

A ONE HEALTH APPROACH TO FOOD

THE DOUBLE PYRAMID CONNECTING FOOD CULTURE, HEALTH AND CLIMATE



A ONE HEALTH APPROACH TO FOOD

THE DOUBLE PYRAMID CONNECTING FOOD CULTURE, HEALTH AND CLIMATE



This publication was jointly realized by the research team of the Barilla Foundation: Katarzyna Dembska, Francesca Recanati, Silene Casari, Marta Antonelli; and University of Naples Federico II: Olga Vaccaro, Ilaria Calabrese, Annalisa Giosuè, Gabriele Riccardi.

We thank the authors of the in-depth contributions: Elisabetta Moro and Marino Niola; Ludovica Principato and Pin-Jane Chen. We are also grateful for the scientific support provided by Simona Castaldi and Francesca Gagliardi.

We thank ALMA, La Scuola Internazionale di Cucina Italiana, the partnering schools and the chefs for developing the regional recipes: Andrea Sinigaglia, Candida D'Elia, Debby Laatz, Johan Sebastian, Kenneth Kam, Shinya Endo, Georgina Torres, Marta Confente, Patrick Secord.

The contribution of the following experts, to the consultation on the Cultural Double Pyramids and to the review of the report is gratefully recognized: Fabrice DeClerck, Roberto Flore, Susanna Kugelberg, Marta Bianchi, Danielle Nierenberg, Barbara Burlingame, Cecilia Rocha, Alessandra Luglio, Ana Islas Ramos, Hidemi Takimoto, Olivia Yambi, Gerry Salole, Raja Sriswan Mamidi, Krishnendu Ray, Jeyakumar Henry, Hagit Ulanovsky, Manuel Moñino Gómez, Elena Carrillo Álvarez, Júlía Muñoz Martínez.

We acknowledge the review of the Advisory Board of the Barilla Foundation: Million Belay, Barbara Buchner, Danielle Nierenberg, Livia Pomodoro, Camillo Ricordi, Gerry Salole, Riccardo Valentini, Stefano Zamagni.

April 2021

www.barillacfn.com - info@barillacfn.com

Recommended citation:

Barilla Foundation & Research Unit on Nutrition, Diabetes and Metabolism, University of Naples Federico II, 2021. A one health approach to food, the Double Pyramid connecting food culture, health and climate.

ISBN 9788894528053



Index

1. INTRODUCTION	4
Unleashing sustainable and healthy diets	6
Connecting Food and Health: the Health Pyramid	8
Connecting Food and the Environment: the Climate Pyramid	10
The importance of food culture	12
The Mediterranean diet to build the future	14
Towards healthy and sustainable diets: factors influencing individual food choices	16
The pathway towards achieving sustainable diets should encompass the fight against food waste	18
2. METHODOLOGY	20
The Health Pyramid	22
Salt consumption	26
Physical activity and mindfulness	28
The Climate Pyramid	30
The Cultural Double Pyramids	32
3. RESULTS	34
The Double Pyramid Model	36
The Cultural Double Pyramid	40
Africa	40
South Asia	50
East Asia	60
Latin America	70
The Mediterranean	80
The Nordics and Canada	88
USA	98
4. CONCLUSIONS	106
Conclusions and recommendations	108
APPENDIX	112
Representative food items in the Cultural Double Pyramids	114
The Double Pyramids - Graphics	116
BIBLIOGRAPHY	132



1. INTRODUCTION

Unleashing sustainable and healthy diets

Food affects every aspect of our life: from health and longevity, well-being, to the condition and state of environmental resources, socio-economic development, culture and social stability. Today, we face the major challenge of resetting food systems from farm to fork, as they are currently failing to provide adequate and equitable food for all, while posing an unsustainable burden on ecosystems and natural resources. **Health and the environment need to be considered together when addressing food systems from farm to fork.**

More than five years since the global commitment to the 2030 Agenda for Sustainable Development, 690 million people lack sufficient food (1) and economic projections suggest that the COVID-19 pandemic may add an additional 83 to 132 million people to the ranks of the undernourished, as the outbreak has exacerbated the global food flaws and insufficiencies, impacting the most vulnerable populations. Meanwhile, 1.3 billion tons of food are wasted globally each year (2), utilizing 38% of total energy consumption in the global food system (3). Child and adult overweight and obesity are increasing in almost all countries, and on a global level the cost of a healthy diet is 60% higher than the cost of a nutrient adequate diet, and almost 5 times the cost of an energy sufficient diet. High-income countries have the highest affordability figures of the healthy diets. Affordability is compromised especially in low- and middle-income countries, due to low productivity, insufficient diversification towards the production of horticultural products, legumes, small-scale fisheries, aquaculture, livestock and other nutritious food products, pre- and post-harvest losses, fiscal and trade policies. Reducing the cost of nutritious foods and increasing the affordability of healthy diets start with a reorientation of agricultural priorities towards more nutrition-sensitive food and agricultural production (1).

In addition, unhealthy diets come with additional health costs. Imbalanced diets, defined as those providing excessive energy intake, low in fruits and vegetables, high in saturated fats, refined grains, sugar, salt, and red and processed meat, represent one of the greatest health global burdens (4), and diet-related cardiovascular diseases, cancer, and type 2 diabetes have a strong impact on well-being and quality of life, and require costly treatment. If the present food consumption patterns continue, diet-related costs due to mortality and non-communicable diseases (NCDs) are projected to exceed USD 1.3 trillion per year by 2030, while the cost of greenhouse gas emissions is estimated to reach more than USD 1.7 trillion per year by 2030 (5). Feeding the global population currently accounts for 21-37% of total net anthropogenic greenhouse gas (GHG) emissions (6) and including more plant-based foods can help mitigate climate change. Food production is also responsible for 70% of freshwater withdrawals. Globally, this accentuates the vulnerability of 1.2 billion people who live in irrigated or rainfed areas affected by severe water shortages (2).

Food consumption patterns have been recognized as a powerful lever to reverse these trends, to improve health, well-being, and longevity, and reduce disability and premature deaths, while remaining within the Earth's safe operating space. Recent studies have shown that healthy and sustainable diets can reduce wildlife loss by up to 46%, premature deaths by at least 20%, and food related GHG emissions by at least 30% (7). Sustainable diets can accelerate the achievement of poverty reduction and social inclusion; increasing fairness and equality; ensuring education and health care for all; fostering biodiversity conservation, water security, and climate change adaptation and mitigation are all embodied in the **2030 Agenda for Sustainable Development**, adopted by all UN member states in 2015, and in the 17 Sustainable Development Goals (SDGs). The **2021 UN Food Systems Summit** will be convened to raise global awareness and achieve global commitments to transform our food systems to deliver healthy, safe, and affordable diets for everyone, everywhere and at all times.

In this context, **the Double Health and Climate Pyramid, also referred to as the new Double Pyramid, is introduced to unleash the power of sustainable and healthy diets, by providing a tool to inform food choices.** The new Double Pyramid also aims to bridge global dietary recommendations and local contexts by celebrating the richness and diversity of dietary traditions and cultures across the globe, leveraging synergies between culture, food and education for sustainable development. In this release, seven **Cultural Double Pyramids are proposed to embrace the multiple versions of sustainable and healthy diets, and to show that these can be pursued in a way that is accessible, affordable, safe, equitable and culturally acceptable.** These prototypes are a first experimental exercise to capture the diversity of sustainable diets, and we welcome feedbacks to improve the models in future releases, which will include new regions.

By providing immediate and clear information, the new Double Pyramid provides citizens with tools to make healthy and sustainable food choices, leverage synergies between food education and culture, and facilitate food environments that encourage the adoption of sustainable diets. The new Double Pyramid stresses how sustainably produced, high-quality nutrient-dense foods must be accessible and affordable for all. It recognizes the role of farmers and fishers in fostering change in global food systems, as custodians of valuable traditional and indigenous knowledge, and the support they require to ensure access to land, markets, seeds and technology, to guarantee food sovereignty, increase productivity and resilience against external shocks, while preserving biodiversity and ecosystems. Furthermore, it underscores the key role of food businesses in aligning their strategies and operations with the SDGs and the Paris Agreement. **With the G20 Summit and key global events including COP26 and the UN Food Systems Summit set to take place, 2021 will be critical to raise the profile of sustainable food systems.** The promotion of a sustainable diet through the new Double Pyramid is inspired by the concept of **"One Health" (8), where human, animal, and environmental health are interconnected.** This paradigm requires multidisciplinary approaches to solve complex problems to improve health and society and safeguard natural resources (9).

FOOD AFFECTS EVERY ASPECT OF OUR LIFE. HEALTH AND THE ENVIRONMENT NEED TO BE CONSIDERED TOGETHER WHEN ADDRESSING FOOD SYSTEMS FROM FARM TO FORK

Connecting Food and Health: the Health Pyramid

Lifestyle changes for health promotion are urgently needed, given the epidemic of overweight and its health consequences in most countries. **Food choices are the most important factor undermining health and well-being, leading to 9.1 million premature deaths from cardiovascular diseases worldwide every year, which account for as much as 50% of all cardiovascular deaths.** This picture highlights the optimization of dietary patterns as a powerful tool to subdue the burden of heart diseases globally and, more generally, to reduce the impact of non-communicable diseases on the population's health (10). **A healthy diet - focused on fruit, vegetables, nuts, legumes, whole grains, fish and non-tropical vegetable oil - can, in fact, prevent both malnutrition and non-communicable diseases.**

In recent decades, awareness of the diet/heart relationship has spread among scientists as thousands of scientific publications on this topic have been produced. Moreover, already at the beginning of the century, the WHO and FAO organized a Joint Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases, whereby governments, international agencies and concerned partners in the public and private sectors were exhorted to implement more effective strategies to deal with the increasing public health challenges related to diet and health (11).

However, looking at the trends in dietary habits, the picture is not as reassuring as one would have expected given the robustness of the available evidence on the dietary prevention of cardiovascular diseases and the relevant recommendations issued by authoritative international bodies. In fact, in recent years a mismatch has occurred between increased knowledge on the health-improving potential of diets and the relatively modest risk modification achieved among the population (10).

Faced with this worrying scenario, **there is urgent need for an appropriate strategy to increase people's awareness of the relationship between specific food choices and health and to facilitate the educational role of health professionals on this issue**, particularly in the primary health care context. A useful communication tool to facilitate the implementation of healthy dietary habits is represented by the **Health Pyramid**. This aims to be a clear and effective communicative instrument **which conveys the message about making appropriate food choices for health promotion through a model that gives intuitive and clear recommendations on the frequency of consumption**. In fact, foods are grouped on the basis of nutritional similarities and placed in one of the layers into which the pyramid is split in ascending order, according to the recommended consumption appropriate to their impact on health.



Connecting Food and the Environment: the Climate Pyramid

The inextricable relationship between global food systems and the health of natural ecosystems is clear. Feeding the global population currently accounts for 21-37% of total net anthropogenic GHG emissions (6), 70% of freshwater withdrawals (2), soil degradation (12-14), nutrients depletion (6), deforestation and loss of natural ecosystems and biodiversity (15-17). On the other hand, food systems, especially agriculture, are among the sectors most damaged by the effects of environmental degradation and climate change (6). Changes in rainfall patterns, the increasing frequency and intensity of droughts and other extreme events have adversely impacted the functioning of terrestrial ecosystems, contributing to desertification and land degradation in many regions (6,18), and are consequently impacting current and future agricultural productivity (19) and food security. To close the loop, **transforming food systems is among the most effective solutions to restore natural ecosystems and mitigate and adapt to climate change, through more sustainable agricultural practices, the transition to healthier and more sustainable diets, and the reduction of food loss and waste** (6, 20, 21). It is therefore critical to restore food systems from farm to fork, making this a core climate change strategy to achieve the SDGs (6, 18, 22-25).

In this context, measuring and assessing the impacts of food systems and related products on the environment and climate becomes crucial. Among the existing approaches, Life Cycle Assessment (LCA) has been widely used by academics, companies, and policy makers to assess the environmental impacts of anthropogenic production systems, including food systems. This approach considers the entire life cycle of a product, from raw material production to its end of life. One of the indicators calculated with the LCA is the **carbon footprint**. This indicator represents the **climate-related impacts associated with the production of a commodity or a service throughout its entire life cycle, and it is expressed in terms of carbon dioxide equivalent emissions** (kg CO₂ eq.). This indicator is characterized by a rigorous and unique method defined by the Intergovernmental Panel on Climate Change (IPCC) about 30 years ago (26) and it is usually included in every environmental impact analysis or study.

Given the consolidated method and the critical role of the food system in climate change, the carbon footprint is also one of the most used indicators to assess the environmental impacts of food systems (22). Its widespread application provides a vast amount of literature and data

1. The calculation is made considering the emissions of all greenhouse gases, the extent of which is determined by two variables: the amount emitted and its impact factor in terms of Global Warming Potential (GWP). In fact, the emissions are converted to a value of CO₂ equivalent, as if only CO₂ were emitted by the system, through fixed parameters defined by the IPCC.



covering a wide spectrum of food items and related production systems, both from academia and the private sector. Additionally, **this indicator is relevant for informing policymaking, especially in the context of climate mitigation and decarbonization pathways, such as those advocated by the Green Deal (27) and Farm to Fork Strategy (28) of the European Union**, which promotes the LCA as a tool to support policy decisions and promote environmental sustainability in the region through the Product and Organisation Environmental Footprint (29).

The 2021 Climate Pyramid sheds the light on the carbon footprint of food. The use of one, clear, and widely used indicator fits the purpose of the Double Pyramid since it maximizes readability, comparison with the Health Pyramid, the wider audience's understanding of the difference between the highlighted food groups, and the consequent support in daily food choices. The adoption of the carbon footprint is the first step on this journey, future research directions include the use of other indicators representing other pressing environmental impacts of food systems (30, 31).

THE IMPORTANCE OF FOOD CULTURE

Marino Niola

Food is the sustainable energy of history, as well as the engine of culture. The principal stages of human evolution are linked to food, from the invention of ceramics to the application of biotechnologies, starting from the mother of all transformations, cooking, which marks the transition from nature to culture. If you think about it, civilization itself is a kind of cuisine. Because it tears humans away from their original raw and naked state and transforms them, turning them into “cultivated” beings. It is no coincidence that the words culture and cultivate have the same origin. And humans began to distinguish themselves from other animals from the moment they stopped eating *nature* and started to cook. Perhaps showing that homo *sapiens* and homo *edens* are the same person. And its story begins with the human discovery of fire, the basic requirement of every kitchen and the trigger for that anthropological mutation that distances both humans and food from their original raw and naked state. At the same time as humans began to produce fire, fire began to produce humans. By cooking their food, humans are also transforming themselves according to rules that establish the languages and identities of food. What to eat, what not to eat, how much, when, how, with whom. And also, types of cooking, the succession of courses, religious taboos, table manners, dietary precepts. Rules and customs that transform nutrition into flavor, exchange, memory, narration, sharing. That is, into a cultural asset, both material and immaterial. In short, if food is the most universally human language, every kitchen is the mirror of a society. Which is why, from the time of the primitive skewer to the era of the induction plate, different cultures are identified by what they eat. And knowing one's food culture and that of others is an educational tool that reduces distances, mistrust and differences. It makes diversity less fearful and identities more welcoming. Our future therefore depends on the use we make of food. Not only to survive, but above all to live long and healthy lives. In addition to being at peace with ourselves, with others and with the environment. And to meet this challenge, we need to redefine our food values. With a new culture and a new scale of individual and above all collective measures. A scale of values founded on sustainability and conviviality. It is no coincidence that the Spanish *comer* comes from *cum edere*, i.e. to eat together. And that, according to many linguists, the word *educate* comes from *edere*, to eat, as if to say that education is a process of cultural metabolization.

This is why promoting the culture of food is one of the great challenges of politics, training and information. To give the right, far-sighted answers to the thirst for knowledge which has become the dominant thought of our time. Which has made food both a passion and an obsession. Swinging between food mania and food phobia, ethics and dietetics. But also the raw material of a new idea of development and security, ecology and economy, fairness and happiness, health and pleasure. The great themes of today: quality of life, protecting the environment, respecting the living, safeguarding biodiversity, animal bioethics, protecting short supply chains, enhancing identities and communities, require a sensitivity to food, and the right food choices to be made.

In this sense, **the Mediterranean diet** – which UNESCO included in the intangible heritage list in 2010 and which FAO proposed as a more sustainable lifestyle – **is perhaps the very image of tomorrow's food: good, democratic, seasonal, convivial and supportive. But there are other traditional food systems in the world that are healthy, sustainable and validated by history.** Behind every food, every flavor, there is a social and personal story that comes from afar. From the skill of the artisans, peasant wisdom, the creativity of women, forced to make a virtue of necessity, transforming scarcity into goodness. What makes the great material and intangible heritage of food around the world extraordinary is the ancient intertwining of culture and measure that they express. Where measure indicates a kind of golden balance that regulates social and environmental relations. A “fair” algorithm. As indicated by the Italian word *cibo* (food), derived from the Greek *kebos*, which



was the instrument used to calculate the right amount of food. That sense of measure that has been forgotten at a time of consumerist bulimia. When the idea of infinite development has produced bodies in its image and likeness. Obese on the one hand and underweight on the other. Both malnourished, either by too much or too little food. Because even today humanity remains divided in two. Between those who have more hunger than food and those who have more food than hunger. Between those trying to eat and those trying not to eat.

This is why studying, archiving, protecting and enhancing the food heritage of the various culinary regions is necessary and fundamental to answer the new questions of today. This is precisely the great cultural emergency of the planet. To recognize and popularize the extraordinary richness of food and cultural biodiversity, the deposits of “green oil” that are the pride and wealth of every country, and to transform cooking into a grand rehearsal for humanity in the future.

THE MEDITERRANEAN DIET TO BUILD THE FUTURE

Elisabetta Moro

Tradition is the gastronomic laboratory of history. And it brings the legacy of the past and the expectations of the future together into the present. This is why it is a fundamental key to building a greener, more supportive and happier tomorrow. But what does tradition at the table really mean? It is certainly not about immobilizing or embalming the past, if anything it is a continuous flow of ideas, transformations, acquisitions, contaminations and values that support each other and reinforce that reassuring sense of “feeling at home”. In the case of Italian cuisine, this historical stratification has its roots in the distant past and in particular in that cultural matrix that is the Mediterranean diet. With its symbolic foods: cereals, olive oil and wine. The fundamental elements of a nutritional model exemplified since the nineties by the food pyramid, which emanates directly from the studies conducted by Ancel and Margaret Keys, the most important nutrition scientists of the twentieth century, as well as the international team of researchers of the Seven Countries Study. The study that first demonstrated the effectiveness of the Mediterranean lifestyle.

My ten-year research on the history and anthropology of the Mediterranean Diet, and Italian food in particular, revealed that the role of tradition was very important to these scientists since the 1940s. **Because they were perfectly aware of the fact that nutrition is never just about biology, it is always a cultural act.** And that in the folds of this cultural heritage lies a series of secrets, tricks, associations, rules that have been laid down over time and have validated the empirical experience, turning into a philosophy of life and a recipe for health. Because in traditional customs we find a way to enhance the seasonality of agricultural products through a wide repertoire of recipes that ensures we can always serve new and varied dishes. Furthermore, **local cultures have spontaneously enhanced biodiversity, appreciating the fact that different cultivars of the same plant enrich flavors and increase the pleasure of eating.** And even hunting and fishing for centuries have been carried out with foresight to allow the species to reproduce. Last but not least, **Mediterranean food culture has internalized the Hippocratic health lesson of “making food your medicine and medicine your food”.** It is no coincidence that the Mediterranean diet has been endorsed by major international agencies, including the WHO, FAO and UNESCO, which ten years ago included it in the prestigious list of the Intangible Cultural Heritage of Humanity. And today it encompasses a range of knowledge that can also be used to deal with new European challenges. Because never as in this historical moment can Italy's economic recovery and eco-sustainable development find the synthesis of new territorial policies in an international symbol like the Mediterranean Diet.

For the Greeks, *diata*, the origin of our word diet, was a philosophy, a mentality, a holistic lifestyle. In the words of Leopardi, it was a way of “poetically inhabiting the earth”. In short, a complex concept full of meanings that lends itself to a contemporary interpretation. Because this healthy, convivial, ecologically virtuous and supportive lifestyle can be an inspiration to many good practices of the future. Because if what the Keys said is true, that **“the Mediterranean diet is a natural stroke of luck”**, then this fortune must be shared to create a healthier, more cohesive and supportive world.

