commission, 2012), the indications have an informative function on the health properties of foods or their components. Health claims declare if food has beneficial nutritional properties. The so-called functional foods bear the health claims that constitute an important tool available to the consumer to achieve their health goals in conjunction with an adequate lifestyle. The success of functional foods depends, among other reasons, on the progressive aging of the population, the negative impact on the health of inadequate lifestyles (sedentary lifestyle, overweight, and obesity), as well as the development of innovative technology that makes it possible to develop innovative foods (Lammi et al., 2020; Lammi et al., 2020). For these reasons, functional foods constitute a sector in continuous development often with high information asymmetry (Roselli et al., 2017). Consumers can recognize functional foods at a premium price that reflects the monetary value of health risk insurance that they could contribute to decreasing. The Med Index is a tool that breaks the information asymmetry and helps the consumer to recognize, within the same product category, products that differ in their health properties.

## 3. Environmental sustainability

### 3.1. Local food products certified by the traceability system

The Mediterranean diet fits well into the definition of local foods not only for the opportunity to have fresh foods but also for the contribution to the local food market development linked to the economic growth and job creation. The geographical proximity is a verifiable criterion measurable by means traceability. Food labels can report different systems of certification to ensure authenticity and traceability of specific local products, at every stage of the supply chain (i.e Food traceability - ISO 22,005 certification). The traceability of food products and responsible consumption contribute to creating the foundations on which the concept of environmental sustainability rests (Rainero and Modarelli, 2021). The information normally found on product packaging is not always sufficient to answer consumer questions, mostly relating to the origin and processing of the foods purchased. Tracing products means putting in place control activities and systems necessary to validate, verify, and guarantee the origin, handling, and transformation of raw materials into finished products, independently of drugs, aeronautical parts, or agri-food products.

Regardless of the supply chain to which it belongs, traceability as an

absolute value has the objective of guaranteeing, on the one hand, the transparency and trust of the supply chain path from origin to consumption, and vice versa to demonstrate its traceability backward along the entire supply chain, to protect the final consumer at all levels. Lack of transparency along supply chains has always raised doubts and challenges regarding fraud, pollution, human rights violations, and other inefficiencies. The Blockchain is an IoT-based traceability system that has the potential to offer an unprecedented level of transparency, thanks to the use of a shared and decentralized database in which immutable and encrypted copies of information are stored on each node of the network. This ensures that the parties involved in various flows have peer-to-peer transactions and an absolute level of traceability and transparency along the food supply chain. The blockchain technology combined with specific algorithms also allows to the evaluation of the sustainability indicators related to the entire life cycle of the product (Parmentola et al., 2021).

### 3.2. The production process of the agri-food product takes place in full compliance with environmental and animal welfare regulations

Recently a revision and restructuring of the Mediterranean Diet Pyramid has been updated to incorporate more recent findings on the sustainability and environmental impact of the Mediterranean Diet pattern. Full compliance with environmental regulations can be demonstrated by a food manufacturer through environmental certifications, such as ISO 14,001 certification (Nowicki et al., 2021). The ISO 14,001 standard represents the regulatory reference point for companies and organizations equipped with or intending to adopt; an Environmental Management System. The standard defines an “Environmental Management System” as part of the company management system aimed at managing environmental aspects, meeting the obligations of legislative compliance, and addressing and evaluating risks and opportunities.

The Environmental Management System is characterized by the development and implementation of the environmental policy and the objectives that commit the organization to the full mandatory (legislative) and voluntary compliance (concerning additional voluntary requirements or dictated by the market). The food company itself, therefore, subscribes to these requirements in order to establish or integrate into its internal organizational system the rules for effective management regarding the significant environmental aspects.