Find out more: Moro E.-Niola M., *I segreti della dieta mediterranea. Mangiare bene e stare bene/Secrets of Mediterranean Diet. Eat Well and Stay Well*, Bologna, Il Mulino, 2020.



TOWARDS HEALTHY AND SUSTAINABLE DIETS: FACTORS INFLUENCING INDIVIDUAL FOOD CHOICES

Pin-Jane Chen

Global food systems present a complex and multi-faceted set of challenges from farm to fork. However, improving food choices at individual level can be a crucial and practical solution (21). According to the Food and Agriculture Organization (32), sustainable healthy diets are dietary patterns that promote all dimensions of an individual's health and wellbeing. They have low environmental pressure and impact; are accessible, affordable, safe, and equitable; and are culturally acceptable. In line with this statement, the Double Health and Climate Pyramid serves as a guideline for daily food choices in enhancing people's awareness and enriching their knowledge about the impacts of food choices to encourage dietary patterns that are healthy for humans and more sustainable for the planet. Nevertheless, **behind the food choice, one cannot overlook the factors influencing our decision-making process when choosing foods.** It is important to understand what those factors are in order to effectively adopt measures and take actions to achieve healthy and sustainable food choices.

Individual food choices evolved according to changes in the natural environment, biological basis, physical need, lifestyle, and the development of technology (33). As an example, biologically, the evolution of human beings results in an expanding brain, a shrinking large intestine, and lengthening small intestine, have paralleled the increase of nutritionally dense foods in the habitual diet (34). Biological features such as the innate senses of taste, olfaction and texture influence food choices as well as how efficiently we digest foods (35). Especially, the evolved taste abilities are for identifying nutrients for people living with food insecurity, while for people who have easy access to tasty, energy-dense foods, sensitivities for sugary, salty and fatty nutrient-poor foods may contribute to having overnutrition-related diseases (e.g., obesity and diabetes) (36). Generally, the interaction between individuals' food and the food environments is influenced by a liking for sweet taste, and the capacity to detect bitter influence, with greater bitter taste sensitivity being linked to lower liking of vegetables, along with higher liking of sweet foods (37).

Development of the ability to cook (e.g., to use tools and control fire) increases the variety of food choices. However, the shift to intensive agriculture since the Neolithic revolution (e.g., relying on a few domesticated plants) largely narrowed the variability of food intake, thus reducing some nutritional qualities of the diet (34). Urbanization and the industrialization of the food system in recent decades has resulted in a nutritional transition involving a further reduction in the variety of foods, limiting people's food choice, owing to the massive production of ultra-processed, high-density foods, especially with added sugar and fats (34). **In recent years, research has therefore addressed the factors affecting food choices, suggesting healthier and more sustainable options** (38):

1. **Food-related features:** Food-internal factors, such as *nutritional properties and the health value* (e.g., absence of contaminants) of food are important in determining choices (39). As Food-external factors, *information* based on nutrition facts, sustainability labels, and organic identity have proved to be important drivers (40). Moreover, certification of origin and food miles, recycling packaging, as well as indications of local, traditional, ethic, and environmentally friendly products, also affect food choices (41). *Social interaction* is also an important food-external factor for making decisions about food (42). For instance, studies have found that eating in the company of other people affects the types and amounts of foods eaten. People who eat alone are less likely to prepare boiled vegetables and salads than when they cook for others. In addition, unless they are involved in social networks, people show less willingness to change their diet and adapt to dietary recommendations owing to less social support (e.g., unsuccessful weight loss in obesity management). The final factor is the physical environment. The *availability* of healthy and sustainable food and the *accessibility* of nutrition, the environment, supermarket, or local stores are critical for the choice (43).



2. **Individual difference:** Personal-state factors, such as psychological components, have impacts on healthier and organic food choice. When personality such as "openness to change" is low, health consciousness has a positive effect on organic food identity, and thus indirectly influence intentional organic food behavior (44). *Emotion*, especially "fear", has been shown to affect consumers' purchasing decisions about organic meat (45). Motivation and intention are important factors contributing to the final food choice (44). Cognitive factors such as *belief, attitude, awareness, self-concept, and positive outcome expectation* are influential on healthier and more sustainable food choice (46).
3. **Society-related factors:** *Sociocultural context* and cultural habits such as dietary restrictions may result in increased of vegetable intake with the belief that consuming plant-based food could contribute to the well-being of people and the environment (42). *Income* and *food prices* heavily affect whether consumers will choose healthier and more sustainable food or not. Low-income households usually have less access to nutritious food due to higher prices for food, including fruit and vegetables (47). Indeed, according to FAO (1), globally, the cost of a healthy diet exceeds the international poverty line (established at USD 1.90 purchasing power parity per person per day), resulting in unaffordable choices for more than 3 billion people in 2017 (1). While in high-income countries, healthy diets including more fruit, vegetables, fish, and nuts, cost about USD 1.50 more per day than unhealthy diets with processed foods, meats, and refined grains (48). However, the yearly cost of consuming healthy foods (USD 550 per person) is considerably lower than the economic costs of diet-related non-communicable diseases (48). Finally, *policy* plays an essential role in making healthier and more sustainable food choices available. According to a survey conducted in the European Union, the top three characteristics of sustainable food are "Nutritious and healthy" (41%), "Little or no use of pesticides" (32%), "Affordability of food for all" (29%) (49). Thus, according to FAO, policies that promote healthy and sustainable diets, such as the promotion of food environments, food industry regulations, nutrition education, are urgently needed (1). Moreover, consumer-oriented policies such as reducing poverty and income inequality, as well as the subsidization of nutritious food, are essential and basic to make healthy and sustainable food an option to everyone (1).

As a brief conclusion, with awareness and knowledge, clear and precise information, a supportive social environment, available and accessible healthy and sustainable food items, and the implementation of related policies, individuals have a great potential to achieve healthiness and environmental sustainability by choosing healthier and more sustainable foods.

THE PATHWAY TOWARDS ACHIEVING SUSTAINABLE DIETS SHOULD ENCOMPASS THE FIGHT AGAINST FOOD WASTE

Ludovica Principato

Food waste (FW), defined as “the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers” (3), is undermining the achievement of the SDGs from an environmental, social, and economic point of view. Indeed, food that is produced but ultimately wasted causes GHG emissions (50) that contribute to climate change and, since we are already aware of the health-related effects of climate change, we can say that in some direct and indirect way, FW impacts on public health too. Due to the significance of this phenomenon, its halving has been included among the 17 Sustainable Development Goals of the UN's 2030 Agenda, and specifically in target 12.3, which aims to: “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains” by 2030. In line with this, a group of leading scientists have stated that its reduction, along with a shift towards plant-based diets and agriculture innovation, represents one of the top three goals that need to be achieved to keep the food system within environmental limits (51). Moreover, another recent study (52) showed that one of the **pathways towards more sustainable diets should encompass the reduction of food waste.** Indeed, in this study researchers analyzed the environmental impacts of the current American diet and found that a shift in diet composition (i.e. by reducing red meat and dairy consumption), combined with a reduction in caloric intake and a 50% reduction in FW, can significantly lessen people's dietary footprint. According to FAO (3), FW could potentially affect food security and nutrition, given its effects on the four dimensions of food security: food availability, access, utilization, and stability. Indeed, a recent study (53) analyzed food waste under a food security and nutritional perspective, highlighting that annual per capita food waste (65 kg per person per year) can provide a healthy diet to one person for 18 days. Indeed it has been seen that, due to their perishability, **the foods that we waste the most are also those with the highest nutritional value** (globally on average 25% of vegetables, 24% of cereals and 12% of fruit), therefore reducing FW can create win-win nutritional and environmental effects.

As reported in several studies (3,54,55), **Western countries are responsible for the majority of FW, and more specifically the largest portion of food waste occurs among consumers (especially in the home).** This is mainly due to behavioral reasons, such as incorrect practices, habits and/or attitudes in the management and consumption of food (55-58). *The Household Wasteful Behavior Framework* (59), which shows how there are several bad habits along the food management process that result in FW, is a useful tool that can be used to gain a better understanding of the main factors, incorrect habits and behaviors that drive individuals to waste food at home. To give a few examples, during the planning phase, behaviors like not planning meals or not writing a shopping list before grocery shopping, result in FW. While shopping, people should beware of any “buy 2 get 1 free” marketing strategies that often make them buy more than they need. Before preparing food, people should pay attention to correct food storage and food preparation, in order to avoid waste (like knowing the difference between “best before” and “use by dates”, or improving their cooking skills to make delicious meals with leftovers). Finally, when it comes to eating food, food preferences, food safety and freshness fears play a role in wasteful behaviors.

During the COVID-19 pandemic, due to movement restrictions and lockdowns, many households were forced to go grocery shopping once or twice a week, thus resulting in better food management practices that ultimately led to a reduction in FW. Indeed, some studies across the world highlight a positive behavior change among individuals, like starting to implement weekly meal planning or drawing up a grocery list (59-63). According to a study conducted in Italy (64), it seems that these changes have more markedly affected young people who, according to previous research, are the consumers who usually waste the most. The hope is that these positive behaviors will last over time.

Food wasted outside the home is the second source of FW during consumption (65,66). In this phase, FW can occur during food preparation (Kitchen FW) or consumption (Client FW) (58,67). Recent studies have shown that the main source of food wasted outside the home is represented by customers' leftovers. This is mainly due to food preferences, excessive portion sizes, ordering too much food, and not asking for a doggy bag (68), therefore highlighting behavioral issues at this level too.

To conclude, **FW also affects the retail sector.** Indeed, in the EU about 5% of total FW occurs at this level, rising to 13% in the US. Since this phase influences consumer preferences towards food in several ways, retailers have been acknowledged to be a key stakeholder in the fight against the phenomenon (69,70). The main causes that lead to FW at this level are: damaged packaging; over-stocking and over-preparing; high aesthetic standards required by customers who, for instance, do not allow “ugly” but perfectly edible foods (like a crooked carrot, or a bruised apple) to appear on the shelves (71).

Among the solutions that have been put forward to reduce FW, some rely on technologies and innovation, like food sharing platforms which - thanks to digitalization - allow excess food to be shared for charity, either from retail outlets, outside the home or from households (i.e. Plan Zeros in the UK) or for profit (i.e. TooGoodToGo in Europe), or among peers (i.e. Olio in the UK). Others are starting to use blockchain technology to trace surplus food in a transparent and safe way and donate it to people in need or at a lower price. The Italian “Spesa Sospesa” is worth mentioning in this respect. Launched during the pandemic, it uses the blockchain to optimize stock management in food supply chains by (re)allocating excess production from various production and distribution stages to the final stages of the supply chain, thus providing food aid to vulnerable people. At consumer level, the Chinese government recently launched an awareness-raising campaign called “Clean Plate” with the aim of changing people's attitudes towards food consumption and waste, while not forgetting the food security issues that still affect the country.

Due to the importance and magnitude of the phenomenon, there must be a coordinated effort among the different parts of society to tackle it. Indeed, governments should put forward mechanisms to measure national FW and set specific targets and policies for reduction, and are urged to make FW part of climate strategies under the Paris Agreement; public and private organizations should also measure their FW and use unavoidable waste with a Circular Economy approach, for instance donating it to people in need. Finally, individuals must shop carefully, store food correctly, reuse leftovers, and be more aware of the food they waste at home and outside the home.

Among the interventions that seem to be more effective at consumer level, three have proven to significantly modify food waste behavior: (i) interventions that changed the size or type of dishes in the hospitality sector have proven to reduce FW by 57%; (ii) information campaigns, that can reduce FW by 28%; and (iii) changes in nutritional guidelines for schools (72). This last intervention relates to healthy diets and waste reduction strategies, indicating that diet reformulation in schools can reduce vegetable waste by up to 28%.

In short, if we want to reduce FW, we need to keep individuals informed and engaged in educational activities and behavioral interventions that modify their habits, while improving their understanding of the systemic consequences of FW.



2. METHODOLOGY

Since its inception, the Double Pyramid has been designed graphically to show the relationship between health and the environmental impact of foods.

The present study proposes a new Double Pyramid based on an evidence-based methodology to foster health and longevity, and its impact on the environment, and more specifically on climate change.

The Health Pyramid

Over the years, various organizations and research institutes - including the WHO (World Health Organization), CIISCAM (Inter-University Centre for International Studies on Mediterranean Food Cultures), and the Harvard School of Public Health - have developed communication systems based on the image of the food pyramid (73-75). However, so far, the food pyramid has been built on the basis of purely qualitative evaluations, without any reference to specific and quantitative markers of the impact on health of each food. **The present project aims to bridge this gap and provide an evidence-based methodology for the development of the Health Pyramid.**

Therefore, we have carried out a review of the literature, searching systematically in databases of scientific articles for evidence linking the consumption of each food by the adult population to health outcomes and, in particular, to the risk of cardiovascular diseases, which are the most important cause of death and disability. Foods have been grouped according to their origin (whether animal - meats, eggs, fish, dairy - or plant-based - cereals, legumes, vegetables, fruits, nuts); in addition, the literature on the consumption of condiments and beverages has also been reviewed.

All papers dealing with the same foods have been evaluated for their relevance and methodological rigour and, for those passing this scrutiny, results have been summarized utilizing established statistical methods. Thereafter, **all foods have been listed in ascending order according to their relationship with the risk of cardiovascular diseases (myocardial infarction, stroke, sudden death)**; this list has been employed to place each item at the different levels of the pyramid. When available, data from the analysis of the association between the amount of food consumed and the risk of cardiovascular events has been used to identify, for each of them, the quantity linked with the best impact on health. This is particularly useful in order to provide specific dietary recommendations to the general population on the amount and the frequency of consumption for each food.

The most common foods utilized worldwide have been clustered in 18 groups of items similar for their nutritional features and their impact on health. These groups have been stratified in seven layers on the basis of their association with the risk of cardiovascular diseases (table 1).

The food groups associated with the highest beneficial impact on cardiovascular diseases and, more in general, on health - placed at the bottom of the pyramid in the first layer - are fruit, vegetables, and wholegrain cereal foods. Since their consumption should be encouraged, two

Table 1. **FOOD GROUPS AND ITEMS, LAYERED ON THE BASIS OF THEIR ASSOCIATION WITH THE RISK OF CARDIOVASCULAR DISEASES**

RECOMMENDED CONSUMPTION	FOOD ITEMS	SERVING SIZE
OCCASIONALLY	Processed meat (i.e.: sausages, bacon, salami)	50 g
NOT MORE THAN ONE SERVING/WEEK (for each food group)	Butter or cream, or hard margarine, or tropical oils*	20 g
	Red meat (i.e.: beef, pork, lamb)	100 g
	Cakes, pastries	100 g
NOT MORE THAN TWO SERVINGS/WEEK	High Glycemic Index refined cereal foods or potatoes*	100 g white bread or 70 g refined rice or 350 g potatoes or 50 g plain biscuits
NOT MORE THAN THREE SERVINGS /WEEK (for each food group)	Milk	250 ml [^]
	Cheese (i.e.: Parmesan, Emmental, Cheddar, Roquefort)	* 50 g
	Eggs	2 eggs
	Poultry	100 g
FOUR SERVINGS /WEEK (for each food group)	Legumes (i.e.: beans, lentils, chickpeas, peas)	180 g fresh/frozen or 80 g dry or 240 g canned
	Fish (i.e.: sardine, mackerel, cod, salmon, shellfish)	180 g fresh or frozen
ONE SERVING/DAY (for each food group)	Low Glycemic Index refined cereal foods *	80 g pasta or 70g barley or 70 g parboiled rice
	Yogurt	200 g
	Nuts	30 g
	Non-tropical vegetable oils (i.e.: extra-virgin olive oil, sunflower oil, corn oil, soybean oil) or soft margarines*	25-40 g
TWO SERVINGS/DAY (for each food group)	Fresh fruit (i.e.: apple, pear, and citrus fruit)	200 g
	Vegetables (i.e.: raw vegetables, green leafy, carrots)	200 g
	Wholegrain foods *	100 g wholegrain bread or 80 g wholegrain pasta or 70 g wholegrain rice or 50 g wholegrain breakfast cereals or 50 g wholegrain plain biscuits

Each food serving can be split and utilized on more daily or weekly occasions, or it can be reduced and replaced by an equivalent amount of another food in the same group.

* The amount can vary in relation to the energy needs.

[^] It corresponds to one cup every two days or to one glass every day.

Beverages and Salt:

- **Water:** at least 2 liters per day;
- **Coffee or tea:** not more than 3 cups per day;
- **Wine or beer:** not more than 1-2 glasses of wine or 1 can of beer;
- **Soft drinks:** occasionally;
- **Salt:** 5 g per day (~1 teaspoon); to make the dishes more pleasant, spices, vinegar and aromatic herbs can be used. Be aware of the salt content of processed or canned foods.

servings daily are recommended for each of them (76,77). Moving up to the second layer, there are food groups for which regular consumption should be encouraged but without exceeding one daily serving for each of them: refined cereal foods with a low Glycemic Index (*low glycemic*) - having a low effect on blood glucose - like pasta, parboiled rice and barley, as well as nuts, yogurt, olive oil and other non-tropical vegetable oils (i.e.: corn and sunflower oil). In fact, they are also beneficial but to a lower extent than the previous ones (78-82). Moreover, most of these foods are also characterized by a high energy density and, therefore, they could facilitate weight gain if consumed in larger amounts. The third layer includes foods like legumes (i.e.: beans, peas, lentils, chickpeas) and fish that are associated with a reduced risk of cardiovascular disease, and therefore should be consumed in three to four servings per week; any further increase is not associated with additional risk reduction (83,84).

The fourth layer includes foods like poultry, eggs, cheese, and milk that have neither a beneficial nor a detrimental relationship with the risk of chronic diseases if their intake is moderate (no more than three servings per week for each of them) (85-88). However, the health impact of their higher consumption is not clear, and, in some cases, it might be even unfavorable.

The next three layers of the pyramid contain food groups for which there is evidence of an association with an increased cardiovascular risk. The foods included in the fifth layer are high Glycemic Index foods (*high glycemic*) - like white bread, refined rice, and potatoes (78). These are foods utilized widely and almost daily worldwide (10). Accordingly, their consumption should be limited to no more than two servings per week as a compromise between the necessity to minimize the risk of chronic diseases and the need to avoid excessively stringent limitations that are not feasible in the long term by most people. Butter and red meat are placed in the sixth layer of the pyramid since their consumption is associated with a significantly increased risk of cardiovascular events; this association is due, among other reasons, to their high saturated fat content, which has untoward effects on plasma lipids and other cardiovascular risk factors (84,89). Palm oil is also rich in saturated fat and, therefore, should similarly be reduced. Since cakes and pastries are rich not only in saturated fat but also in refined flour and sugar, they are placed in the sixth layer as well. For all these foods, the advice is to limit the consumption of each of them to no more than once a week. At the top of the pyramid - in the seventh layer - there are foods, like processed meats (i.e.: sausages, bacon, salami), rich in saturated fat and salt, associated with a high risk of cardiovascular and other chronic diseases and that should be consumed only occasionally since they are not a necessary component of a balanced diet (78, 84, 90, 91).

Beverages and salt are not included in the food pyramid but there are footnotes that summarize relevant evidence-based advice on their consumption. In particular, there are very consistent data showing that the regular consumption of soft drinks is associated with a higher cardiovascular risk, besides untoward effects on body weight and diabetes; therefore, these beverages should only be consumed occasionally. As for alcoholic drinks, there is very convincing evidence that moderate consumption (no more than 2 glasses of wine or 1 can of beer) is associated with a lower risk of cardiovascular diseases. Similarly, intake of up to 3 cups of tea or coffee has been shown to be linked with protection against heart diseases and other health outcomes. Therefore, these patterns of consumption for beverages can be allowed in people who already use them, provided that their amounts do not exceed the limits indicated above since, otherwise, any potential health benefits may vanish (91-94). The footnotes also contain an alert about keeping salt intake below 5 grams per day, as scientific literature is very supportive of this recommendation (90).



SALT CONSUMPTION

Sodium is an essential nutrient for the normal functioning of human cells and for many physiological mechanisms of our bodies, like nerve impulses transmission and the fluid homeostasis. On the other hand, **excess sodium can pose risks to our health**: cardiovascular disease - in particular stroke - all-cause mortality, and other conditions, such as kidney disease, stomach cancer, and osteoporosis are related to high sodium intake and their risk can be reduced with a controlled salt consumption (95). The physiological mechanisms underlying the link between salt consumption and these conditions are complex and only partially understood, but inflammation, hormonal and fluid homeostasis, the immune system activity and the composition of our gut microbiota are surely involved.