It is possible to estimate the impact of a diet on animal welfare using indicators such as the number of animals that die to meet human food needs and the conditions in which the animals are kept. The frequency of consumption of proteins of animal origin in the Mediterranean diet is decidedly lower than in Western dietary models, and its promotion among European citizens could favor a change in consumption aimed at consuming less meat but of better quality, with positive effects for animals, welfare and environmental health. For animal products, compliance with environmental regulations is closely linked to the requalification of farming techniques, pursued by implementing sustainable policies, including animal welfare, to which breeders can adhere through a process of gradual improvement over time. Regarding animal welfare regulations, over the years, EU consumers have growingly expressed their wish to be better informed on the farming conditions of animals. Apart from eggs, most animal welfare claims are voluntary; there is no EU harmonized system for most products. There are also EU voluntary marketing standards for poultry meat, which include references to types of farming. In addition, the EU organic farming rules encourage a high standard of animal welfare. The challenge food companies face in the international trade of products from animals reared to a definable welfare status is due to the lack of recognized equivalence of different welfare assurance schemes. In Italy, the legislative premises for the development of a national certification scheme were established with Article 224-bis (Law of 17 July 2020, no. 77), which introduced the National Quality System for Animal Welfare

(SQNBA). The article aims to define a national production scheme that establishes the general rules and technical requirements for the management of the breeding process of animals reared by the evaluation of parameters established on a scientific basis. The SQNBA strengthens the environmental, economic, and social sustainability of animal products, thanks to the accredited certification of farms and the supply chain. In particular, the sustainability of animal products can be achieved through breeding techniques that are attentive to company management and biosecurity, aspects directly connected to animal welfare. Joining the system is voluntary and can be accessed by all operators who undertake to apply the relevant regulations and undergo the required checks. The objective of the SQNBA is to represent a single reference standard in the voluntary certification relating to animal welfare, thus putting an order in the various certification protocols currently existing concerning the same area, contributing to more clear information to the consumer. All these certification systems make the criterion of the Med Index verifiable and measurable.

### 3.3. Zero-residue product from conventional farming systems

If the Mediterranean diet is aimed to provide many health benefits, it is important to reduce or eliminate the risk consuming too many environmental contaminants. Under the Green Deal's Farm to Fork strategy, the European Commission has set a target of 'at least 25 % of the EU's agricultural land under organic farming and a significant increase in organic aquaculture by 2030'. This ambitious goal underlines that today most of the food that European citizens consume is not organic and therefore could contain environmental contaminants. "Zero residue" means the guarantee, on the food subject to certification, that there are no synthetic pesticides beyond the analytical detection limit. The "zero residue" approach requires a considerable commitment on the part of the farmer in defining the best strategies for containing diseases and parasites, both by adopting preventive and curative methods based on integrated pest management or using exclusively molecules with rapid degradation (in a few days, independently of climate - temperature, humidity, etc. - and technique of application) and respecting "safety" times; the pesticide residue must be under 0.01 mg/kg.

"Zero residue" is an antechamber of entry into organic farming (Romero-González, 2021), to learn how to deal with the threats posed by diseases and parasites through environmentally friendly solutions that respect the health of the consumer. It starts with zero residues and ends up in organic. It is an evolutionary path that farms are increasingly called upon to follow in order to be not excluded from the market. The claim "Zero residue" is certifiable and, as consequence, this criterion of Med Index is verifiable and measurable.

### 3.4. Product from organic farming systems

If the Mediterranean diet is aimed to provide many health benefits, also reducing, or eliminating, the risk of environmental contaminants, the organic products represent the best food choice. Cultivating in an organic way means working the land with techniques that respect natural cycles. The used processes safeguard the agricultural ecosystem and biodiversity, allowing sustainable rural development. Cultivating in an organic way also means not resorting to pesticides and fungicides of chemical origin, but instead, preferring periodic rotations that improve soil fertility and choosing biological control to combat parasites and weeds.

In particular, organic agriculture undertakes to apply a strict specification:

- a. no use of synthetic chemicals (fertilizers, pesticides, etc.), but only pesticides and fertilizers of natural origin;
- b. no use of GMOs;
- c. recycling of agricultural and organic waste;
- d. crop rotation for soil regeneration;
- e. pest control with biological agents.

Livestock in an organic way means providing high standards of animal welfare. In fact, their physiological rhythm is respected. They are raised in freedom and maintain their natural behavior.

Organic farming follows the principles of:

- a. animal feeding with organic feed;
- b. priority to alternative medicines and prevention;
- c. attention to animal welfare (surface area of living spaces, outdoor paths, pasture, prohibition of cage farming);
- d. respect for the environment and conservation of natural resources;
- e. maintenance and development of biodiversity (cultivation and breeding of different species).

Since 2007, the EU has made mandatory the use of the common organic brand (the green flag with the leaf of European stars) for all packaged products, made in the territory of the European Community, which contain at least 95 % of organic ingredients. EU legislation provides for the obligation to submit to the control system of all companies in the supply chain, from agricultural production to marketing. Due to this specific certification system this criterion of Med Index is verifiable and measurable.

### 3.5. Eco-friendly management of all waste throughout the entire production cycle, including the packaging

The Mediterranean Diet is also characterized by frugality. Frugality means moderation. In an abstract sense frugality can also be translated to a "zero-waste" approach when foods are consumed. The basis of all current European waste regulations is Directive 2008/98 - Waste Framework Directive: waste must be managed without compromising human health and without damaging the environment, in particular without risks to water, air, soil, plants, or animals, without causing annoyance by creating noises or smells, and without compromising the territory and places of particular interest. This ambitious directive aims to support the transition of the EU regions to a circular economy. In contrast to the traditional, linear economy, in the circular economy, products must be designed and produced so that they would be easy to share, lease, reuse, repair, refurbish, and recycle while using regenerative resources and renewable energy. The goal is to minimize waste (Tschamtko et al., 2021) and to keep products and resources in the economy for as long as possible. This win-win approach benefits both the economy and the environment.

### 3.6. Circular economic model

The Mediterranean Diet is a lifestyle rooted in tradition and dynamically evolving by adapting its principles to global changes. As a sustainable dietary model, the Mediterranean Diet must integrate production models that reduce the environmental impact also by adopting approaches based on the circular economy. Switching to the circular economic model not only creates new job opportunities but also provides environmental sustainability benefits deriving from a more conscious and responsible use of primary resources. However, the transition from the linear to the circular model (Niero and Rivera, 2018) turns out to be insidious and therefore requires specific standards and certifications to normalize this process.

The first standard that regulates circular economic models, and to which companies can refer, is BS 8001, born in 2017 in England thanks to the British Standards Institution (BSI). BS 8001 standard helps companies to integrate the principle of the three Rs (reduce, reuse, recycle) of the circular economy into their business model. In fact, this standard can be considered as a real "guide": it provides advice and recommendations on best practices for the transition of companies to circular economic models. BS 8001 can be applied internationally to any organization, regardless of location, size, sector, and type. In addition, it also provides practical ways to ensure small business goals can be achieved quickly. At the same time, it supports organizations to rethink the way of managing their resources, in order to increase the benefits related to

economic, environmental, and social sustainability. The presence of a recognized standard offers food companies the possibility of dealing with an independent third party during the transition from the linear to the circular economic model. The certification body, through gap analysis, training, and assessment services, can also guide the organization itself towards achieving its circularity objectives. Due to this specific certification system this criterion of Med Index is verifiable and measurable.

### 3.7. Renewable energies

As a sustainable dietary model, the Mediterranean Diet has to integrate production models that reduce the environmental impact also by adopting approaches based on renewable energy. Food goods represent the most important sector of the manufacturing industry in the European Union, with a presence of small and medium-sized enterprises of over 90 % distributed mainly in Southern Europe (only 1 % of companies in the sector can be cataloged as “large enterprise”).

In the coming decades, an important challenge arises for the sector worldwide. The FAO (United Nations Organization for Food and Agriculture), in fact, has predicted that the world population will rise to exceed 9 billion in 2050 and that it will therefore be necessary to produce 70 % more food. In the face of growing demand and constant international competitiveness, the national food industry must also rethink products so that they use fewer resources (energy, water, raw materials) and have a low ecological footprint. From an energy point of view, the European agri-food sector has high consumption, equivalent to about 11 % of industrial consumption. It is necessary to reward the efforts of companies in the time sector oriented towards the diversification of energy sources and increasing the contribution of renewables, with the search for innovative solutions that allow lowering consumption and energy costs.

Some food companies are applying a mark (100 % CERTIFIED GREEN ENERGY) to food products that give the guarantee that they have used Certified Green Energy, coming from production plants from renewable sources (Albert-Seifried et al., 2022). Due to this specific certification system this criterion of Med Index is verifiable and measurable.