The primary source of sodium in diet is salt: each gram of salt contains approximately 400 mg of sodium. Under normal conditions, an adult needs 100-600 mg of sodium per day, which corresponds to approximately 0.25-1.5 grams of salt, with a slightly higher requirement in hot weathers. **These quantities are easily reached and often exceeded with a normal diet**: according to WHO, most people consume on average 9 to 12 grams of salt per day, or around twice the maximum recommended intake of 5 grams per day (equivalent to 2000 mg sodium/day)(96).

In the ancient times, salt was particularly precious; it is no coincidence that the term “salary”, still used today to indicate the wage of an employee, was coined at the time of the Roman empire to give a name to the remuneration of legionaries. It is clear that salting foods, apart from being an ancient method of food preservation, also has a profound cultural significance. While salt was once a precious commodity and was used sparingly, nowadays dietary patterns are changing towards an increased consumption of highly processed foods like ready meals, processed meats, instant noodles and salty snack foods, high in saturated fats and salt. Processed foods are often the main source of excess salt; however, salt is present in high quantities also in less processed but frequently consumed food like bread, canned food, or in seasonings and sauces like soy sauce or fish sauce, widely consumed especially in Asia. A regular consumption of highly salted foods is linked to a reduced consumption of fresh fruit and vegetables, thus further shifting diet far from the nutritional indications.

Strong scientific evidence suggests how maintaining salt consumption under 5 g/day improves health and increases disease-free longevity.

Reducing salt intake is possible by taking a few small measures:

- while cooking, gradually reduce salt of your dishes, your taste buds will adapt;
- use spices, herbs, garlic, vinegar and citrus fruits in place of salt and stock cubes to enhance the flavour of foods;
- drain and rinse canned vegetables and legumes;
- eat more fresh fruits and vegetables and prefer them to processed foods;
- check the labels before buying to choose less salty food items;
- do not put salt and salty sauces on the table, so that even the youngest of the family get used to not adding salt;
- limit the consumption of salted, processed meat or packaged foods high in salt, considering that in many countries around 60-80% of salt consumed is not added during cooking or at the table, but is already present in processed and packaged foods;
- substitute salty snacks with plain yogurt, fruit or unsalted nuts and seeds, and dine at home often, where you can control the salt contained inside dishes.

It is worth mentioning that the sodium content in drinking waters, including tap water, is insignificant in the



total count, providing from 5 mg (water with very low mineral content) to 15-20 mg of sodium per litre.

From the policy point of view, placing limits on added salt in preserved foods can help to save lives and capital in national health spending every year. In fact, the World Action on Salt & Health (WASH) - an association with partners in 100 countries established in 2005 to improve the health of populations through the gradual reduction of salt intake - estimated that reducing salt intake to this limit would prevent about 2.5 million deaths every year (97). This estimate is supported by WHO, which claims that limiting salt intake could generate an extra year of healthy life with a cost that falls below the average annual income or gross domestic product per person, making salt reduction measures one of the most cost-effective measures countries can take to improve population health outcomes.

PHYSICAL ACTIVITY AND MINDFULNESS

The positive effect on health of physical activity and healthy eating was already considered between the fifth and fourth centuries BC by the philosopher Hippocrates: **"If we were able to provide everyone with the right amount of food and physical exercise, neither in defect nor in excess, we would have found the way to health"**. Today science has extensively demonstrated that a daily moderate physical activity, paired with a healthy diet, is essential to promote health, longevity, and psychological wellbeing.

Physical exercise is essential from childhood for the full development of the body and to maintain optimal health both in the short and long term. **A healthy diet combined with regular physical activity allows to maintain a healthy body weight**, reducing the onset of overweight and obesity, risk factors for the development of non-communicable diseases like cardiovascular and neurodegenerative diseases, cancer, and type 2 diabetes, which together are responsible for more than 70% of all deaths worldwide (98). Moreover, **regular exercise promotes a good mood and has a general positive effect on psychological health**, reducing anxiety states and depressive symptoms; it contributes to the maintenance of proper brain and learning activity, delays the onset of dementia, cognitive decline and prevents the risk of Alzheimer and Parkinson diseases onset (99, 100). Physical activity refers to any movement of the body produced by skeletal muscles, which involves an expenditure of energy higher than the basal one. Physical activity includes but it is not equivalent to physical exercise, which consists of a planned, structured and repetitive movement improving or maintaining one or more components of physical performance such as strength, flexibility, and endurance. Sports like running, football, tennis, weightlifting and others are therefore considered physical exercise, while physical activity includes also the spontaneous movement from daily activities such as walking, cycling, climbing stairs, doing housework, dancing, washing car, carrying shopping bags, gardening, etc.

According to the latest WHO guidelines (101), a healthy adult 18-64 years of age should engage in at least 150-300 minutes of moderate-intensity aerobic activity, or at least 75-150 minutes of vigorous activity over the week, and in strengthening exercises of major muscle groups 2 or more times a week. This can be achieved for example through 5 exercise sessions of at least 30 minutes per week; by doing at least 25 minutes of vigorous intensity exercise 3 times a week; or by combining moderate- and vigorous-intensity activities. The recommended physical activity levels are intended as a minimum limit: additional activity brings further health benefits.

Over the past 40 years, the most recent technological changes have, for some aspects, improved our life. However, the dominance of motorized transport and the decline of physical labour have led to a radical decrease in the population's physical activity with a gradual shift towards a more sedentary lifestyle. The WHO has estimated that **globally 1 out of 4 adults and 3 out of 4 adolescents do not reach the minimum levels of physical activity**. This change in lifestyle has contributed to tripling the number of overweight people since 1975. In 2016, it has been estimated that more than 1.9 billion people were overweight, including over 650 million obese. These estimates are no longer an exclusive of high-income countries, but are recognized as serious public health problem in low- and middle-income countries as well.

Nutrition and physical activity are strictly connected to each other: on the one hand a correct diet allows the body to introduce the energy and nutrients necessary for carrying out physical and sport activities, on the other exercise allows to reach and maintain a good state of health and psychophysical well-being over time.

An increasing number of scientific studies are observing how physical exercise associated with a regular practice of mindfulness multiplies all these benefits. **"Mindfulness"** is the translation of the term "sati" in the Pali language, used by Buddha for his teachings. The term indicates **attention and full mental awareness**,



key qualities to be cultivated through meditation. The practice has influenced the modern mindfulness psychological technique, bringing the subject's attention in a non-judgmental way towards the present moment, with improvements in the perception of physical and mental well-being (102, 103). This sense of awareness can be applied to every aspect of our life: mindfulness is becoming an increasingly widespread practice in every field, from clinical to business, from sports psychology to diet. **"Mindful eating", or conscious eating is the ability to bring full awareness to the food experience**, paying attention to the sensations of our body and its signals of hunger and satiety, thus allowing self-regulation of food intake (104).

In light of all these benefits, including an adequate level of physical activity in our daily routine is essential. Even for those with a busy life, these tips can make the difference:

- don't use the elevator, take the stairs
- walk at a fast pace, as if you were late
- walk or bike instead of using the car, also reducing your CO₂ emissions
- park your car or get off the bus one stop earlier, to cover the rest of the journey on foot
- while watching TV, do some stretching exercises or ride a stationary bike.
- use breaks at work to go out for a 10 minutes' walk, perhaps with a colleague
- housework is an excellent physical activity, including gardening
- when on vacation, take long nature walks or bike rides and involve the whole family

The Climate Pyramid

Given the critical interactions between food systems and climate change, the widespread application of carbon footprint and related wide data availability, **the new Climate Pyramid of the 2021 Double Pyramid focuses on the carbon footprint of food.**

The background database that underpins the new Climate Pyramid based on Carbon Footprint data of food items has been developed by Petersson *et al.* (105) in the context of the EU funded Su-Eatable LIFE project (106). This new release of the Double Pyramid builds on a larger amount of data available compared to the 2016 release (107). Starting from the background database, three steps have been carried out to build the Climate Pyramid.

In a first *matching and mapping* step, the different food items included in the background database have been classified according and grouped into the 18 food groups considered in the Health Pyramid.

In the second step, the *median carbon footprint* of each food group has been calculated. Each value accounts for different types of production systems (e.g., conventional and organic agriculture, heated and non-heated greenhouse), as they are covered in the background database.

The resulting 18 carbon footprint values are used as an input for the third step: defining the layers of the Climate Pyramid. These layers have been defined by performing a cluster analysis. In particular, the *k*-means method is chosen as a discriminant². To evaluate the performance of the methodology, the silhouette index has been computed (108).

The result of the cluster analysis is shown in Table 2. The 18 food groups have been clustered into 7 layers of the Climate Pyramid. These layers have been scaled and labelled from *very low* to *very high* carbon footprint.

The results show that the production of animal-based products - especially red meat, followed by cheese and processed meat (layer 5-7) - **causes the highest GHG emissions compared to plant-based products**, mainly due to the production of the significant amount of feed required by the animals (especially ruminants) and emissions of methane from manure. These results are in line with the scientific literature (51, 109). Fish is in layer 4, with medium carbon footprint mainly caused either by feed production for farmed fish or transportation and logistics in the case of species caught offshore by trawling and long line fishing fleets (110-112). Secondary animal-

based products, such as milk, yogurt, eggs, and poultry have low and medium-low emissions (layer 2-4), with the production of protein-based feed being the main cause of GHG emissions for poultry and eggs (113-115). Plant-based products, either fresh or characterized by low levels of processing, make the smallest contribution to climate change (layer 1). The main causes of GHG emissions are production inputs, from cultivation to distribution (e.g. chemicals, fertilizers, fuel and energy used for machinery and irrigation), and emissions from fertilized soils, such as dinitrogen oxide (N₂O), which has a global warming potential about 300 times higher than CO₂ (116, 117).

Table 2. **LAYERS OF THE CLIMATE PYRAMID**

FOOD GROUPS	LAYER	
RED MEAT	VERY HIGH	7
CHEESE	HIGH	6
PROCESSED MEAT	MEDIUM-HIGH	5
FISH	MEDIUM	4
BUTTER		
POULTRY	MEDIUM- LOW	3
EGGS		
YOGURT		
PASTRIES	LOW	2
NON-TROPICAL VEGETABLE OILS		
NUTS		
MILK		
HIGH GLYCEMIC FOODS	VERY LOW	1
LOW GLYCEMIC FOODS		
LEGUMES		
WHOLEGRAIN FOODS		
VEGETABLES		

2. The cluster methodology has been applied also using different methods of grouping and all of the lead to same results in terms of grouping. This is a strong support on the robustness of the results.

The Cultural Double Pyramids

The Double Pyramid model has been applied to different cultural contexts. In this release, seven experimental Cultural Double Pyramids are a first attempt to capture the diversity of South Asia, East Asia, Africa, the Mediterranean, the Nordics and Canada, Latin America, and USA. These have been defined by analyzing a selection of representative countries, and improved models are foreseen in the future, also for other regions and food cultures.

Representative countries for each region have been included based on population size and geographical distribution, and namely: India, Sri Lanka, Bangladesh, Nepal, Bhutan and Pakistan for South Asia; China, Japan, Taiwan and South Korea for East Asia; Nigeria, the Democratic Republic of Congo, Tanzania, Ethiopia and South Africa for Africa; Italy, Spain, Egypt, Morocco, Israel and Lebanon for the Mediterranean; Denmark, Sweden, Norway, Finland, Iceland and Canada for the Nordics and Canada; Mexico, Brazil, Argentina, Chile and Peru for Latin America; and the United States.

For the purpose of developing context-specific Double Pyramids, **experts have been consulted across the different regions analyzed.** In the preliminary step, (September–November 2020), a literature review (grey literature, scientific papers) was conducted in order to identify the most representative food items of the 18 food groups identified in the Health Pyramid.

As a second step, **an online consultation took place (December 2020–January 2021), during which 44 experts were invited to participate.** 21 responses were received, with a 47% response rate, covering all the seven Cultural Double Pyramids. Experts were selected based on their expertise on nutrition, dietary habits, and public health policies in the regions of interest. Seven online surveys were carried out in this phase, one for each Cultural Double Pyramid, comprising 19 open-ended questions and a set of multiple-choice questions. Experts participated in one of the seven surveys, according to geographical relevance.

The survey was organized into 3 main sections: the first one included a review of a food item list, proposed as being representative of the food group, in the considered geographic area. The experts expressed a judgment on the representativeness of the single food item. Their agreement or disagreement could be expressed in a choice of 5 options, ranging from "totally agree" to "totally disagree", as used in other validated questionnaires. Secondly, for every food group, an open-ended question asked to include comments on the food items just analyzed, inviting the expert to provide reasons for their answers and to suggest possible additional items particularly representative of the considered diet. The final part of the questionnaire asked for a general comment about the representativeness of the food items proposed. Finally, the last part posed an open-ended question asking experts to provide key recommendations for



enhancing sustainable diets in terms of policy, education, research that have been included in the recommendations section of this report.

The results of the survey have been analyzed (January–February 2021) and integrated in the first selection of representative food items of the 18 food groups. Decisions were taken based on the predominance of answers (positive, neutral, and negative) and degree of concordance. The analysis led to the development of **seven Cultural Double Pyramids that include 45 food items divided into 18 food groups.** These foods take into account traditional and local diets, as well as new trends and influences.



3.RESULTS

The Double Pyramid Model

The Double Health and Climate Pyramid has been designed to illustrate the relationship between the impact of food on human health, wellbeing and longevity, and the food system's pressure on the environment, and more specifically on climate. The Double Pyramid aims to communicate in a simple and direct way the features of a balanced, healthy, and sustainable diet by advising on the appropriate frequency of consumption for all food groups and showing the associated impact on cardiovascular diseases and the climate. As such, it can help implement dietary changes suitable for promoting health and protecting the environment in different educational contexts, that include more vulnerable citizen groups. Compared to other tools, including the plate model, the **Double Pyramid has the advantage of taking into consideration all eating occasions**, such as snacks, street food or sandwich lunches, and also to go beyond a single meal by giving a daily and weekly perspective on frequencies of food consumption.

The Health Pyramid proposed here is based on a very comprehensive and detailed examination of the scientific literature, according to a sound and validated methodology, to assess the relationship between each food choice and the risk of cardiovascular diseases; associations of food choices with other non-communicable diseases like cancer and diabetes follow similar gradients. The Climate Pyramid is based on the database provided by Petersson et al. (105) within the EU Su-Eatable Life project, to classify the different foods according to their carbon footprint, from very high to very low carbon footprint.

The resulting Double Health and Climate Pyramid is offered as a tool to inform daily food choices and encourage dietary patterns that are healthy for humans and more sustainable for the planet. The Health Pyramid orders food according to frequency of consumption, with the base including those that should be eaten more often (fruit, vegetables, and wholegrains). Legumes and fish are the preferred sources of protein, while red meat and high glycemic foods should be consumed in moderation. The Climate Pyramid shows that the production of animal-based products makes the highest contribution to climate change, while plant-based products make the smallest. As a result, the Double Pyramid corroborates the message that **through a varied and balanced diet we can promote our health, longevity, and wellbeing, while reducing our carbon footprint.** In fact, foods that should be consumed more frequently for our health also have a low climate impact.

The Health Pyramid is consistent with scientific evidence indicating that, overall, in the adult population, diets with a higher intake of plant foods are associated with a substantially better health profile compared with diets including predominantly animal foods; therefore, they should, in general, be preferred (118). In particular, regular consumption of fruit, non-starchy vegetables



and wholegrain cereal foods should be specifically promoted to prevent cardiovascular diseases and, more generally, to improve health; these are, therefore, placed at the bottom of the pyramid (76-78, 119). Conversely, processed meats, associated with a high risk of cardiovascular events, should not be consumed frequently and are therefore placed in the top layer of the food pyramid (78,84). In between are foods to be consumed with intermediate frequencies (78-88).

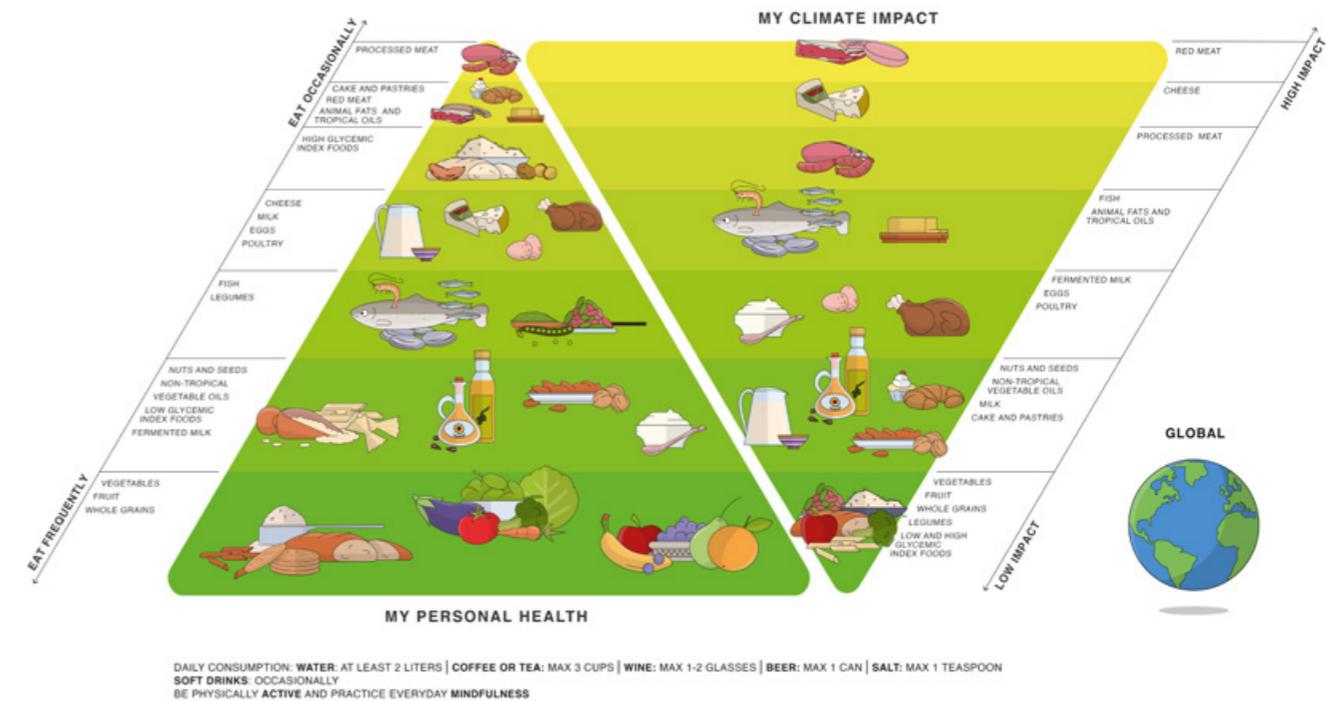
Some significant new findings related to appropriate food choices for cardiovascular disease prevention emerge from the evidence reviewed in support of this Pyramid which, therefore, represents a truly innovative tool, not only in terms of the methodology used, but because of the message conveyed. In particular, with regard to animal-based foods, the most recent research calls for more attention to be paid to the different types of meat, distinguishing not only between processed and unprocessed meat but also between red meat and poultry. In fact, the latter may be



a suitable replacement for red meat, since it has been shown to have a neutral relationship with health outcomes. Other even more suitable substitutes are legumes and fish, which are protective (85). Another new understanding relates to dairy products. Recent evidence does not support different attitudes to the consumption of these food items based on their fat content (full fat or reduced fat dairy products) and suggests, instead, that where overall consumption is moderate – less than 200 g/day – there is no increased risk of cardiovascular diseases (88). Moreover, among dairy products, fermented products, like cheese and yogurt, are associated with a reduced risk of cardiovascular diseases and, therefore, should be preferred (80). With regard to plant-based foods, recent evidence supports the need to differentiate not only between wholegrain and refined cereals but also among the refined ones, those with a low or a high Glycemic Index. The recommendation about limiting the consumption of high glycemic foods (white bread, refined rice, potatoes) and replacing them with both wholegrain foods and low glycemic cereals (pasta, parboiled rice, barley) is gaining increasing support from recent scientific data and has, therefore, been clearly highlighted in this new pyramid (78, 119).

The Climate Pyramid shows that the production of animal-based products – especially red meat – causes the highest GHG emissions compared to plant-based products, mainly due to the production of animal feed and due to emissions of methane from manure (51, 109). Fish has a medium carbon footprint (110-112) while milk, yogurt, eggs, and poultry have low and medium-low carbon footprints (113-115). The main causes of GHG emissions are inputs to production, from cultivation to distribution and emissions from fertilized soils, of plant-based products (116, 117).

⊕ VIEW A LARGER IMAGE



Either fresh or minimally processed, these products have the smallest carbon footprint.