### 3.8. The product has an environmental sustainability certification relating to the carbon footprint

A shift from a Western Dietary pattern to a Mediterranean diet would lead an average family to cut 95.78 MJ / month and 27.46 kg CO<sub>2</sub> eq / month without any significant difference in monthly food expenditure. The carbon footprint of a food product allows for evaluating the environmental impact in terms of global warming by the product along its life cycle (Rondoni and Grasso, 2021). This assessment intends to provide a common reference tool for quantifying, managing, and reducing greenhouse gas emissions. It is useful for credibly developing companies' environmental reputation, and demonstrating “accountability” in the fight against climate change to customers or institutions. To determine the Carbon Footprint the following rules can be used:

- a. ISO 14067;
- b. GHG Protocol;
- c. PAS 2050.

The ISO 14064 standard has the main purpose of providing credibility and guarantee (trust) to the reporting and monitoring processes of GHGs, in relation to the emission declarations by organizations and their reduction projects. UNI ISO 14064 is a standard made up of three parts that want to define the best international practices in the management, reporting, and verification of data and information referring to GHG (GHG - greenhouse gases). The standard is useful for planning and managing GHG inventories at the organization level (1st part), the

projects to reduce emissions/increase removals (2nd part), and give the requirements and principles for the operation of those bodies that carry out verification and validation of the declared data (3rd part).

Basically, the standardization of approaches (up to the publication of the ISO standard they were many and diversified ones) for the accounting and verification of emissions data should ensure that, for example, a ton of CO<sub>2</sub> is always the same, everywhere. It promotes consistency, transparency, and credibility in the counting of emissions and at the same time promotes their surveillance, checks, and the drafting of reports; allowing companies to identify and manage the risks and responsibilities related to harmful emissions of greenhouse gases; facilitates the marketing of permits and emission credits; favors the planning, development, and application of initiatives and programs aimed at the abatement of pollutants. Due to these specific certification systems this criterion of Med Index is verifiable and measurable.

### 3.9. The product has an environmental sustainability certification relating to the water footprint

the Western Diet has a 29 % higher WF in comparison with the Mediterranean Diet. The water footprint is a multidimensional indicator that quantifies the potential environmental impacts related to water (Asgharnejad et al., 2021), in quantitative and qualitative terms, considering both direct and indirect consumption of water and with a life cycle approach. In a general context of increasing water stress, and with particular reference to the problems of exploitation and pollution of groundwater in the European landscape, the water footprint (WF) is proposed as a useful means for:

- a. quantifying and communicating environmental impacts;
- b. optimizing the management of water resources and production processes.

The reference standard is UNI EN ISO 14046 “Water Footprint” (Zucchini et al., 2021), which specifies the principles, requirements, and guidelines relating to the WF assessment of products, processes, and organizations based on the LCA (Life Cycle Assessment) methodology. The water footprint, including the use and pollution of the resource along the entire supply chain, differs from the traditional concept of consumption, understood as simple withdrawal. A complete assessment of the water footprint is developed through:

- a. definition of the objectives and scope of the study, illustrating the purposes of the study, the applications and intended recipients, the assumptions and boundaries in the system;
- b. inventory phase, or the phase of collecting and quantifying water-related inputs and outputs for products, processes, and organization;
- c. assessment of the impact of the WF, represented by one or more parameters that quantify the potential environmental impacts of the product, process, or organization related to water;
- d. interpretation of the results, which includes the identification, based on the results of the WF assessment, of the significant aspects (e.g., processes, elementary flows, environmental mechanisms, etc.).

Finally, water footprint allows to:

- a. formulate more targeted environmental policies;
- b. optimize the processes with the greatest impact on the water resource;
- c. strengthen the image of the company nationally and internationally;
- d. promote transparent information for consumers.

The water footprint can be a significant complement to LCA and Carbon Footprint studies. Due to this specific certification system this criterion of Med Index is verifiable and measurable.

## 4. Social sustainability

### 4.1. The production process in full respect of the labor regulations

The general population is showing a renewed interest in the in

rediscovering a traditional dietary model, such as Mediterranean Diet, that can be more than a nutritional pattern, guaranteeing socially sustainable production systems and territorial development. Labor standards are constitutive elements of social sustainability. In Europe, the temporary nature of their activity can make seasonal workers more vulnerable to precarious living and working conditions and large retailers are increasingly developing ethical brands to contrast modern slavery in agriculture.