The Health Pyramid promotes changes in the habitual diet that are consistent with the features of the traditional Mediterranean Diet, one of the recognized models of sustainable diets (21, 120). This model has proven to promote longevity and well-being, not only by considering specific food items and dietary patterns, but also taking into account the culture and the history of populations living in that region, as well as social aspects such as tradition and conviviality (121). Moreover, it is strongly tied to a gastronomic background that links health with enjoyment. This may be extremely important for the implementation of feasible programs for the prevention of chronic non communicable diseases. In fact, long lasting lifestyle changes are difficult to achieve and, although health motivations may lead to satisfactory dietary compliance in the short term, pleasure remains an important determinant of any dietary change that is intended to last.

The Double Pyramid shows that all foods can be part of a healthy and sustainable diet, with proper frequency of consumption and serving sizes. A healthy and sustainable diet includes a large share of plant-based foods, such as fruit, vegetables, and wholegrains. It includes a variety of protein sources, mainly legumes and nuts, but also dairy, fish, poultry, and eggs. Among the animal sources, fish and poultry are recommended more frequently than red meat and have a lower climate impact. **The broad message is that, on the overall, foods that should be consumed more frequently for our health are generally also the ones with a low climate impact.**

The Cultural Double Pyramid

AFRICA

At a glance

African food culture is very varied, due to the vastness of the African continent and the various influences that have been absorbed by the different regions of the continent, from North Africa, which has been included in the Mediterranean Double Pyramid, to the Sahel, an immense flat and predominantly desert area south of the Sahara Desert and historically inhabited by Nomadic Transhumant Pastoralists. Central Africa, on the other hand, is characterized by the presence of large rivers, such as the Niger and Congo, and the equatorial forest. In the savannah that straddles central and southern Africa, farming and agriculture are traditionally practiced, activities that are also widespread on the vast plateaus of southern Africa where fishing part of the daily living along the flat coastal strip. According to the Food Sustainability Index (FSI), all analyzed African countries present high levels of environmental biodiversity. It is important that readers understand that the examples that follow result in an experimental African Double Pyramid referred mainly to the countries of Nigeria, the Democratic Republic of Congo, South Africa, Tanzania, and Ethiopia, but applicable to the whole African region.

Food Culture

The African continent is extremely rich and diverse, but generally, some common traits can also be found, such as the single-course meal based on a starchy ingredient and a stewed preparation of vegetables, legumes or sometimes fresh fish or meat cooked with groundnuts, spices and aromatic herbs. In many traditions, food is placed on a plate in the center of the table from which the guests serve themselves. Many meals across the continent are largely plant-based, and include green leafy vegetables, tropical fruits, legumes, tubers, and small-grain cereals, mainly millet and sorghum. Animal products were traditionally consumed in moderate quantities and consisted of oceanic and freshwater fish, fermented milk and, to a smaller extent, game, poultry, beef, and mutton. Rising incomes in recent years and rapidly growing urbanization have contributed to a radical change in the diet of Africans: traditional cereals and tubers are increasingly giving way to corn, rice and wheat, and local varieties of fruit and vegetables are less and less consumed and are being supplanted by imported species (122); convenient prepared or semi-prepared foods are becoming widespread.

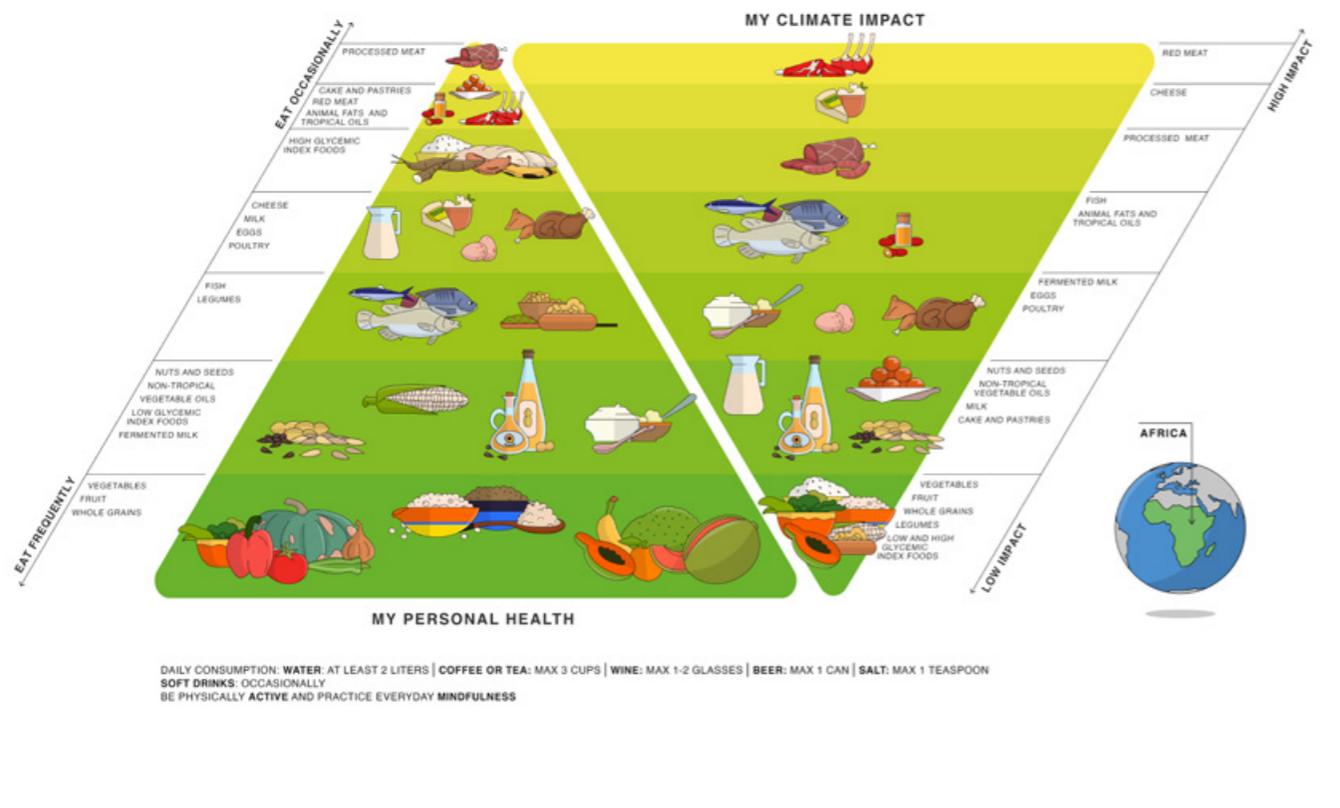
Furthermore, the outlook on food is also closely related to religion. For example, those who practice the Muslim, Jewish and Ethiopian Orthodox faiths do not eat pork or shellfish.



The African Double Pyramid

This section is a guide to interpret the African Double Pyramid. The Health Pyramid orders food according to frequency of consumption, with the base including those that should be eaten more often such as fruit, vegetables, and wholegrains. Legumes and fish are the preferred sources of protein, while red meat and high glycemic foods should be consumed in moderation. The Climate Pyramid shows that the production of animal-based products - especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products - generally makes the highest contribution to climate change, while plant-based products make the smallest.

⊕ VIEW A LARGER IMAGE



In the Health Pyramid, plant-based foods such as fruit and vegetables are at the base. African tropical fruit is abundant and is also used in salty preparations; it includes baobab fruit, citrus fruits, guava, mango, papaya, passion fruit, banana, jackfruit, pineapple, and coconuts.

Leafy greens are omnipresent across sub-Saharan African traditions. Cabbage leaves, cassava and yam leaves, baobab leaves, pumpkin leaves, cowpea leaves, or African eggplant leaves are just a small list of all the different leafy greens commonly cooked. Eggplant, gourd, green pepper, okra, squash, pumpkin, and tomato are some examples of other common vegetables. In parts of Ethiopia, the moringa tree is particularly appreciated as it is entirely edible: leaves, seeds, fruits, roots and trunk are treated and cooked in different ways. This plant can adapt to different weather, soil, and other environmental variables (123) and is resistant to arid conditions that are becoming more frequent in the areas due to climate change (124).



Among wholegrains, millet has been the most widely consumed cereal across the continent for centuries, due to its resistance to droughts (124-126), which have contributed to human migration, cultural separation, and population dislocation (127). According to the National Research Council, pearl millet was domesticated over 4,000 years ago in West Africa (128), but other types of millet such as *fonio* or finger millet are also typical in certain regions. **Sorghum is another traditional grain crop** grown by many communities in arid and semi-arid regions of Africa and is used interchangeably with millet. **Teff is a cereal originating from the area of Ethiopia and Eritrea and is the basic ingredient of injera**, the Ethiopian flatbread served with different types of stews. The teff flour is soaked and left to ferment for a few days, allowing a natural form of leavening. Wheat has an important place in countries like Kenya and South Africa, where whole wheat bread and cornbread are popular and are often served alongside main courses (129). Amaranth is quite a widespread pseudocereal that also provides edible leaves.

Sunflower oil and peanut oil are widely used vegetable oils with a positive effect on health; sesame oil, with a stronger flavour, is also common. Coconut oil and coconut milk are, on the other hand, cooking fats richer in saturated fats and should be consumed less frequently. Coconut milk is commonly used as a flavorful cooking fat used for preparations like coconut rice or *pweza wa nazi* ("octopus and coconut"

in Swahili), an octopus boiled in coconut milk and seasoned with curry, cinnamon, cardamom, garlic and lime juice, typical of the Tanzanian archipelago. Palm oil has long been consumed throughout West and Central Africa but in last 20 years expansion of palm oil plantations has accelerated in several African countries. Despite accounting for 24% of the world's total oil palm cultivated area, a large fraction of oil palm expansion in the last two decades has occurred at the expense of forest outside large agro-industrial concessions (130).

Among nuts, groundnuts or peanuts represent the group and can be eaten as a snack or ground into paste and used in a multitude of sauces and soups that accompany the main meal. Sunflower seeds are widespread where wide sunflower fields are common, while the dried and ground seeds of pumpkin and melon are known as *egusi* and are a major ingredient in West African cuisine.

The next level includes fermented milk, and is worth mentioning that pastoralist populations traditionally consume large quantities of milk, predominantly of cow and goat origin. The Tutsis and the Fulani are populations with a long history of nomadic herding, living in East and West Africa, respectively. Among these populations, other dairy products like **yogurt, sour milk and cheese are also key elements of the diet**. In many areas, the increase in incomes and urbanization has however brought changes to food consumption patterns, including a rising demand for milk and dairy products of cattle, goat and sheep origin.

Among the low glycemic foods, we find white maize. Maize was probably introduced to the African continent by the Portuguese (131) and subsequently became one of the most widespread crops in Africa, although its cultivation is less suitable for the African environment than drought-resistant sorghum and millet. White maize flour can have different glycemic indices according to preparation: for example, *ugali* (also known as *nshima*, *mealie pap*, *sadza*, or *tuwo* in different parts of the continent), a firm porridge widely eaten across Africa, has a high glycemic index. *Ugali* variations made with flours of finger millet or sorghum can also be found (132).

In the next layer, we find **legumes and fish, recommended protein sources for health**. Legumes like lentils, beans and chickpeas are quite common, particularly due to their nutritional properties and affordability and should be one of the main sources of protein. They are usually stewed in soups that accompany the thick porridge made of sorghum or maize. *Maharagwe* is a popular African dish made of red beans stewed in coconut milk along with onions and tomatoes and flavored with cardamom, cinnamon, onions, tomatoes, garlic, curry powder, chili and green peppers. Bambara beans or nuts are an indigenous legume of sub-Saharan Africa, very resistant thanks to their subterranean pods. They guarantee a good yield even in drought conditions and low soil fertility. The beans are dried, ground and sieved to obtain a fine flour, used to prepare a variety of dishes, including flans, confectionery, and cookies (133).

Among fish we find tilapia, the most popular fish across the continent. This freshwater fish has a light flavor and has become essential for aquaculture around the world, especially in low- and middle-income countries, since its fast growth and low cost make it an accessible source of protein for a wide range of people. Given the need for optimal freshwater conditions, tilapia production and aquaculture are challenged by water scarcity, non-optimal temperature, and oxygenation levels of water (134), while they can be a cause of excess nutrients in water bodies, ultimately causing eutrophication (135). Another common freshwater fish is Nile perch, a large fish widespread in all the major rivers, including the Nile, Niger, Blue Nile and Congo river and in the main lakes of the continent.



In Tanzania, fisheries are an important source of food and income both on the coastal area and in inland lakes. The deep waters of the Indian Ocean are rich in fish like tuna, mackerel, and grouper. Nevertheless, both unsustainable and unregulated fishing activities are increasing, damaging the oceans' ecosystem, and consequently endangering the sources of revenue for millions of people (136).

In the following layer we find chicken, eggs, and cheese. Chicken is by far the most consumed poultry but guinea fowl, endemic to Africa, is also consumed on special occasions. Africa has the lowest pro capita egg consumption in the world equal: an average of 2.3 kg/capita/year (137) despite eggs being a cheap source of high-quality proteins, vitamins, and minerals and that could be consumed up to three times a week. This section of the pyramid also includes soft and hard cheese. Besides the traditional varieties from pastoral and nomadic traditions, cheesemaking in South Africa has long been adapting available ingredients to local environmental conditions and is also gaining momentum in the Democratic Republic of Congo with the production of *goma*. Although not included in the Double Pyramid because of current lack of evidence on the effect on health, **it is also worth noting that 470 species of insects are eaten in Africa**, and the Central African region is an important hotspot of entomophagy culture. Caterpillars and locusts are the most widely eaten across the continent. Many edible insects are believed to harbor medicinal properties, but cost-effective rearing, harvesting and processing technologies are required to prevent depletion and ecological disruption while ensuring food safety (138).

In the high glycemic group, we find starchy roots and fruits, although there are difference in glycemic index based on ripeness. Among roots, yams and cassava are the most common, and their glycemic index can vary according to botanical features and cooking procedures. The root and the trunk of the enset tree, also known as "false banana", are both edible and represent important food resources for many households in Ethiopia. Plantains are another staple food especially in the humid regions of east and central Africa. The Ugandan *matoke* consists of boiled and mashed plantains served with a relish made from pumpkin, cowpea or cassava leaves, with the addition of groundnut sauce or red palm oil. *Fufu* is a staple food typical of West and Central Africa made of cassava and plantain flour cooked into a sticky thick mush and served with groundnuts soup and varied vegetables while in the streets of Ghana, strips of fried plantains served as a street food are known as *kelewele*.

Moving to the next level of the pyramid, we find red meat, which should be consumed occasionally. Some examples of dishes that include meat are the West African *suya*, grilled beef or sheep meat skewers or *kilishi*, dried spicy meat stripes made from deboned cow, sheep or goat meat (129). *Zighini* or *wot* is a typical dish from the area between Somalia, Eritrea, and Ethiopia. It is a meat stew, usually made of mutton, beef or lamb, with vegetables such as tomatoes and onions and legumes and flavored with berberè, a typical mix of spices.

The top of the pyramid includes sweets, cakes and pastries, and can be often based on bananas, goyaba, coconut or dates. Fritters made of flour, eggs and sugar are a dessert made in a variety of shapes, such as the *koeksisters*, long South African fritters with a twisted shape.

The African Double Pyramid attempts to illustrate that **is possible to respect local traditions and preferences while recommending a frequency with which foods should be consumed to promote improved health and a low impact on the environment.**



CHEF DEBBY LAATZ

YEMISER SELATTA, SPICY KALE AND AYIB

Yemiser Selatta is traditionally served as a Coptic Christian Lenten Fasting meal. Eaten across Ethiopia, this classic lentil salad adaptation is a fantastic lunch or light supper.

Ayib Cheese is Ethiopian cottage cheese, similar in process to a ricotta, but a slightly sourer form made from whole milk. Ayib serves as a fantastic compliment to spicy or hot wats (stews) that are typical of the Ethiopian cuisine.

Yemiser Selatta and the kale salad can be served independently as an even lighter lunch or simple supper. The combination of the three highlights the complexities of Ethiopian flavours.



METHOD AND PRESENTATION

AYIB CHEESE

1. In a heavy-bottomed saucepan, bring the milk to a slow simmer. It should be foamy and steamy and if using a thermometer just reach 85°C. Do not let it boil.
2. Slowly pour in the lemon juice and stir for a few seconds, then remove from the heat. Allow to stand undisturbed for about 15 minutes until curds form.
3. Moisten a piece of muslin with water, wring it out, and use it to line a large colander which is resting on a bowl. Gently ladle or pour out the curds, draining the liquid through the colander.
4. Set aside to drain for 20-60 minutes until the curds are "dry". 1 liter of milk should yield approximately 400g of curds. Transfer to an airtight container. The whey liquid can be used to cook your lentils in for additional nutrient uptake.
5. Store ayib in a sealed container in the refrigerator for up to three days.

KALE SALAD AND SPICY DRESSING

1. Thoroughly wash and then rinse the kale.
2. Chiffonade the kale and place in ice water to retain crispness. Do this as close to eating/service as possible.
3. Combine the chili, garlic and lime juice with a whisk in a bowl.
4. On service, toss the dressing, toasted seeds through the well-drained kale. Garnish with the onion flakes, garlic and sweet potato crisps if desired for extra crunch and a touch of sweetness.

YEMISER SELATTA

1. Rinse the lentils and split peas under running water in a sieve.
2. Bring a medium size pot of water to boiling, enough to cover the lentils by 5 cm.
3. Add the lentils and split peas, simmer for approximately 30 minutes until al dente. Do not overcook.
4. Drain thoroughly, rinse and set aside.
5. Meanwhile heat oil in a sauté pan and add the cumin, coriander, garlic and ginger.
6. Add the onions and carrots and gently fry until translucent about 5 minutes.
7. Add the lentils and split peas and mix well. Transfer to a bowl.
8. Stir in the toasted seeds and lemon juice. Season with salt and pepper.
9. Serve warm/room temperature with dressed kale and ayib cheese.

INGREDIENTS 4/6 PEOPLE

	G
KALE SALAD	
Ethiopian cabbage / kale / spinach	130
Toasted sesame seeds	20
Toasted sunflower seeds	20

SPICY DRESSING

Chopped chili	10
Crushed garlic	10
Lime juice	30 ml
Honey	10 ml

YEMISER SELATTA

Red lentils	200
Split peas	50
Vegetable oil	20 ml
Ground cumin	5
Ground coriander	5
Crushed garlic	2,5
Fresh ginger, grated	15
Brunoise carrot	80
Brunoise red pepper	80
Fresh lemon juice	60 ml
Salt and pepper to taste	

AYIB

Full cream milk (better not UHT)	1000 ml
Lemon juice (freshly squeezed)	60 ml

ENERGY AND NUTRIENTS, PER PERSON

Kcal	421
Proteins	24 g
Fat	21 g
Carbohydrates	28 g
Fibre	21 g

CARBON FOOTPRINT, PER PERSON

0,07 Kg CO₂ eq

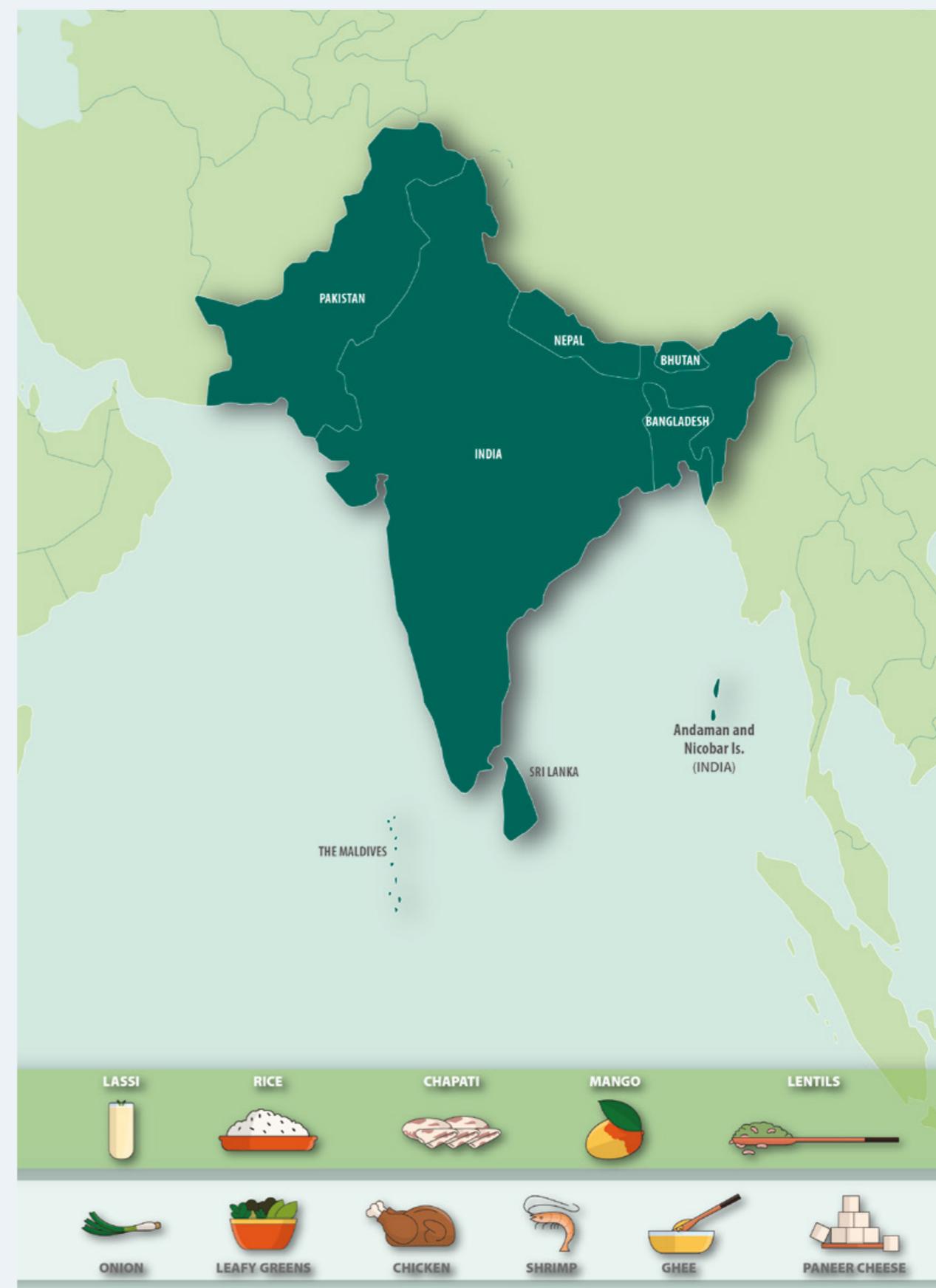
SOUTH ASIA

At a glance

The South Asian Double Pyramid has been defined by looking at culinary habits from countries with different cultures like India, Nepal, Bhutan, Sri Lanka, Pakistan, and Bangladesh. **South Asia is home to one fifth of the world's population, speaking dozens of languages and thousands of dialects, with diverse cultures and, of course, culinary traditions.** Some of the typical foods have been known for more than five thousand years, like leafy vegetables, lentils, ghee, and yogurt. The people who settled in the Indus Valley between 3300 and 1700 BC began to cultivate rice, wheat, barley, tamarind, eggplant, and cucumbers, making a great use of spices such as black pepper, ginger, cumin, cilantro, and turmeric root, dried and ground into an orange powder, and saffron brought by the Greeks. This vast variety of spices is reflected in the widely used curries (*masala*), a mixture of spices pounded in a mortar whose composition varies from region to region and according to uses.

Under the Mughal Empire, influences of the Turko-Persian cuisine of Central Asia introduced leavening and baking wheat bread, marinating meat with yogurt, stuffing of meat and poultry, rice pilaf and cooking in the tandoor, a typical earthen clay oven (139). They introduced tea, which quickly became part of everyday life, and from 1700 AD the Portuguese and British popularized ingredients such as potato, tomato and cauliflower. With Indian, Pakistani, and Bangladeshi migration, the cuisines of South Asia have spread around the world, with further innovations and contaminations, such as the British Tikka Masala. The use of spices such as turmeric, cumin, cilantro, black pepper, cinnamon, ginger, cloves, nutmeg, chili, saffron, cardamom and many others is widespread in the region. Their wise dosage allows the flavor of dishes to be enhanced without adding excessive amounts of salt but giving the food unforgettable aromas.

In recent times, quick social and economic changes have occurred with an impact on dietary habits, showing increasing proportions of energy being derived from vegetable oils and refined carbohydrates (140). Furthermore, South Asian people present a genetic predisposition towards cardiovascular diseases, diabetes, and obesity (141) and, Body Mass Index (BMI) levels being equal, the population turn out to have higher percentages of body fat (closely correlated to diabetes and cardiovascular risks) compared to Africans or Caucasians (142). The Food Sustainability Index highlights how India is among the countries that suffer the most from the impact of nutrition food systems on health, expressed as disability-adjusted life-year due to nutritional deficiencies, cardiovascular diseases, and diabetes (98).



Food Culture

The outlook on food is closely related to religion. Populations of Muslim faith do not eat pork or shellfish. Many Hindus are vegetarian and do not eat beef. In terms of meals, food is usually served in one go, as single dishes rather than individual portions, while Bengali cuisine has a multi-course tradition. The custom of eating food directly with the right hand is common in India, Pakistan, Bangladesh and Sri Lanka, and people might share a meal on a floor covering, from a common central bowl or plate (143). Street food is a constant presence in South Asian roads and alleys and often represents the source of at least one of the main meals of the day. Samosas, pakoras, chevdas, plantain chips, spring rolls and egg rolls, are typical street food. South Asian eating traditions are abundant in wholesome foods such as vegetables, fruits, legumes, nuts, and whole grains: this, combined with a healthy lifestyle, can promote long-lasting wellbeing.

The South Asian Double Pyramid

This section is a guide to interpret the South Asian Double Pyramid. Defining a single South Asian culture can be challenging, but the number of local and regional ingredients, preparations, flavors and textures share common traits (139). The Health Pyramid shows foods according to the frequency of consumption suggested for better health, well-being, and longevity. South Asian cuisine makes widespread use of plant-based ingredients like rice, legumes, and local vegetables, thus showing a general propensity for sustainability. The Climate Pyramid illustrates how production of animal-based products - especially red meat,

followed by cheese, processed meat, fish, poultry, eggs, and dairy products - generally makes the highest contribution to climate change, while plant-based products make the smallest.

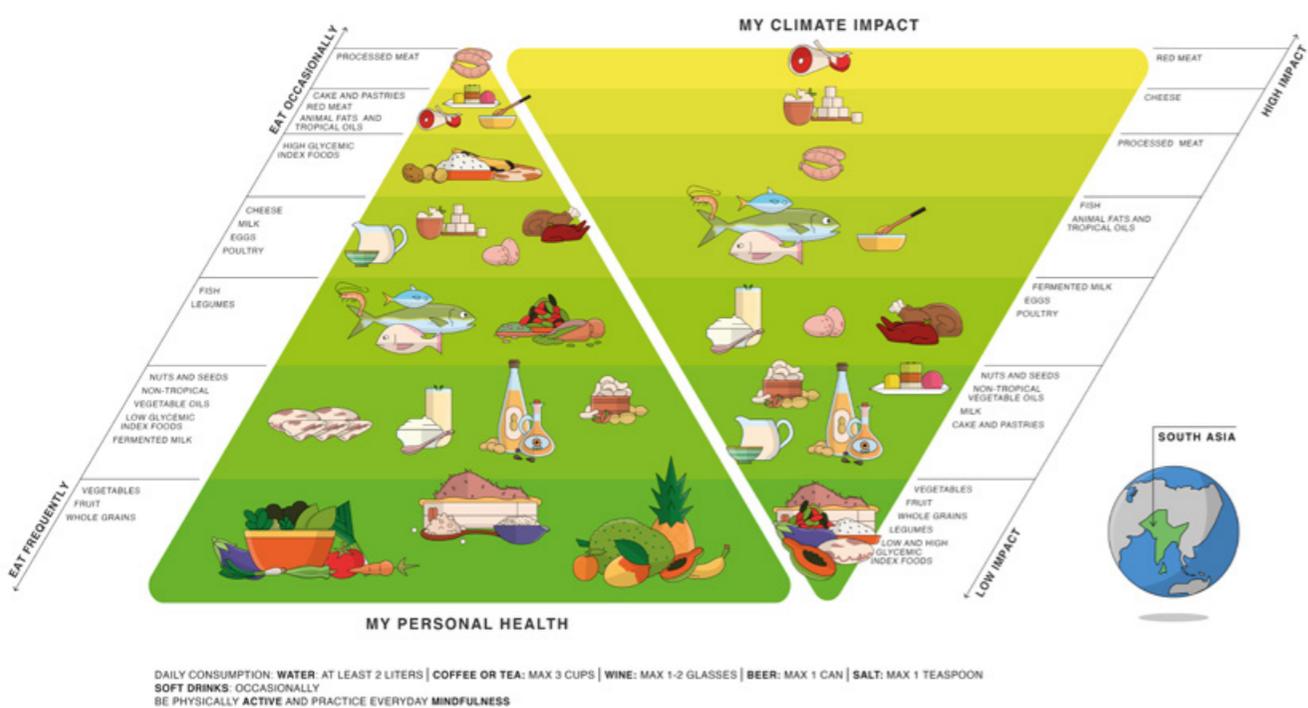
Starting from the base of the Health Pyramid, **fruits and vegetables are recommended daily**, and these are a constant presence in traditional diets. Leafy greens like mustard leaves, fenugreek, spinach and other vegetables like okra, onion, leek, cabbage, carrots, eggplant, turnip, tomato, cauliflower, bell pepper, and cucumber are widely grown. **India is also a major world producer of fruit and is known as the world's fruit basket.** Among fruits we find mangos, grapes, apples, apricots, oranges, bananas, pineapple, jackfruit, guava, lichi, papaya, sapota and watermelons (144). Mango is one of the most popular fruits and can be consumed fresh, dried, or processed and is widely used in chutneys. **Among wholegrains, we find brown rice, millet, and sorghum**, which used to be a major staple in central and southern India, brought from Africa to the region about 2,000 years ago for its excellent tolerance to drought, and is now regaining popularity (145). The region is indeed already experiencing an increase in the frequency and spatial extent of droughts (146), which will likely pose significant challenges for food and water security in India by depleting soil moisture and groundwater storage that provides an invaluable buffer (147). Bhutanese cuisine is characterized by the use of red rice, the only rice variety capable of growing at the high altitudes of this country. India is the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, and fruit. Irrigation causes 89% of water abstraction, the process of taking water from a ground source, which has implications for the status of groundwater: the groundwater level in India declined by 61% between 2007 and 2017 (148).

Moving up the pyramid we find nuts like **peanuts, cashew, pistachio, or almonds** which are present in South Asian cuisine in curry dishes or as ingredients of sweets and desserts like rice puddings. Peanuts can be also mixed with black and white sesame seeds, dried coconut and jaggery, a form of unrefined sugar, into delicious traditional sweet balls while chia seeds are often mixed into yogurt and yogurt-based smoothies. **Among vegetable oils, peanut oil, sunflower oil, and soybean oil are recommended** and commonly used for high heat cooking and stir-frying, while sesame oil is characterized by a more particular aroma and is more frequently consumed as raw condiment. Palm oil and coconut oil are common too, but less frequent use is recommended due to their higher content in saturated fats (149). Consumption of palm oil and its derivatives has grown significantly over the last two decades (150) and about 70% of its demand is met through imports, mainly from Indonesia and Malaysia, where the land-use change associated with the expansion of oil palm is a major cause of deforestation and consequent carbon emissions (151-155).

The consumption of milk and dairy products has been rooted in the South Asian tradition for many centuries, and the share of buffalo milk is around 50% of total milk production, as buffaloes are particularly productive in the changing climatic conditions (156). **The health benefits of fermented milk have been documented by Indian Ayurvedic scripts** dating back to around 6000 B.C (157). Yogurt and a yogurt-like curd are consumed in their plain form, and as aromatic sauces paired with meat or vegetable curry. Lassi is a popular yogurt-based drink made of a mixture of yogurt or curd, water, and spices and served salty, sweet, or fruity, like the popular mango lassi.

In western India, wheat is an important foodstuff, and Atta flour, a strong, high-gluten, durum wheat flour is the basis of **breads like chapati and paratha, just to name a few which are low glycemic foods**, while baked roti can be considered moderately low glycemic. Chapati is a round flat bread made of flour and water: it is salt-free and meant to be paired with savory and spicy

⊕ VIEW A LARGER IMAGE



foods. It is torn off with the hands and used as a spoon to collect food. **Legumes are recommended as one of the main sources of protein and form an important part of South Asia's cuisines.** The term *daal* indicates various types of dried lentils, peas, beans, and chickpeas cooked in a thick soup with onions and tomatoes and flavored with spices. India and Pakistan are the world's top producers of chickpeas, probably introduced by Mughals into the subcontinent (158). Legumes can be used also in the form of flour in the preparation of foods like papadum, a crunchy flatbread used as a snack or side dish in India, Pakistan, Bangladesh, Nepal, and Sri Lanka. Hulled black mung bean flour is used, but also chickpeas and lentil flours are common.

Fish consumption is also recommended, and oceanic fish is abundant for the coastal areas' population while fresh-water species are available for inland dwellers. In Sri Lanka, 70% of the country's animal protein supply comes from fish, and in Bangladesh it is the most commonly consumed animal-source food (159). Bangladesh ranks fifth among the world largest producers of aquaculture fish, in particular the shrimp industry is a great source of food and employment in the country, and the frequent use of freshwater fishes like butterfish and ilish is a distinctive feature of the country's cuisine. Other consumed fish species in the subcontinent are king fish, seabass, Indian mackerel, white snapper, pink perch, and Indian salmon.

Moving up the pyramid we find **poultry, recommended up to three times a week**, and in South Asia chicken is by far the most widely consumed. It can be prepared in many different ways, like tandoori chicken, cooked in a tandoori oven, chicken korma, a creamy chicken stew, the savory chicken tikka or grilled. Chicken eggs are an ingredient in some regional cuisines and egg dishes are particularly popular among Parsis. Among cheeses we find paneer, which unlike many other cheeses, is obtained by coagulation using lemon juice instead of rennet, making it completely lacto-vegetarian.

Moving further up the pyramid, we find **high glycemic foods**, such as rice, naan and potatoes. **Because of their effect on glycaemia, limited consumption is recommended, favoring wholegrain versions instead.** Rice is the main ingredient of many common rice dishes like biryani, which contains spices, meat, fish, eggs, or vegetables. Rice is more than mere livelihood: it has shaped history, culture, art, and lifestyle. It is regarded as a sign of fortune and well-being, and plays a part in weddings, seasonal festivals, and rituals. Rice is a staple food for 70% of South Asia's population, and food security is strictly linked to maintaining its stable prices (160). Because of its effect on glycemia, the wholegrain version should be preferred. India has become the world's second largest rice producing nation, with the largest rice harvesting area in the world, and Sri Lanka currently produces 95% of domestic requirement (161). The two countries, and Bangladesh, are among the most disaster-prone countries in the world but, despite recurrent floods, they have maintained steady production growth for the last three decades. According to the latest FAOSTAT data, emission of methane from rice cultivation causes about 15% of agricultural GHG emissions (in kg of CO₂ eq.) in Southern Asia (137).

Widespread throughout central and southern Asia up to Iran, naan dough is very rich, and wholegrain flour is recommended: in addition to Atta flour, water, salt, yeast, milk, butter and yogurt are added, and the mixture is leavened and fermented. Naan bread can be served as an accompaniment, especially for meat dishes or soups, or buttered with ghee and soaked in tea or coffee for breakfast, or even stuffed with minced meat, nuts, raisins, vegetables, cheeses. Breads are then cooked either in the tandoor oven, on hot cast iron plates called *tava*, or fried.



Potatoes were introduced to the subcontinent by the Portuguese in the XVII century and used as ingredients of many dishes like the *aloo gobi* (potatoes and cauliflower flavored with spices) popular in Indian and Pakistani cuisine. Taro root, sweet potatoes, yam root and other tubers can also be found with some regional differences.

Among saturated fats we find ghee, which is one of the main cooking fats used in Asian countries and is obtained by clarifying butter at a high temperature. This process produces an almost anhydrous milk fat that can be preserved for months at room temperature and is used for frying in numerous Indian preparations (162).

Red meat is recommended occasionally, and includes mutton and lamb in recipes like vindaloo or Bihari kebab. Processed meat is not common, but chicken sausages are eaten occasionally, and are found on the higher pyramid layer, to be eaten in moderation.

To conclude, the South Asian Double Pyramid is an attempt to illustrate an example of a healthy and sustainable diet, considering local food, tradition, culture and religion, and the great diversity that this region offers.

CHAPATI, CHICKPEAS AND VEGETABLE DALCHA

Chapati is an unleavened flatbread originating from the Indian subcontinent, made of whole-wheat flour. Chapati was introduced to other parts of the world by immigrants from the Indian subcontinent, particularly by Indian merchants to Central Asia, Southeast Asia, East Africa & the Caribbean islands.

Dalcha is a lentil curry that is made from dried split pulses originating in the Indian subcontinent. Dalcha is traditionally prepared mutton, however it can be replaced with chickpeas to produce an equally flavorful dish on its own. This recipe was recreated using vegetable trimmings and unused ingredients from kitchen classes.

CHAPATI: METHOD AND PRESENTATION

1. Sieve and weigh 200 g of flour in a large mixing bowl. Remaining flour will be used for dusting and rolling the chapati later. Add in salt.
2. Add in the 3/4 of water. Mix gently in a circular motion until it forms a mass. Add more water if it is too dry and firm.
3. Knead until it becomes soft and pliable and does not stick to your fingers.
4. Once done, the dough should be smooth. Press the dough with your fingers, it should leave an indentation.
5. Cover with a damp cloth and rest for 1 hour at room temperature.
6. After the dough has rested, give it a quick knead again.
7. Divide into 8 equal size balls (47 g). Cover the rest.
8. Take one of the balls and press it between your fingers to make it smooth. Then roll it between your palms to make it round and smooth.
9. Dust area with remaining flour, flatten with your hands and roll it with a rolling pin into a 7 inch disk. Dust surface with flour if dough sticks.
10. Place chapatti on a hot griddle and cook for 30 seconds or until bubbles appear on the surface.
11. Flip and cook the other side for 45 seconds.

12. Use a tong to remove the chapati and place it on an open flame. If the chapati has been rolled properly, it will puff up at this point.
13. Flip and repeat until it has brown spots.
14. The chapattis are best served warm accompanied with a chickpea and vegetable dalcha. (see next recipe).

CHAPATI: INGREDIENTS 4 PEOPLE

	G
Whole wheat flour	225
Water	147 ml
Sunflower oil	8 ml
Salt	3

CHAPATI: ENERGY AND NUTRIENTS, PER PERSON

Kcal	240
Proteins	6g
Fat	2g
Carbohydrates	34g
Fibre	4g

CARBON FOOTPRINT, PER PERSON

0,02Kg CO₂ eq



DALCHA: METHOD AND PRESENTATION

1. Rinse lentils and transfer to medium size pot. Add water, ginger and garlic.
2. Bring to a boil on medium heat. Skim any scum that forms.
3. In a separate sauté pan, add in 2 tablespoons of sunflower oil.
4. Add in tempering ingredients, sauté until fragrant and onions lightly browned.
5. Stir continuously, followed by adding the spice mix. Lower the flame down.
6. Continue cooking until the spice mix is cooked and forms a paste. Set aside.
7. Check simmering lentils as it should be soft (12-15 minutes of simmering).
8. Add in chickpeas and vegetables. Simmer for 8 more minutes.
9. Ensure vegetables are tender and cooked. Add in cooked spice mix paste.
10. Followed by coconut milk, tamarind juice and check for taste.
11. Adjust with salt and white pepper.
12. Serve with warm chapatti.

**DALCHA:
INGREDIENTS 4 PEOPLE**

	G
Split yellow lentils	100
Garlic, minced	5
Ginger, minced	5
Carrot, diced	100
Chickpeas, drained	100
Eggplant, diced	100
Long beans	100
Water	500 ml
Low fat coconut milk	100 ml
Tamarind juice	80 ml

TEMPERING INGREDIENTS

Sunflower oil	20 ml
Red onion, sliced	200
Cinnamon stick	2"
Star anise	n. 1
Cloves	n. 2
Cardamom pods	n. 2
Curry leaves	n. 2
Dried chillies	n. 2

SPICE MIX

Cumin powder	5
Fennel powder	5
Turmeric	10

**DALCHA:
ENERGY AND NUTRIENTS, PER PERSON**

Kcal	362
Proteins	20 g
Fat	5 g
Carbohydrates	48 g
Fibre	6 g

CARBON FOOTPRINT, PER PERSON0,09 Kg CO₂ eq

EAST ASIA

At a glance

The East Asian Double Pyramid has been designed by analyzing the culinary traditions of countries like China, Japan, Korea, and Taiwan, where differences in history, geography, available resources, climate, cooking techniques, religion, and lifestyle stretch back over thousands of years. **In this region, common ingredients can be found with different styles of preparation.** However, a common trait is that food-preserving methods like salting, pickling, drying, and fermentation have widely developed over time and are now combined into the different local habits (163). China is an enormous and populous country, encompassing diverse food cultures and cuisines from the inner region of Sichuan to the coastal regions of Jiangsu and Guangdong, just to name a few (164). China's geographical variety is also reflected in its foods, encompassing road plains to mountain valleys, from three-month growing seasons to year-round agriculture, from fishing villages to enormous cosmopolitan cities (165).