The EU already has an impressive regulatory framework to counter labor exploitation in its agri-food system, which includes legislation to better protect non-EU migrant workers (the Employer Sanctions Directive and the Seasonal Workers Directive, for instance) and EU laborers from other member states (the body of EU legislation on intra-EU mobility, including the revised Posted Workers Directive), anti-trafficking laws and the new European Labor Authority. The SA8000 Ethical Certification (Jain et al., 2018) finds its *raison d'être* in the acronym of Social Accountability 8000, a globally recognized reference standard created with the aim of ensuring optimal working conditions.

The SA 8000 Ethical Certification is an accredited standard that meets the needs of organizations that intend to stand out for their commitment to sustainable development, with particular attention to social issues. A management system that has the SA 8000 Ethical Certification, therefore, turns out to be an effective tool that allows the correct management and constant monitoring of all the activities and processes that impact the issues related to the conditions of workers (human rights, development, enhancement, training and professional growth of people, health and safety of workers, non-discrimination, work of minors and young people) and its requirements are also extend to suppliers and sub-suppliers. The SA 8000 Ethical Certification accreditation represents a fundamental guarantee for the market since it ensures a uniform approach and robustness of the procedures with which the certification body carries out its business. Accreditation adds value to the certificate issued by a certification body, offering the guarantee of independent control. Due to this specific certification system this criterion of Med Index is verifiable and measurable.

#### 4.2. *The income deriving from the product is equally divided among the players in the supply chain*

Consumption frequency of the main food categories of the Mediterranean Diet is deeply affected by socioeconomic and demographic factors: fish, fruit and vegetables are consumed more if the income of people is high. Higher incomes are associated to a reduced consumption of meat and eggs, dairy products. The problem of income inequality has to be resolved starting from the food production systems to make Mediterranean Diet a really sustainable model.

The organization of the agri-food chain, in fact, represents a delicate and fundamental issue, and its optimization is recognized as having an important role in improving the profitability of agricultural production and ensuring a fairer and more relevant distribution of value among the players in the supply chain (Riccaboni et al., 2021). Agricultural producers are generally in the middle of two competitive positions: the oligopolistic position of their buyers (i.e., wholesalers, traders, distributors) and the oligopolistic position of their suppliers of goods and services (technical means and financial services).

This phenomenon, combined with the pulverization of production companies, leads to an unequal distribution of value among the players in the supply chain, mainly to the detriment of the actors of the primary transformation, which threatens the social and economic sustainability of the agri-food systems. To face this threat, voluntary ethical brands have been developed which ensure complete traceability of the product by controlling the entire supply chain, managed according to an ethical model, and which guarantee its values such as:

- a. traceability of the product in all its phases from the raw material to the finished product;
- b. transparency of the product value chain;

- c. fair distribution of value among all the players in the supply chain;
- d. support farmers and breeders in their business activities;
- e. support and development of the biodiversity of the various production areas, respecting animals and the environment, as a heritage of territorial identity.

Without action made to reduce the income gap among the different actors of the food supply chain, in the long period, the elements of sustainability of the Mediterranean Diet will fall because the producers of foodstuff will be the first subjects unable to buy products from the Mediterranean basket and to be able to aspire to a healthy lifestyle.

Some companies have started to draw up a social report in order to make their organization more transparent. Through the Social Report, companies implement a certification of the ethical profile, reinforcing their link with the territory and the social fabric that insists on it.

The presence of concrete actions in favor of reducing the unequal distribution of value along the supply chain, appropriately documented in the social report, represents an evaluable and therefore measurable criterion within the Med Index.