Northern Chinese cuisine generally makes large use of cooking oil, particularly used for frying, and is characterized by the strong flavors of garlic and vinegar, while Southern style cuisine is lighter and prefers fresh ingredients. The use of dried and preserved foodstuffs is another characteristic of Chinese cuisine. Foods, spices, and seasonings are of great importance in cooking, and are considered to have medical properties, promoting a balanced long life. For example, ginger is considered effective in heating the blood, so should be eaten by those with anemia (143). Chinese cuisine also spread throughout many other parts of the world and evolved into different flavors of other continents. Japanese cuisine is characterized by a high attention to the seasonality and the good quality of ingredients, which is as important as the aesthetic of the dish. Japan's culinary tradition offers numerous recipes based on local ingredients cooked with little or no oil and fat that might mask the flavor of every ingredient. Korean cuisine is rooted in the ancient prehistoric traditions of the Korean peninsula and makes great use of ingredients like rice, vegetables, and meats. Traditional Korean meals are characterized by a high number of side dishes (*banchan*) that accompany the typical steam-cooked short-grain rice. Kimchi, a fermented spicy vegetable, is served at almost every meal. Taiwanese cooking has a long and complex history, with unique indigenous, Chinese and Polynesian features.

Food Culture

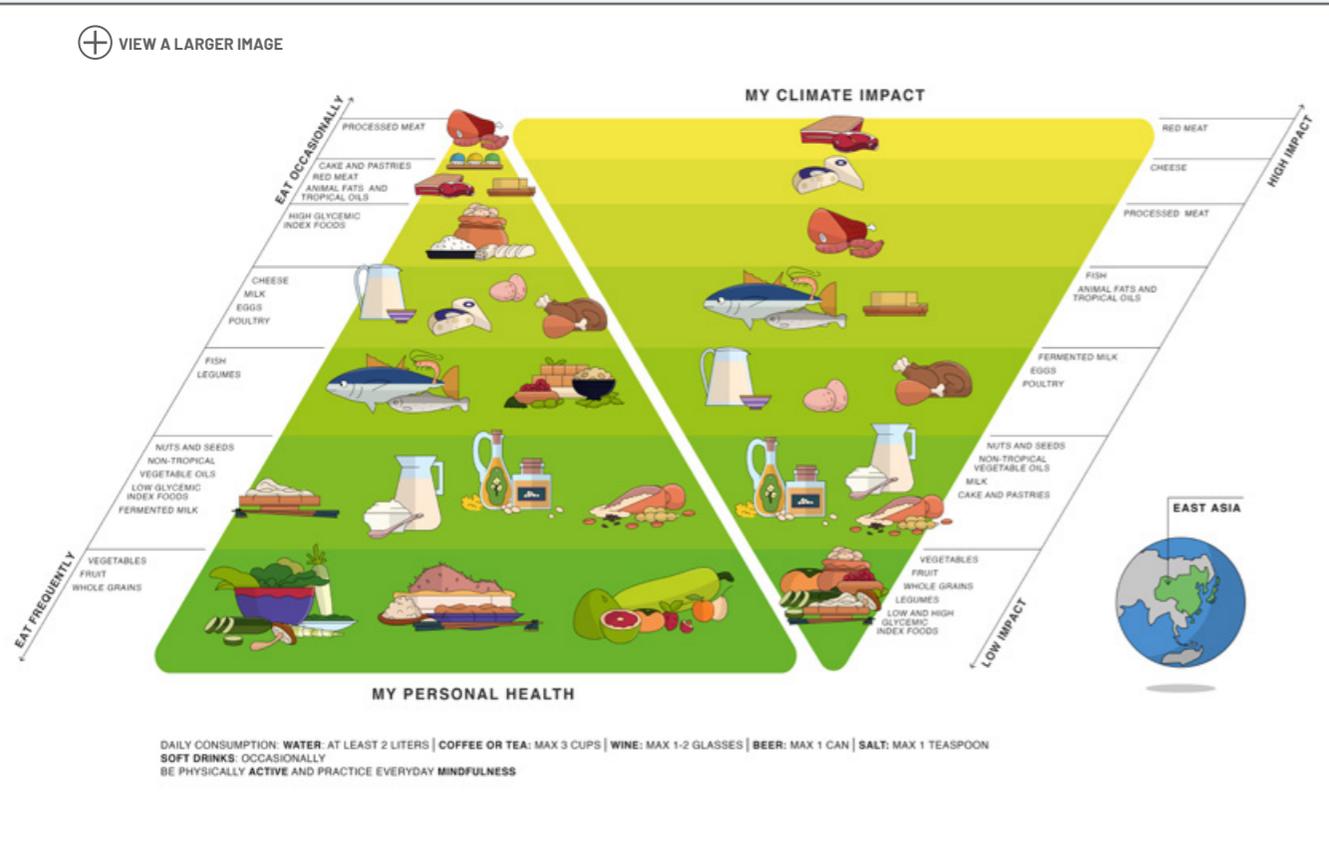
Chopsticks are a common feature of East Asia, widespread in China as long ago as the second century B.C. Most Chinese have three meals a day, and rice, porridge, and soup are served in a precise order (166). Korean meals have historically been served with *bap* (cooked rice), *kuk* (dishes with broth), *kimchi*, and *banchan* (side dishes) to be eaten at the same time (167). In general, in



recent decades home-cooked meals have often been replaced by out of home dining (168). Given the numerous regional traditions, it is challenging to define a single cuisine that could embrace such a vast region. However, we can identify some recurring food items found in most of the different dietary cultures of East Asia. **Rice has always been a common staple, while wholegrains like millet used to be quite common and now regaining popularity.** Every country has a variety of fruit and vegetables, and protein sources include soy, traditionally processed in many forms such as tofu and soy sauce, but also fish, eggs, and meat. Despite the countries in question are home to many wholesome and fresh ingredients, it is worth mentioning that the entire Asian witnessing increased prevalence of overweight and obesity, linked to rapid economic growth, and consequent societal trends like dietary changes towards habits characterized by higher meat and fat consumption. This is particularly worrying in the Asiatic population, genetically predisposed to developing non-communicable diseases associated with overweight like diabetes (141).

The East Asian Double Pyramid

This section is a guide to read the East Asian Double Pyramid, where the Health Pyramid arranges foods based on their impact on health, and foods at the bottom should be consumed more often than the ones on the top. The Climate Pyramid shows that the production of animal-based products – especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products – generally makes the highest contribution to climate change, while plant-based products make the smallest.



The base of the pyramid includes many plant-based foods, such as fruit, vegetables, and wholegrains. Vegetables are often the central ingredient of a dish, adding nutrients, flavor and color. China produces a huge variety of unique vegetables like bok choy, Chinese broccoli, Chinese eggplant, baby corn, snow peas and watercress. While in Japan, the *Brassica* family – cabbages, radishes, and turnips – is probably the most commonly used. Other popular vegetables are bean sprouts, carrots, tomatoes, potatoes, onions, and Japanese leeks. Over the centuries, imports that have become intrinsic parts of Japanese cuisine, and eggplants, tomatoes, and sweet and hot peppers have been adopted (169). The Korean diet is also characterized by a high intake of vegetables and lettuce, bell peppers, carrots, or cucumbers, often consumed raw with sauces and topped with sesame seeds. Cabbage or spinach are blanched and seasoned with traditional spices (167). Kimchi is probably the most representative food of Korean cuisine, consumed at any time of the day, alone, as an accompaniment or as an ingredient in the preparation of other Korean dishes. South Koreans consume around 1.6 million tons per year of kimchi (170) made of fermented

vegetables with spices (chili powder, shallot, garlic, and ginger) and seafood. There are hundreds of varieties, each with a different vegetable as the main ingredient (171) although napa cabbage and Korean radishes are the most commonly used. One serving of 100 g provides over 50% of the recommended allowance of vitamin C and carotene, contains high quantities of dietary fiber and few calories, plus different amounts of vitamin A, thiamine (B1), riboflavin (B2), calcium and iron according to the main vegetable used (172). Being a fermented food, it also contains bacteria like lactic acid bacteria, including the typical species *Lactobacillus kimchi* (173). However, kimchi is a very salty preparation and should therefore be consumed in limited amounts, especially by individuals who need to control their sodium intake. Asia can boast a great variety of mushrooms, like the long and thin *enokitake*, with a crispy texture, or the bigger *shiitake* type. Mushrooms can be consumed fresh or dried, added to the Japanese miso soup or served sauteed in many Chinese vegetarian dishes. Seaweed has been a part of East Asian cuisine since prehistoric times (174). Japan is the country that consumes seaweeds the most, using more than 21 different varieties



in its cuisine. Popular seaweed varieties, such as Nori, Kombu, and Wakame are also becoming popular in Western countries, due to their high nutritional values, including a high B group vitamin content and micronutrients like iodine, calcium, and magnesium (175, 176). **Fruit includes different varieties** and in Japan about 150 varieties of native apples were known by the eighteenth century, as were oriental pears (nashi), persimmons, melons, grapes, and mandarin oranges, most of these imported from China (169). In addition to those just mentioned, other common fruit in East Asia include bananas, durian, pineapple, apples, guava, and plums. Some other items, despite being fruit, have other uses: for example, yuzu is a very acidic citrus used in the preparation of the famous yuzu sauce; winter melon is eaten as a vegetable or used in the preparation of tea; goji berries are used as a condiment or for hot infusions.

Whole grains have a long history of consumption in East Asia, either as cooked grain or as porridge, and are recently regaining popularity (177, 178). Black or brown rice can be tasteful

variations in the Chinese congee (a kind of rice porridge) or in a stir fry, while buckwheat is the staple ingredient of the Japanese soba noodles, which can be served either as a noodle soup in hot broth or chilled with a side sauce. Millet is another common grain and used to be the main staple food before rice took its place.

In the next layer, we find vegetable oils. Soybean oil is one of the most used, and is recommended for the balanced proportion of omega-6 and omega-3 fatty acids contained in it. Sesame oil, with its strong nutty flavor, is usually used as a flavor enhancer. Peanut oil has a high smoking point, making it suitable for popular cooking methods like stir-frying and deep-frying. Canola oil has a more neutral flavor compared to peanut oil and is therefore suitable for a greater variety of cooking styles and dishes. Nuts and seeds are excellent sources of healthy unsaturated fats and are recommended on a daily basis. China and Korea are two of the major pine nuts producers and exporters in the world (179). These small nuts have been consumed in Asia since the Palaeolithic period, baked into bread or added to meat, fish or vegetable dishes. Peanuts can be ground into creamy accompanying sauces or used whole to add crunchiness to the dish. The black variety of sesame seeds is nuttier and crunchier than the white one and is the most common in Asia, giving a pleasant crunch and flavor to many local dishes.

Low glycemic foods include noodles, which come in a wide variety of colors, shapes, textures and sizes. They can be served in hot soups, cold or stir fried and are usually made of rice or wheat flour.

Legumes are recommended as a source of protein, and beans are highly consumed and are present in many varieties such as mung beans, azuki beans, kidney beans, broad beans, black turtle beans. Soybeans can be eaten whole, cooked, fermented, or ground and are the basis of many traditional Asian dishes and foods. The soybean is the second most important source of food to the Japanese, after rice, and usually destined for miso soup, soy sauce (*shoyu*), and tofu. Tofu is a common protein source and is prepared through the coagulation and successive pressing of soy milk into white blocks of different textures and tastes. Its very subtle flavor makes tofu suitable for many preparations and dishes. Edamame are immature soybeans usually steamed inside their pod and salted, while fermented and salted black soybeans are used for the preparation of *douchi*, an extremely savory Chinese condiment. The Chinese also developed the fermented soybean preparation *jiang*, primarily in the form of paste or liquid, as a ready-made seasoning. *Doenjang* is a fermented soybean paste and is considered one of the essential sauces in authentic Korean cuisine. *Natto*, a fermented product of soybeans with a very strong flavor, is a Japan specialty. Increasing demand for soy in China is contributing to deforestation both in the region and in South America: China soy imports cause 51% of GHG emissions from Brazilian soy exports (180).

The azuki bean is smaller in size than other bean varieties and is usually dark red in color, with a thin white line, but yellow, black, grey or brown varieties also exist. It is extremely widespread throughout East Asia and is the most consumed legume in Japan after soy. The beans are usually boiled and sweetened to form a red bean paste (*anko*), an ingredient widely used in many sweet and salty recipes, and in many Japanese desserts such as *daifuku*, small sweets made of a *mochi* (glutinous rice cake) filled with red bean paste, or in the Chinese famous mooncake.

Fish is also recommended, and the sea is the main source of protein in the Japanese and Taiwanese diet, providing fish and seafood. Freshness and seasonality are prized, and tuna is

most often eaten raw as sashimi or sushi. Salmon has recently gained popularity, but grilled trout or eel are also quite common. A fish stock (*dashi*) is for many Japanese dishes the basic and most important flavoring ingredient. The stock has two basic ingredients: dried bonito (*katsuobushi*) and kelp (*konbu*), and usually requires lengthy preparation. The high consumption of fish is threatening the national fish stocks: more than 70% are overexploited or collapsed (181, 182). Surrounded on three sides by oceans, Koreans have also consumed fish using various techniques, such as grilling, boiling in sauce, and marinating. In China, freshwater fish represents a huge market. In addition to being the largest aquaculture producer in the world (183, 184), China also holds the record as the largest number of farmed species. The predominant species is by far the carp, but other species like the Japanese eel are also important (185), and snakehead mullets, mandarin fish, pond loaches, and tilapia have been introduced into aquaculture. It is worth mentioning that in traditional East Asian dishes, it is common to find meat and fish mixed together. **Poultry is traditionally widely cooked:** the *kung pao chicken*, a Sichuan recipe made of stir-fried chicken with spices, peanuts, and vegetables, is only one of the countless dishes based on this ingredient. Duck deserves special mention in China, where it has been consumed for centuries. Duck meat is classified as poultry but has a higher saturated fat content (186). For this reason, its consumption should be limited only to special occasions. **Poultry eggs are quite common too, especially from the most widely eaten chicken, duck, and quail.** Dairy products are not traditionally widespread in East Asian cuisine, especially among the population that was not used to domestic animal milk consumption and cows supported work like ploughing. Furthermore, a large share of the population is also congenitally lactose-intolerant. However, the reinvention of milk as a staple of modern China sees the country as one of the major world's producers (187), and we find it in the Pyramid. Cheese and yogurt are also becoming popular in Japan, and the soft *sakura cheese*, created in Hokkaido, has been recently recognized worldwide and prized. Soy milk has a similar nutrient composition to cow milk, and has been part of the tradition, while almond milk, walnut milk and coconut milk are gaining popularity.

In the high glycemic foods we find refined rice and potatoes. Archaeological findings dating back 15,000 years have shown that wild rice was already an important source of nutrition in some areas of Korea and China and some islands of Southeast Asia. Rice is used in countless Asian dishes, from the Japanese sushi and onigiri, to the Korean *kimbap*, to the many regional variants of the Chinese fried rice. **In Japan the term "eating rice" is synonymous with "having a meal".** The *Oryza sativa* species constitutes the vast majority and is the most widespread species in Asia, to which the different locally grown subspecies belong, such as the *indica*, elongated, typical of tropical climates, very widespread in southern China, or the *japonica*, typical of temperate climates, shorter and rounded, cultivated in Japan, Korea, and northern China (188). Before the Japanese colonial period, most of the rice grown in Taiwan was long-grained *indica* rice; afterwards, the Japanese introduced short-grained *japonica* rice which quickly changed both the farming and eating patterns of the Taiwanese. Rice fields are a significant source of methane emissions that is one of the GHG with the highest contribution to climate change: in Eastern Asia, rice fields cause about 18% of total agricultural emissions (in kg CO₂ eq.). Rice flour can be used to make rice noodles, but most of it is used for glutinous rice cakes widely eaten as desserts and during traditional religious festivals. *Sungnyung* is a traditional Korean drink made from the roasted crust of rice which forms on the bottom of a pot after cooking rice (167). In China, rice is usually the staple food

for people living in the South, while food made of wheat flour such as steamed bread, bread, and buns is the staple for people living in the North (166). Because of the effects on glycemia, the wholegrain versions should be preferred. Starchy roots are another common source of carbohydrates. The Japanese sweet potato has a distinctive reddish or purplish skin and a creamy sweet white flesh and it is typically harvested in autumn. Cellophane noodles (from their glass-like appearance when cooked) are made from starch of different kinds, like potato or sweet potato starch, tapioca, or mung bean starch.

Among red meat, we find pork, a traditional ingredient of many dishes in Taiwan, Korea, and China, like the *char siu*, a popular flavored and grilled pork typical of Cantonese cuisine. Traditionally, meat portions are small and often used for the purpose of flavoring the dish or soup. Today, beef consumption is rapidly growing in China, while in Korea, cattle have been part of family life and the economy for a long time. Here, beef is served boiled in soups, roasted, or grilled in the famous *gogi gui*, the Korean barbecue where other types of meat, like pork or chicken, are grilled (189). Due to the abundant supply of seafood, the Japanese diet traditionally makes little use of meat; nevertheless, the modern cuisine includes an increasing variety of meat dishes. In general hamburgers and hotdogs are gaining popularity, especially the younger Japanese. The three most commonly available meats in Japan are chicken, pork, and beef (169). Deep-fried battered pork cutlet *tonkatsu* is among the nation's favorite dishes.

East Asian cuisine is extremely savory and spiced. Garlic, scallion, ginger root, cilantro, cinnamon, fennel, and various pepper varieties are just a few of all the possible seasonings used in cooking. The most widely used sauce is certainly soy sauce, but oyster or other fish sauces, yellow bean sauce or different types of vinegars can be also used according to the dish and the different regional traditions.

Among beverages, tea deserves a special mention. Archeologic findings have revealed that infusions of leaves from various wild plants, including the tea plant, might have been consumed for more than 500,000 years. The people of Japan and China, but also India, and England, have elevated tea from a simple beverage to a social custom. Tea derives from the leaves of *Camellia sinensis*, which contains nearly 4,000 bioactive chemical compounds, one-third of which are polyphenols. Green tea has the highest concentration of catechins (a type of natural antioxidants) per gram of dried leaves compared with black and oolong teas (190). The custom of tea was transmitted from China to become an integral part of each East Asian culture. Tea has had deep ties with and has played a large role in religion—particularly Buddhism in China, Korea and Japan, and various distinctions exist in the adoption of tea culture, religion, and rites in these regions. The custom of families drinking tea in "tea rooms" is disappearing due to rapid social changes (191). GHG emissions are substantial in tea cultivation due to the use of chemical fertilizers (192), but tea agroforestry systems can support climate change mitigation through carbon stock (193).

To conclude, the East Asian Double Pyramid attempts to illustrate an example of sustainable diets that are adapted to the local context, blending tradition with innovation, while providing recommendations to promoting health and a reduced carbon footprint, and for the active compounds of typical foods of the East Asian diet, such as soy, seaweed and green tea, this way of eating has also proven to promote longevity and well-being.



CHEF SHINYA ENDO

(Recipe inspired by The Japanese Culinary Academy's Complete Japanese Cuisine Book)

CHAWAN MUSHI STEAMED EGG CUSTARD

The Chawan Mushi Steamed Egg Custard has a long history starting from the eighteenth century. It is said that its roots can be traced to Nagasaki's banquet cuisine also called Shippokku. Its soft and smooth texture is completed by an explosion of umami in the mouth. This dish is one of the most appreciated dishes in the Japanese cuisine.



METHOD AND PRESENTATION

DASHI (5,5 L)

1. Place water and kombu in a large pot.
2. Heat over low heat, slowly raising temperature to 60°C.
3. Once liquid has reached 60°C, simmer for one hour, adjusting heat to maintain even temperature. This step brings out maximum umami.
4. Remove kombu and raise temperature to 85°C over high heat. When temperature reaches 85°C remove pot from heat and add bonito flakes.
5. Wait for the bonito flakes to thoroughly soak up water.
6. 10 seconds later, strain liquid through a fine-mesh cloth and leave to drain naturally, without squeezing the cloth.