#### 4.3. *The production systems protect the Mediterranean landscape and its identity role*

Food production is the only manufacturing activity with which, in addition to transforming raw materials, creating significant amounts of income, at the same time, the environment, the territory, and the landscape are protected (Provenza, 2021). Therefore, the Mediterranean food landscape represents the set of principles and actions in defense of territorial integrity and national environmental and landscape values, which allows agricultural producers to be able to use food raw materials from healthy substrates suitable for packaging with entrepreneurial skill and with respect for traditions and the different agro-food products which represent an important voice of the economy (Dipalmo et al., 2016). Biodiversity at the table far from being a speculative or aesthetic concept is a mirror of the enormous food heritage of biological diversity of the European states. Sustainable agriculture of a European character, in addition to guaranteeing food supply ("food security"), maintaining the profitability and competitiveness of farms, guaranteeing landscape management and animal welfare, reducing greenhouse gas emissions, ensuring a fair standard of living for farmers, should, at the same time, maintain the vitality of local communities, manage natural resources, protect animal and plant species ("Biodiversity") respecting the landscape. It is, therefore, a question of producing healthy foods for the consumer at reasonable prices (Roselli et al., 2018), respecting the environment, treating workers and animals with dignity, allowing farms to remain economically viable, safeguarding the recreational characteristics of the landscape, protecting precious ecosystems, and biodiversity benefit of rural communities. To date, there is no ethical label that awards farmers who are committed to safeguarding the Mediterranean landscape, although this aspect, which is part of the intangible quality characteristics of the food product, is an emerging need for consumers. The fulfillment of this criterion, and therefore its measurability, can be documented in the social report or corporate social responsibility report, which is a document with which a company periodically communicates the results of its activity on a voluntary basis, not limited to the financial and accounting aspects only. The most widespread definition of social responsibility was published by the European Union: "Voluntary integration of the social and ecological concerns of companies in their commercial operations and in their relations with interested parties" (Surrey, 2000).

#### 4.4. *The producer implements food education actions*

Education and training play a fundamental role in the transition process towards the improvement of adherence to the Mediterranean Diet and the implementation of sustainable food production systems; this transition can only be possible if the concept of sustainability

becomes an integral part of the educational path that transversally involves civil society (Clodoveo et al., 2020). Education is the basis of every sustainability topic. Food education is one of the most powerful levers for optimizing human and environmental health through the modification of diets to achieve the Sustainable Development Goals of the 2030 Agenda (Lanou et al., 2021). Food companies that embark on a sustainable development path should invest in education projects food, aimed at workers in the company, students in schools, or citizens. Invest part of the profits in food education actions and see the commitment made for the present and future generations rewarded with the premium price. An ethical product label that includes actions in favor of healthy and sustainable food education does not yet exist even if it represents an emerging need of citizens demonstrated by the reward points awarded to companies that participate in European tenders for school catering services. The fulfillment of this criterion, and therefore its measurability, can be documented in the social report or corporate social responsibility report.

#### 4.5. The producer invests in R&D aimed to support people's well-being and quality of life

The World Health Organization in 1948 defined health as “the state of complete physical, mental, and social well-being” more than the simple absence of disease or infirmity. The themes of well-being and the organizational climate have been the subject of discussion for many years and for some time also of regulatory attention. In their book of 2003, Avallone and Bonaretti define well-being in these terms: “the ability of an organization to promote and maintain the highest degree of physical, psychological, and social well-being of workers in any type of occupation”. The quality of life is determined by the result of several factors which include:

- a. in the sphere of material well-being, or what is indispensable for physiological existence;
- b. in the psychological and immaterial sphere, afferent to one's own inner well-being, to self-realization, to the relationship with other people.

Corporate well-being is an integral part of the social and economic sustainability of agri-food production systems, and companies capable of investing in this area of sustainability should be rewarded if beyond the strictly regulatory aspects they manage to improve the work environment by conferring additional ethical requirements (Nazzaro et al., 2020). The complementary actions to promote corporate well-being can fall into numerous categories, such as:

- a. offering supplementary insurance;
- b. investing in professional equipment and accessories to facilitate work;
- c. preparing initiatives in favor of flexibility (hours, teleworking, etc.);
- d. providing for actions to ensure safety at work;
- e. offering psychological support to collaborators;
- f. implementing career plans and training projects;
- g. providing aesthetically pleasing and functional work environments;
- h. rewarding performance with bonuses, vouchers, gift certificates, etc.;

#### 5. Encouraging a healthy diet;

- j. encouraging initiatives to support the spending capacity of collaborators;
- k. supporting physical and sports health plans for employees;
- l. facilitating collaborators in managing their private life.