EGG CUSTARD

1. Cut chicken slantwise into six pieces and sprinkle with dark soy sauce to pre-flavor and eliminate gamy odor. Knead briefly to help soy sauce penetrate.
2. Clean lily bulb and detach petals.
3. Steam lily bulb at 100°C for 4 minutes.
4. Remove from steamer and sprinkle with 4 percent salt by weight.

EGG MIXTURE AND FINISH

1. Beat eggs well, cutting through the whites with chopsticks to ensure they are evenly blended with the yolks.
2. Add dashi to beaten eggs, sieve mixture and add soy sauce.
3. Place chicken, lily bulb and ginkgo nuts in.
4. Pour in egg mixture and steam at 85°C for 20-30 minutes.
5. Garnish with yuzu strips.

INGREDIENTS 4/6 PEOPLE

	G
DASHI	
Water	7200
Kombu seaweed	120
Bonito flakes	200

STEAMED EGG CUSTARD

Prawns	80
Chicken breast	80
Lily bulbs	26
Ginkgo nuts	8
Dark soy sauce	5

EGG MIXTURE

Eggs	n. 3
Dashi	350
Light soy sauce	2.5
Strips yuzu	n. 3

ENERGY AND NUTRIENTS, PER PERSON

Kcal	103
Proteins	15
Fat	8
Carbohydrates	1
Fibre	0

CARBON FOOTPRINT, PER PERSON

0,53 Kg CO₂ eq

LATIN AMERICA

At a glance

The Latin American Double Pyramid has been developed by analyzing the culinary traditions of South and Central American countries, including Argentina, Brazil, Colombia, Peru, and Mexico. **These countries have a lot in common but differ in terms of geography, history, language, and cultural heritage, resulting in a different distribution of ingredients and cooking techniques.** Almost all climates can be found in this area, from the Andean region, with its mountains, valleys, and countless rivers, to the great plains of the Pampas, the Amazon, Chiriquete and Lacandon rainforests, the Mexican semi-arid regions, and the coastal areas present in all of the countries. In terms of food variety, indigenous populations had an elaborated irrigation system and terraces to grow potatoes, corn, and beans, which are still the cornerstone of today's diets (194). Chili peppers, avocados, peanuts, and cocoa were also endemic, and Europeans brought livestock, citrus trees, wheat, and almonds. **The result today is a unique blend of tradition, innovation, and contamination.**

Food Culture

Latin Americans usually eat three meals a day, mostly at home, with dinner being the most important eating occasion. However, food vendors on the streets and in the markets, and the high density of restaurants, cafes, and food stands in cities have recently encouraged the population to eat out more frequently. Eating habits preserve some ancient traditions from the pre-Columbian era, and many contaminations, especially in urban areas where diets tend to be more diverse and higher in nutrient and calories, which in some cases have had important effects on the population's health (195). **Mexican cuisine is characterized by intense and varied flavors and since 2010 it has become a UNESCO Intangible Cultural Heritage.** Corn and beans are consumed everywhere in the country, but each Mexican region has a characteristic gastronomy. Brazilian cuisine also varies by climate and region. Typical dishes include staples such as rice and beans, and many dishes have European, Asian and African influence, the latter especially in the Bahia coastal region. Peruvian cuisine is very different from the cuisine of other South American countries, particularly due to the strong influence of Incan culture and is rich in foods typical of the Andean area. Argentine cuisine is characterized by the prevalent use of meat and wheat flour, and by Italian, Spanish and French influences. Chilean cuisine is also a melting-pot deriving from the encounter of indigenous traditions with that of the Spanish colonial period, with subsequent Italian, German and French influences, leading to the birth of the Chilean Creole cuisine, characterized by delicacies that are simple and tasty but not particularly spicy. Spices are widely used in all the dishes of Latin America. The numerous varieties of hot peppers give a



unique touch to local recipes. Aji is a spicy sauce that often contains tomatoes, cilantro, chilies (*aji*), onions and water and is included in many recipes. Cilantro, paprika, and pepper are widely used and in Mexican cuisine the addition of lime to many dishes is also typical.

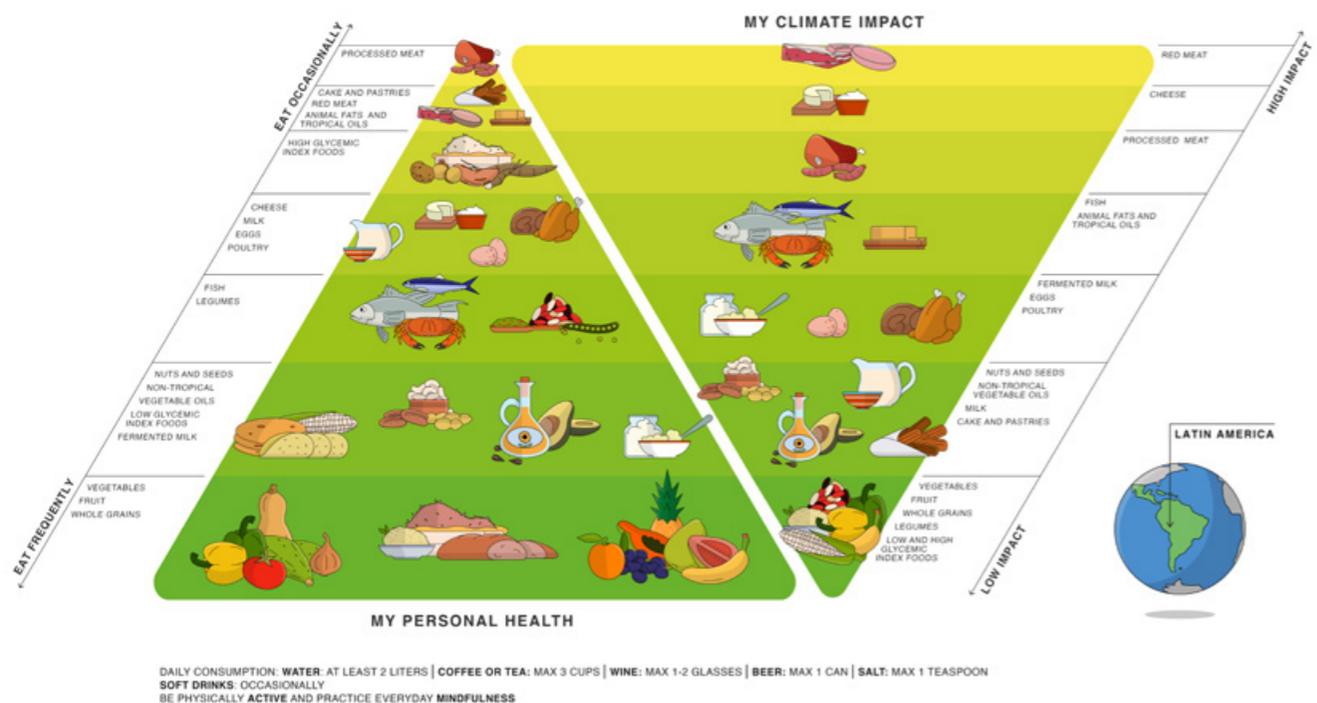
Today, however, the Latin America region is facing a profound shift in diets, with increasing intake of high-energy and low-nutrient foods and sugar sweetened beverages, increased away-from-home eating and snacking and growing levels of overweight and obesity. Studies have analyzed these food system and diet changes, linking them to income growth, policy liberalization, infrastructure improvement, urbanization and the rise of rural nonfarm employment (195). An increase in nutritious, wholesome food could have implications on public health as well as the environment. Sustainable diets can contribute to restoring local self-reliance, conserving and regenerating natural resources and biodiversity, and empowering the local population (196, 197).

The Latin American Double Pyramid

This section is a guide to read the Latin American Double Pyramid, which includes the Health Pyramid arranging food according to recommended frequency of consumption and health, with foods on the bottom promoting health and well-being, and those at top to be eaten occasionally. The Climate Pyramid shows that the production of animal-based products - especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products - generally makes the greatest contribution to climate change, while plant-based products make the smallest.

The base of the health pyramid includes fruit, vegetables, and wholegrains, and due to the climate variability, some fruit and vegetables are more representative of certain areas than others. The list of fruit is infinite and includes tropical and continental fruit that is also used as ingredients in savory dishes and salads, such as banana, mango, guava, pineapple, tangerine, prickly pears, and papaya, a popular breakfast fruit when eaten fresh and cut into slices. Passion fruit or *maracujá*, is the fruit of a climbing herb native to Brazil, and *açaí* is widespread in the Amazon River region, now widely recognized as a superfood and consumed in the form of *açaí* bowls. Coconut and avocado deserve a special mention as they are very rich in fats: coconut is rich in saturated fats and should be eaten in moderate quantities (198) while avocado, rich in healthy unsaturated fats, should be considered as an equivalent to non-tropical vegetable oils. Avocado is also rich in vitamin E and is the key ingredient of Mexican *guacamole*, where it is mixed with lime, onion, pieces of tomatillos and hot pepper. Avocado is a water-intense product (199), and it is mainly exported from water-poor to water-rich countries, e.g. from Latin American countries like Mexico, Peru and Chile to the US, Japan, Canada and the EU, and these export flows may worsen water scarcity in many relatively low income countries (200). Vegetables include green and yellow bell peppers, onions, pumpkin and squash, and tomato. Nopal is typical of Mexican and Central American cuisine and consists of cactus pads cleaned of spines and consumed sliced with eggs, meat or in tacos. Peppers are the most important seasoning ingredient in South American cooking. There are both sweet and hot varieties, and they are used in many creative ways, as in the colorful marinades for ceviche. Wild tomatoes originated in the Andes and their name is derived from the Náhuatl word *tomatl*, while artichokes are more common in Chile or Argentina (201).

⊕ VIEW A LARGER IMAGE



Wholegrains have been shown to protect against cardiovascular diseases and are recommended as a daily ingredient in a healthy diet (194). Quinoa falls in this group: despite being a pseudocereal, it has nutritional characteristics comparable to those of whole grain cereal. Quinoa is also resistant to unfavorable soil and climate conditions and has been cultivated for over 5,000 years on the high stony plateaus of the Andes, where the Incas considered it a holy plant. Unfortunately, the quinoa boom has led to a large expansion of the quinoa-cultivated area, with consequent social and environmental impacts. The global increase in quinoa demand has led to an intensification of production characterized by the greater use of fertilizers and consequent increases in GHG emissions (202). Wholegrain bread and rice are other wholegrain alternatives that are recommended to be consumed daily.

Moving up the pyramid, we find **non-tropical vegetable oils such as peanuts, sunflower seeds and soy oils**, introduced in the twentieth century and now established as local industries. **On the same level we find nuts and seeds**, which include pumpkin seeds, walnuts, almonds, hazelnuts, and macadamias as examples of widely consumed nuts. Pecans, cashews, and Brazil nuts are native to the Amazonian region.

Among low glycemic sources of carbohydrates, corn and its derived products occupy a relevant position. Corn has been cultivated for more than 5,000 years and is the key ingredient of many staple dishes. In Mexico and in the countries of Central America it is the main ingredient of *tortillas*, *fajitas*, *pupusas* and *tamales*. Tacos are grilled corn tortillas filled with meat or fish and seasoned with cilantro, onion, avocado and various sauces. *Tamales* are rolls prepared with a corn-based dough filled with meat, vegetables, fruit, or other ingredients and steamed inside corn leaves, banana trees or other plants. In Mexico, corn is also the basis of *hominy*, a boiled and fermented corn paste that is used in the preparation of *pozol*, a traditional food of the Inca, Maya and Aztecs centuries which had great sacred and ceremonial significance. The fermentation process to which *pozol* is subjected determines an important increase in valuable proteins and vitamins. In Chile, one of the many uses of corn is in the *pastel de choclo*, a typical corn pie made with beef, chicken, black olives, raisins, onions, or slices of boiled eggs, while in Argentina and Chile corn is also used in preparing the dough for *empanadas*, made by folding dough around varied fillings like beef, tuna with tomato or cheese. *Arepas* are small circular breads prepared with white or yellow corn flour, already eaten by the pre-Columbian indigenous populations residing in the territories of present-day Colombia, who still consider it a traditional national dish. In the Andean countries, purple corn (*maiz morado*) is very common and is also used in the preparation of typical sweets like *mazamorra* or drinks, such as *chicha morada*, an extremely common drink made of boiled purple corn with pineapple, apple, cinnamon and clove.

Many fermented products are prepared in different parts of Latin America using raw materials such as milk, cassava, maize, cocoa, coffee, grape, sugar cane, banana. Among fermented milk, recommended daily, we find products such as yogurt and kefir (203), and local varieties include cuajada, milk curd popular in Brasil and Colombia and *jocoque* in Mexico.

Legumes and fish are recommended sources of protein, and Latin America has an endless variety of beans, especially red, black, and pinto, but other legumes like lentils, peas, fava beans and chickpeas are also eaten (194). Legumes are an excellent alternative to animal protein sources and are recommended 3-4 times a week. Beans are extensively used in the preparation of stews or soups, like the white or green-bean soups prepared in Colombia with pork stock, or



the *chupe de porotos* cooked in Chile with celery, bay leaves, and many spices. *Feijoada* is one of the most typical Brazilian dishes, probably derived from the Portuguese culinary tradition. Recipes of *feijoada* vary across the different regions of Brazil, but all include prolonged cooking of the beans, previously soaked in dried meat, to which pieces of pork and cow meat and spices are gradually added.

Regarding fish, the Amazon basin, the Atlantic and the Pacific oceans provide a plethora of fish and seafood like king crab, tuna, and many tropical fish. Among the Chilean seafood specialties are *locos*, giant scallops, and *paila*, a rich seafood soup. Ceviche is a symbol of Peruvian cuisine, made with raw fish or seafood and marinated with *aji*, lime, and red onion. A legacy of indigenous cuisine, the Brazilian *moqueca de peixe* is more than just a fish soup and is made of fish stewed with coconut milk, tomatoes, onions, garlic, cilantro and a little palm oil (*dendê*). Latin America remains a great fish producer and exporter, both through fishing and aquaculture, especially coastal and marine aquaculture. According to FAO, more than 30% of fish stocks were considered over-exploited, with Chile showing the highest rate of 62% (204).

The next level of the pyramid includes milk and cheese. Milk is widely produced and consumed in countries such as Brazil and Argentina. *Licudados* (also known regionally as *batidos*) are a Latin American handmade blended beverage similar to smoothies, made with milk, fruit, and usually ice. Examples of Latin American cheeses include sardo cheese or *reggianito*, popular in Argentina, or *queijo prato*, a creamier gouda-style cheese, while *queso fresco* is an example of a common lightly salted fresh cheese, often added to sauces and crumbled in salads. Cheese can be also



used as a savory ingredient in many recipes like *quesadillas*, which are Mexican warm corn tortillas stuffed with cheese or Brazilian *pão de queijo*, delicious small round bread made of cassava starch mixed with cow's milk cheeses, with a soft and elastic consistency. Sour cream is also a common ingredient in many recipes, as a finishing touch for tacos, enchiladas, and soups.

In the same layer we find poultry, and chicken is plentiful and affordable, while turkey is a popular Christmas dish. The southern part of Mexico is known for its dishes with spicy vegetables and chicken. Chicken appears very often in typical Chilean dishes and is generally accompanied by almonds, olives, zucchini, or in artichoke or marinated sauces. Chicken eggs are commonly served scrambled with onions, tomatoes and spices or used to cook various types of tortillas. Although not included in the pyramid, it is worth mentioning that, due to their sociocultural origin, Brazil, Colombia, Peru, and Mexico stand out among Latin American countries that consume insects such as caterpillars, grasshoppers, termites and beetles (205).

Among high glycemic foods, which are recommended less frequently than wholegrains, we find tubers such as potatoes and sweet potatoes, cassava, and white rice. Potatoes rival corn as the

oldest and most important South American crop and hundreds of varieties are still cultivated in the Andes today. Potatoes and sweet potatoes are fried, mashed, freeze dried, baked, and combined with sauces into many beloved dishes. *Ajiaco* is a thick and particularly popular soup in Colombia. There are several variants but white, red and criolla potatoes are always the central ingredient. Cassava, also known as manioca or yuca, has been grown in the continent as a means of sustenance for many centuries. It is also very popular in Brazil, where the root is roasted to make *farofa*, a key ingredient in *feijoada*. Other regions use a sweet variety of cassava that can be mashed or fried. Sweet cassava has two easily removable skins while the skins of bitter cassava are thicker and more difficult to remove. This is why shoppers usually break the tuber in two, in order to identify them, which is a very common practice in the South American markets (194).

Apart from corn, Latin America has the greatest agrobiodiversity of potatoes, yucca, and the greatest genetic resources base for such crops (206). Rice is part of the Latin American gastronomy, such as in the Peruvian *arroz con pato*, and the classic side of *feijoada*. Also the green fruit of plantains is common and can be cooked in many ways, from sweet to savory, fried or boiled, green or ripe.

In the final top layers we find red and processed meat. Red meat is recommended occasionally, and is found in tacos, arepas, or soups, stewed, or grilled. In particular, the custom of grilling meat has a long tradition throughout Latin America and is often much more than a simple meal, representing an occasion for social gathering. The Argentinian roast, the Patagonian *cordero asado* (roasted lamb), the Brazilian *churrasco* are just a few examples. Beef, goat, sheep, and pork meat are all widely eaten, often together at collective barbecues. In Chile, the grill is quite popular too: in outdoor events, *chopiran*, a chorizo-like sausage is eaten in a sandwich. In the Southern Argentinian region of Patagonia, many people raise sheep and cattle while in the Andean region, llama meat is sometimes also eaten. Cattle ranching is the major contributor to deforestation in the Amazon, being responsible for up to 80% of deforestation rates (207, 208).

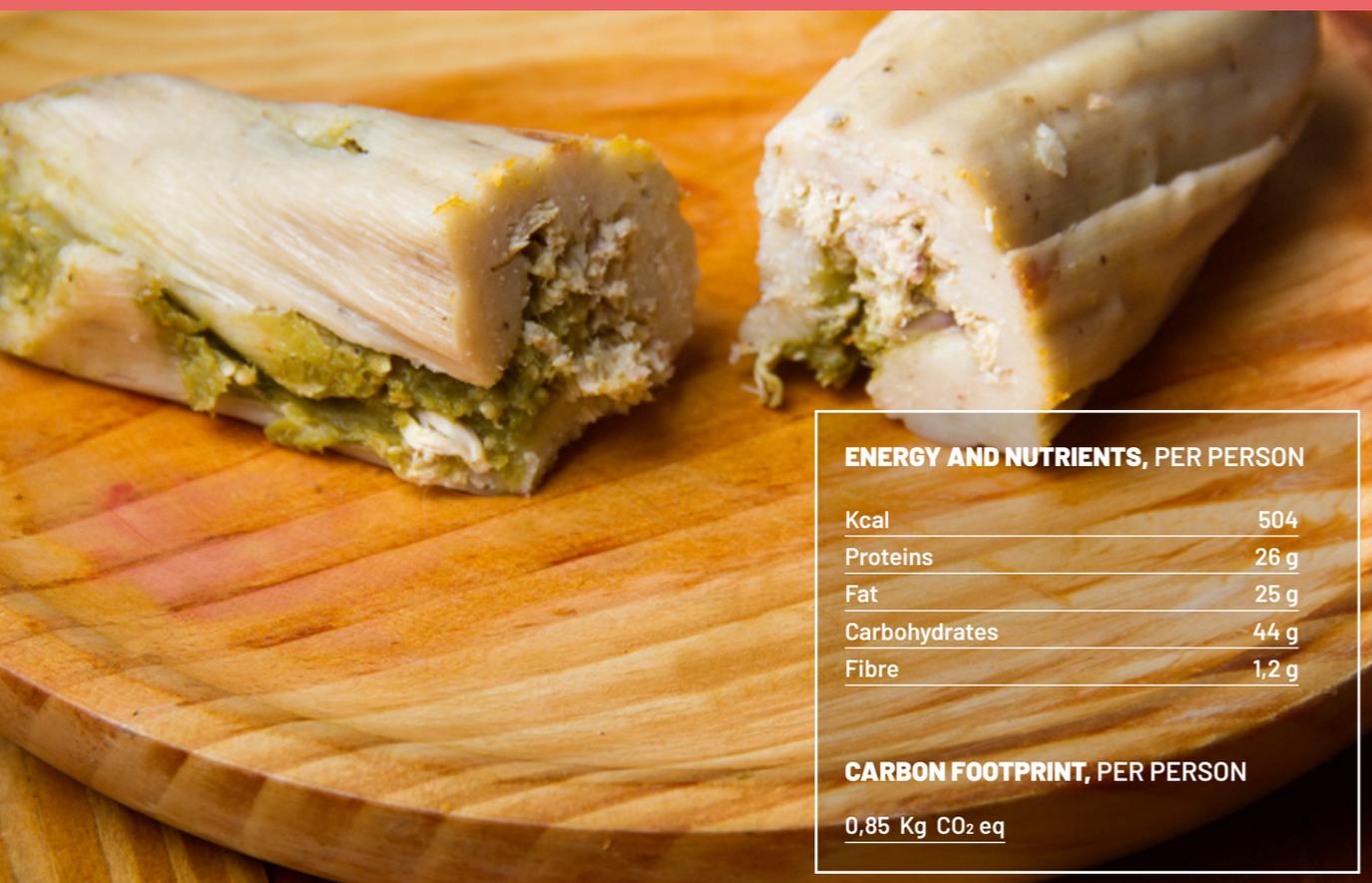
Butter, palm oil and coconut oil are some examples of animal fats and tropical oils recommended occasionally, preferring non-tropical vegetable oils instead. In Latin America, there are many different traditional sweets and desserts, which also are recommended occasionally. Churros, represented in the pyramid, are just an example of the great list of delicious desserts that can be tasted. *Brigadeiros* are typical Brazilian balls made from cocoa, butter, and condensed milk while in Mexico *empanadas* are eaten also in their sweet version. The term *alfajor* indicates different types of preparations, mostly sweets, typical of South America but deriving from Arab cuisine. They are always made up with couples of cookies with different kinds of filling, the most popular being the *alfajores* with dulce de leche, a cream based on milk and sugar.