An ethical product label that includes actions in favor of working well-being within agri-food companies does not yet exist even if it represents an emerging need of the citizens of today and tomorrow. The fulfillment of this criterion, and therefore its measurability, can be

documented in the social report or corporate social responsibility report.

#### 5.1. The producer measures the impacts of the production process on society (social report, SLCA, etc.)

One of the methods companies can use to measure and improve the impact of their production and company activities consists of the social report describing corporate social responsibility. In fact, corporate social responsibility (CRS) is an opportunity and not a constraint for companies (Ali and Kaur, 2021; Amorelli and García-Sánchez, 2021). The attention of organizations today is increasingly focused, also in the food sector, on offering the market products and services that ensure responsible behavior towards society and only the best possible quality. This is a new frontier of business: companies voluntarily take on a triple responsibility (economic, environmental, and social) towards the market and society.

Today, social responsibility is expanding towards one collective vision, in which the subject of socially oriented actions and strategies is no longer just the company, but the community, the territory, conceived as a whole. The social responsibility of the territory is based on the rediscovery of shared values that the socio-economic and institutional actors of a local context are able to strengthen, thanks to solid networks of relationships, and transforming conflicts and frictions into opportunities and growth. The extension of CSR to the territory is based on the objective of improving the quality of life of the community and combining economic needs with social and environmental concerns with a view to sustainable development. An ethical product label that includes territory social responsibility, implemented by agri-food companies, does not yet exist even if it represents an emerging need of the citizens of today and tomorrow. The fulfillment of this criterion, and therefore its measurability, can be documented in the social report or corporate social responsibility report.

#### 5.2. The producer takes positive action to promote gender equity

Women from a socio-cultural point of view are the custodians of the knowledge and transmission of the principles of the Mediterranean diet, preserving ingredients, food combinations, frequency of consumption, preparation techniques of traditional dishes: the same women, from a social point of view -economic, in the Mediterranean rural areas play a central role in development of a region, through their large employment as a labor force, often underpaid compared to men, indispensable for the family and community economy. The gender gap is one of the three gaps that Europe must make up for if it is to grow, together with the territorial and generational gap. Several European countries are developing a certification that accompanies companies to reduce the gap between women and men (Pinheiro, 2021) in terms of equal wages, career opportunities, and maternity protection. With the certification of equality, the awareness of building a context that knows how to introduce elements of equity between male and female workers passes from the cultural to the economic and social level, taking note of the strong gap between genders, above all in terms of remuneration, and focusing on the need to create a system that accompanies and incentivizes companies to adopt policies suitable for reducing the gender gap in all the most critical areas. In addition to working less than men (the female employment rate is 49 %, compared to 67.2 % of males), on average women also have lighter paychecks, and, with the same qualifications, obtain less career advancement than male colleagues. A certification of equality should establish strategies capable of placing equal conditions in career paths, and that, with the same skills and role, there are no pay penalties, supporting motherhood, too often perceived by women as a phase of arrest career rather than simply a life choice. The fulfillment of this criterion, and therefore its measurability, can be documented in the gender report or corporate social responsibility report.

### 5.3. The producer takes positive action to reduce inequality between generations

According to the document “A Dream Deferred: Inequality and Poverty Across Generations in Europe” (Becker et al., 2020) drawn up by the economists of the International Monetary Fund, young people are at the greatest risk of poverty in Europe, especially in the southern area, where the situation is dramatic: to be threatened is even one in 4 youngsters.

Overall income inequality has remained broadly stable in the EU over the past decade, but poverty inequality and income inequality between generations have increased dramatically. In Europe, young people’s real disposable incomes have lagged behind those of other generations. Furthermore, young people are facing increasing risks of poverty compared to those faced by other generations. Young people between the ages of 16 and 34 account for just 5 % of net wealth in Europe and their wealth on average is only a tenth of that of over 65, and the highest ratio is found in the younger generations between debt and assets (49 %) and the greater possibility of ending up among the “protested” (12.4 %). The recent economic crisis has exacerbated the already high youth unemployment and the trend toward job insecurity. Facilitating the integration of young people into the labor market is a strategy to avoid young people lagging further behind the rest of the population, with “lasting effects in terms of social sustainability”. Young people with a long-term job perspective can contribute to social safety nets. Reducing inequalities between generations goes hand in hand with creating sustained growth and rebuilding trust within society.

An ethical product label that includes positive action to reduce inequality between generations, implemented by agri-food companies does not yet exist even if it represents an emerging need of the citizens of today and tomorrow. The fulfillment of this criterion, and therefore its measurability, can be documented in the social report or corporate social responsibility report.

### 5.4. The producer implements positive actions to create new jobs and reduce the forced migration of human capital that deplete the territory

Human capital represents a key factor in the competitiveness and economic and social development of a country (Clodoveo, 2019). The main factors that determine the quality and quantity of human capital are represented by the demographic curve, the education system, the expenditure on research and the overall scientific research system, and the ability of a country to attract qualified immigrants from the rest of the world. Some European countries are facing an emergency, that of human capital, which threatens the future of the labor market, the sustainability of the tax and pension systems, the competitiveness of businesses, and, more generally, the stability of the economic and social system. Food companies that embark on a sustainable development path implementing positive actions to create new jobs and reduce the forced migration of human capital that depletes the territory should see the commitment made for the present and future generations rewarded with a premium price (Iolascon et al., 2021). An ethical product label that includes actions in favor of the implementation of positive actions to create new jobs and reduce forced migration of human capital that depletes the territory does not yet exist. The fulfillment of this criterion, and therefore its measurability, can be documented in the social report or corporate social responsibility report.

## 6. Conclusions

In the last decades, people have changed their habits towards unhealthy nutritional patterns. The consumption of nutrient-poor, energy-dense foods has increased, thus leading to weight gain, higher BMI, and worse health outcomes throughout the lifespan. In contrast with this evidence, consumers are increasingly demanding transparency in food labelling and claiming for their right to make informed choices for

individual and planetary health. Agro-food systems are characterized by social, economic, and environmental factors that negatively influence the sustainability of natural or urban ecosystems, resulting in a detrimental impact on citizens’ health. By 2024, the European Commission will examine new ways to create a sustainable labelling framework that covers, in synergy with other relevant initiatives, the nutritional, climate, environmental, and social aspects of food products. The newly proposed Mediterranean Index (Med Index) is aimed at promoting adherence to healthy and sustainable nutritional pattern that have been already recognized for Mediterranean diet in medical literature, but that can be achieved by assuming foods produced in any part of the world if the same nutritional and healthy properties of Mediterranean Diet are granted, along with simultaneous efforts in stimulating physical activity (Vetrani et al., 2078.) consistent with the energy intake of meals. At the same time food producers should be pushed to provide healthier and more sustainable products [119, 120] into the market.

Med Index is conceived as a holistic front-of-pack (FOP) label, complete and applicable by food producers as it is based on measurable criteria, widely shared by stakeholders, but usually adopted on an individual basis. Med Index covers the three pillars of sustainability, including nutritional, environmental and social aspects, with the assessment of 27 criteria (9 for each pillar), whose presence or absence is made immediately visible to the consumer through a label of different colours on the front of the package (where blue corresponds to the best result). Unlike other models, Med Index does not use an algorithm but a YES or NOT mechanism. the presence of each of the 27 specific criteria is verified thanks to the availability of mandatory or voluntary certifications held by companies. Certifications which will be detailed in the back of the package (e.g. blockchain, DOP, organic, renewable energy certification, ethical certifications, health claims etc.). The aim is not to generate a burden of work or add complexity to the companies that want to use this newly proposed Index, but to provide them with a validated checklist. Therefore, Med Index does not replace but “aggregates” and “summarizes” a series of information that is often fragmented and not immediately visible in order to allow informed, rapid and efficient purchasing choices that respond to the specific needs of different consumers, who may be interested only in the nutritional aspects or in all the dimensions of the sustainability. A single graphic symbol allows, in a few seconds, to simultaneously analyze the different sustainability characteristics of a product and/or its production process, representing a useful tool for comparing food products belonging to the same product category, and a useful system to break the information asymmetry which characterizes the market for many food products.

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### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

No data was used for the research described in the article.

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