Besides coffee and tea, mate deserves a special mention: it is a typical caffeine-rich infused drink obtained from the infusion of *yerba mate* dried leaves and traditionally served in containers made from calabash gourds. It has a strong cultural significance, especially in Argentina and southern Brazil, and is traditionally drunk warm in the Andean region to counteract the effects of altitude sickness.

To conclude, this Latin American Double Pyramid is an attempt to illustrate its great variety of local culinary traditions, ingredients, recipes and ways of cooking which provide an excellent basis for a recommended healthy and sustainable diet.

CORN TAMALS WITH PORK MEAT IN GREEN TOMATO SAUCE

Corn has been cultivated in Mexico approximately since 10,000 BC. The oldest evidence we have is 6,250 years ago, evidence found in the Guila Naquitz cave, in Oaxaca, a few kilometers from Mitla. Corn, as well as chili and beans are an ancient heritage from our ancestors. These ingredients have survived the cultural miscegenation and the passage of time, which makes them historical treasures, which continue to be present in the daily diet of Mexican. Since 2010, Mexican food is considered Intangible Cultural Heritage of Humanity by the United Nations Educational, Scientific and Cultural Organization, UNESCO.



ENERGY AND NUTRIENTS, PER PERSON

Kcal	504
Proteins	26 g
Fat	25 g
Carbohydrates	44 g
Fibre	1,2 g

CARBON FOOTPRINT, PER PERSON

0,85 Kg CO₂ eq

INGREDIENTS 4/6 PEOPLE

	G
CORN DOUGH	
Corn flour	300
Water	500 ml
Lard	150
Baking powder	1
Salt and pepper	To taste
Corn leaves	n. 20

	G
FILLING	
Pork loin	300
Onion	n. 1
Epazote	5 leave

	G
Garlic	1 clove
Oil	10 ml
Salt and pepper	To taste

	G
GREEN SAUCE	
Green tomato	250
Onion	n. 1/2
Garlic	1 clove
Serrano green chili	n. 2
Coriander	2 branches
Salt and pepper	To taste

METHOD AND PRESENTATION

1. Place water and kombu in a large pot.

TO PREPARE THE PORK

1. Chop the onion and garlic finely; Reserve.
2. Clean the pork.
3. Chop the pork into small cubes.
4. Heat oil in a frying pan.
5. Sauté the onion with a little salt until it is transparent.
6. Add the garlic, a little more salt and pepper.
7. Add the pork and stir, add the chopped epazote
8. Rectify seasoning, let cool and reserve.

FOR THE GREEN SAUCE

1. Heat water in a pot.
2. Bring the tomatoes, onion, garlic and chili peppers to a boil.
3. Once cooked, place in the blender.
4. Add a little salt and blend.
5. Add the coriander and blend again.
6. Heat oil in a pot.
7. Pour the liquefied sauce into the hot oil, for 4 minutes.
8. Rectify seasoning and bring to a boil again for 1 minute.
9. Cool and reserve.

FOR THE DOUGH

1. Mix flour, salt and baking powder in a bowl.
2. Add the water.
3. Knead until mixture is smooth; if need add more water.
4. Place the dough in the mixer.

5. Start beating with the mixer paddle utensil.

6. Put the lard in a bowl and beat by hand to soften it.
7. Integrate the lard into the dough, little by little.
8. Once the lard has been added, stop the mixer and lower all the dough from the edges.
9. Keep beating for a few minutes until the mixture is light and fluffy.

TO ASSEMBLE THE TAMALES

1. Drain the corn leaves that were previously hydrated.
2. Place a portion of dough on a sheet and spread.
3. Put the pork and green sauce in the center.
4. Close the tamale.
5. Repeat until finished with all.
6. If you like, you can tie each one with a strip of the remaining corn husks.

FOR STEAM COOKING

1. Put enough water in the steamer and a couple of coins.
2. Cover with the perforated metal base.
3. Make a bed of corn leaves.
4. Arrange the tamales standing on the leaves.
5. Cover with more tamale leaves.
6. Cover the steamer.
7. Tie two strips of corn husk to each ear of the steamer.
8. Place over high heat and when it starts to boil, lower the heat.
9. Cook for an hour to an hour and a half, over low heat.

THE MEDITERRANEAN

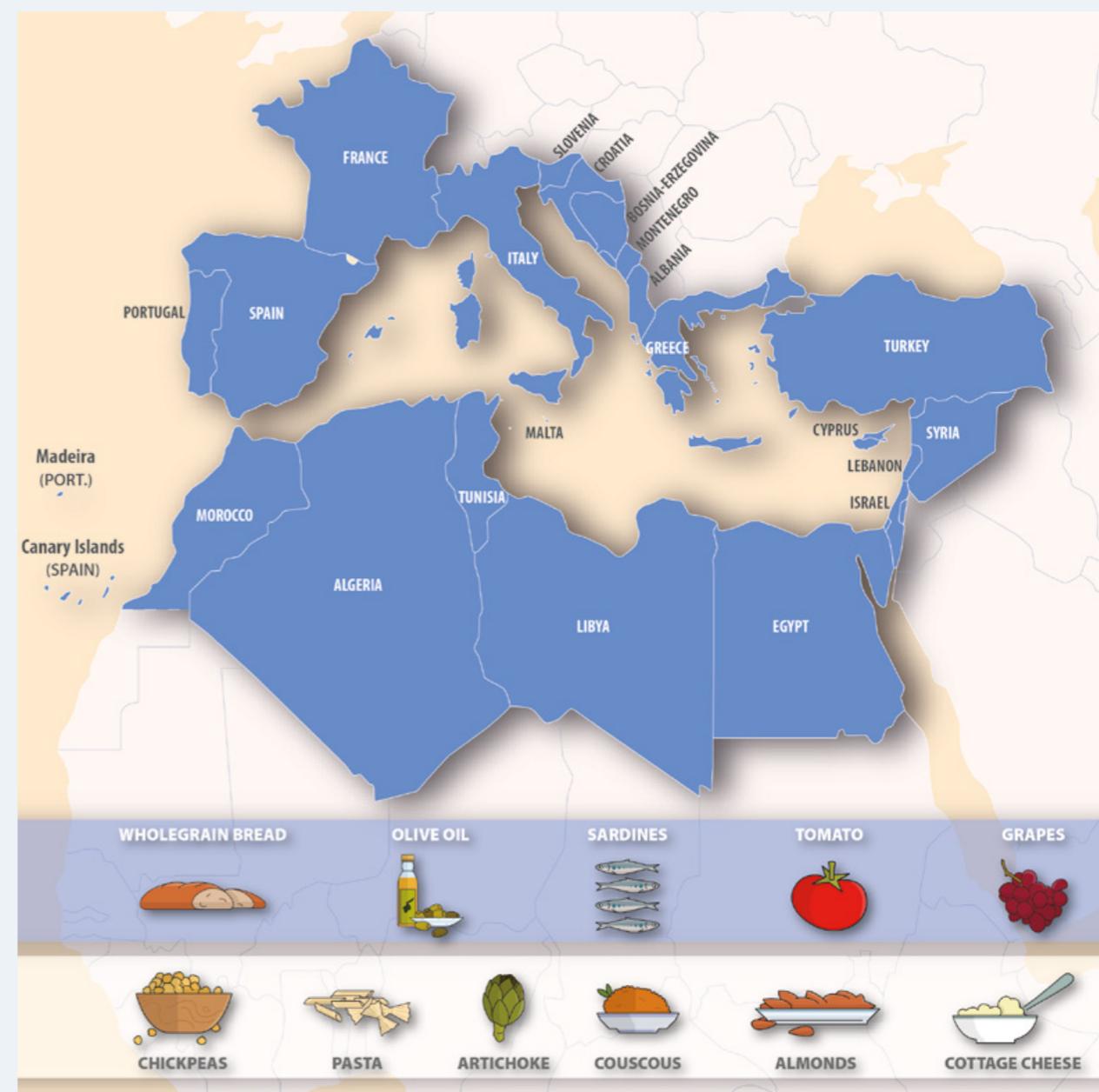
At a glance

The Mediterranean diet is a traditional model widespread in some countries of the Mediterranean basin, and a heritage of centuries of exchanges between people, cultures, and foods. This model is drawn from the analysis of representative countries, such as Spain, Italy, Egypt, Morocco, Israel and Lebanon. **In 2010, Cyprus, Croatia, Spain, Greece, Italy, Morocco and Portugal have nominated the Mediterranean diet for inscription on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity.** The recognition has raised the Mediterranean diet to a cultural model which should be enhanced in the agricultural, political, cultural, economic, and public health fields (209, 210). For the purpose of the report, the Double Pyramid analysis is based on the geographical distribution of selected Mediterranean countries: Spain and Italy in Europe, Egypt and Morocco in North Africa, and Israel and Lebanon in the Middle East. The resulting model is representative of the countries in the Mediterranean Basin (209, 210). **Mediterranean countries present different regional traditions but share agricultural and rural models and recurrent ingredients:** plant-based foods like cereals, fruit, vegetables, legumes, nuts and seeds, and olive oil, combined with a moderate consumption of fish, poultry, eggs, and dairy products, and a sporadic use of red meats and animal fats (211). A widespread use of herbs and spices keeps salt intake low, and moderate quantities of wine and other fermented beverages accompany meals. Altogether, this diet is low in saturated fatty acids and provides high amounts of antioxidants, carbohydrates, fiber, and mono- and polyunsaturated fatty acids. Food is often marketed locally and eating takes place in a pleasant, familiar environment. **The UNESCO inscription includes other dimensions of food, such as the values of hospitality, neighborliness, intercultural dialog and creativity, and a way of life guided by respect for diversity.**

Food Culture

In the 1960s, Ancel Keys coined the term “Mediterranean diet” while conducting his “Seven Countries Study”, which showed a significantly reduced incidence of cardiovascular diseases and cancer in countries of the Mediterranean basin compared to the other studied populations (212, 213). This study opened a new field of investigation and, since then, **increasing evidence has demonstrated the protective effects of the Mediterranean diet against type 2 diabetes, metabolic syndrome, cardiovascular diseases, and some types of cancer** (214-218). Moreover, the Mediterranean diet also provides benefits in terms of longer life expectancy, psychological well-being and perceived health status, making it a great eating pattern for a longer and better life (219).

Mediterranean cuisine is very diverse, ranging from the sweet and sour flavors typical of Sicily to North African spicy nuances, and embraces different traditions, meal patterns, cooking methods, and lifestyles. In all Mediterranean countries, sharing the meal plays an important social role, and



handing down culinary knowledge across generations allows tradition to be kept alive. Mediterranean culinary tradition is characterized by the recurrence of common ingredients. Olives, grapes, and grains are the symbols of Mediterranean agriculture, and citruses like lemons and oranges are widely grown and exported worldwide. Sheep and goat herding is more popular than cattle ranching and harvesting fish has recently become a global enterprise, with worldwide exports.

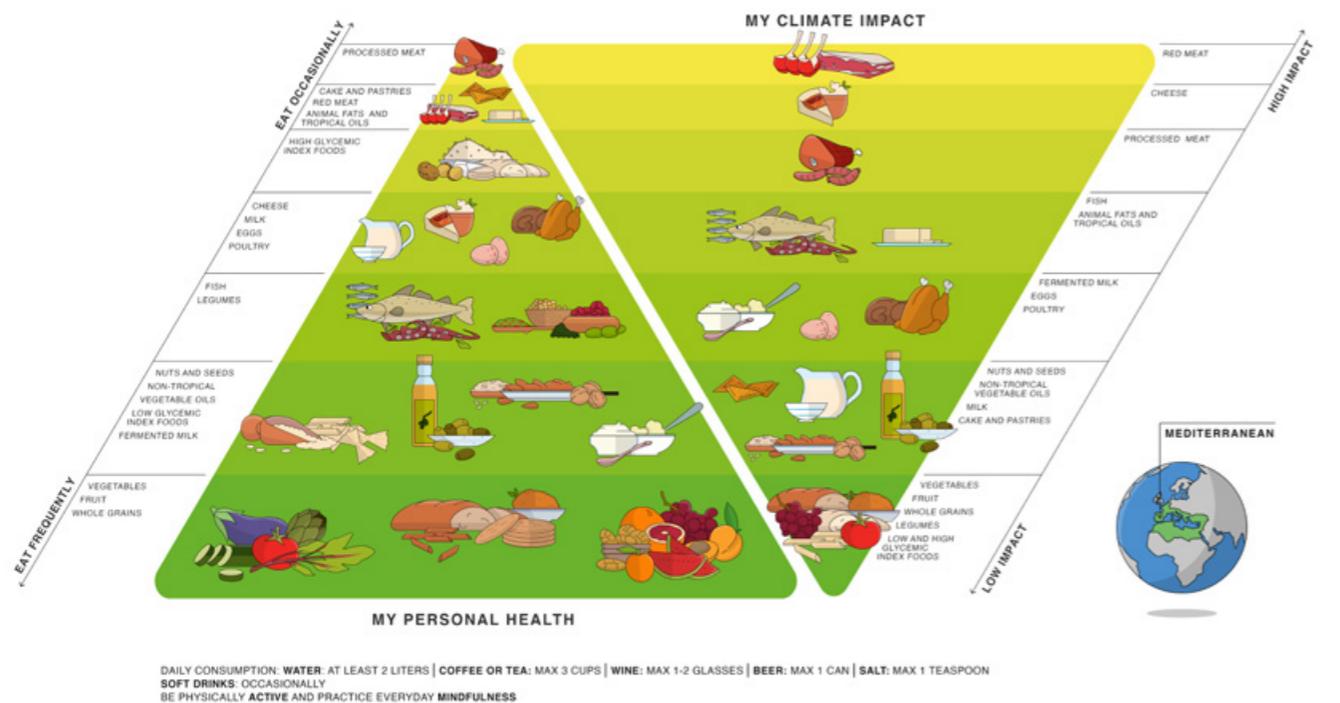
However, the diet currently consumed in the Mediterranean basin is moving away from the traditional way of eating, due to the changes in lifestyle associated with the globalization of food production and consumption (74). According to the FSI, all Mediterranean countries have a very high intake of salt, and overweight and obesity are on the rise, especially in children: in Italy 37% of children and adolescents are overweight. However, longevity is still among the highest in the world: life expectancy in Spain and Italy is 83 years (220).

This analysis includes elements of tradition and contemporary lifestyles, and generally speaking adherence to the traditional way of eating should be encouraged, also for the planet's wellbeing. In 2010, the FAO Scientific Symposium 'Biodiversity and Sustainable Diets: United against Hunger' defined the Mediterranean Diet as an example of sustainable diets, being rich in plant-based ingredients and biodiversity and low in foods of animal origin (221).

The Mediterranean Double Pyramid

This section is a reading guide to the Mediterranean Double Pyramid, including the Health Pyramid showing that cereals, preferably wholegrain, should be present in every meal in the form of bread, pasta, bulgur, couscous, rice, or spelt, together with seasonal vegetables and extra-virgin olive oil. Fruit should be considered as the primary form of dessert or snack. Legumes and fish are the main sources of protein, while poultry, eggs, and dairy are consumed in moderation. The Climate Pyramid shows that the production of animal-based products - especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products - make the highest contribution to climate change, while plant-based products make the smallest.

⊕ VIEW A LARGER IMAGE



Fruits and vegetables are at the base of the Pyramid, and the daily recommendation is paired with the Mediterranean basin variety and availability of these foods. Eggplants, asparagus, radishes, green beans, bell peppers, and cucumber are typically grown in spring and summer. The warm season evokes the scent of tomatoes, native to America but widely cultivated today in a great variety of species, from red to white, green, yellow, or purple tomatoes. Tomatoes can be eaten

fresh or dried, or used to prepare pasta sauces, pizza, or the Spanish *gazpacho*. Yields of vegetables such as tomatoes are and will be limited by reduced water availability in the Mediterranean region due to climate change (222, 223). Autumn and winter harvests include leeks, broccoli, turnip greens, pumpkin and spinach. The poet Neruda dedicated many odes to Mediterranean vegetables, including tomatoes, onions and the artichoke, from the Arabic *al-hursufa*. The artichoke is a cold season vegetable and is the main ingredient of recipes across the basin. Carrots, onions, chard, celery, and salad are other common vegetables consumed all year round. Apples and pears are extensively grown in many different varieties and are available throughout the year. Spring and summer bring peaches, apricots, plums, cherries, melons, and watermelons while oranges, grapes, pomegranates, and figs are more characteristic of autumn and winter. The pomegranate plant is resistant to the dry summer and winter temperatures and archeological findings in Israel and Egypt brought to light residues of seeds and peels dating back thousands of years. Figs, dates, and apricots are commonly eaten fresh or dried.

Cereals occupy a privileged place in the Mediterranean diet, and the wholegrain versions are recommended daily due to their higher fiber, vitamin and mineral content. Examples include wholegrain rice, bread and pasta, as well as bulgur. Durum wheat is used to prepare pasta and bulgur and the soft wheat quality are more suitable for baking. Mediterranean countries are the largest importers and consumers of durum wheat products and Italy is considered to be the leading durum wheat producer in the European Union (224). Wheat productivity is strongly affected by heat waves and droughts (225, 226). For this reason, adaptation and mitigation efforts are strongly needed as the Mediterranean region is experiencing an increase in such phenomena due to climate change, which will worsen if no action is taken (227).

Bread has been a staple for centuries. In the past, Egyptian bread was made of emmer flour, an ancient wholegrain, sprouted wheat or barley flour, to which bakers used to add dates, figs, or honey. Among low-glycemic foods we find pearl barley and pasta. Pasta dishes are best known in Italy, but they are also consumed in many other countries like Greece, southern France, and Spain, where pasta is cooked with a mix of fish and shellfishes in *fideuà*. Bulgur is the main ingredient of the Levantine tabbouleh, that includes finely chopped parsley, onions, and mint, with the addition of tomato and cucumber slices, all dressed with lemon juice and olive oil.

Vegetable oils and nuts are recommended daily, and Mediterranean countries produce more than 80% of the world's olive oil, a cornerstone of the diet and an important product for the economy, culture, and environmental heritage (228). To be defined as extra-virgin, olive oil must be obtained exclusively by mechanical extraction from the ripe olive fruit and have an acidity not exceeding 0.8%. The final product contains many antioxidants like polyphenols, tocopherols, and phytosterols (229) and has shown a protective role against cardiovascular diseases and certain cancers (216, 230). Its unique composition gives it a high resistance to cooking temperatures and should be used for cooking as well as for dressings (219). Ripe olives provide the same healthy profile as unsaturated fats and can be consumed as partial substitutes for the suggested daily amount of olive oil. As said, the Mediterranean basin is the largest area of olive cultivation in the world, but climate change is likely to cause a reduction in precipitation and an increase evapotranspiration. This may lead to an increase in water demand for irrigation, and the unfeasibility of rainfed cultivations (231).

Nuts and seeds are excellent sources of unsaturated fats, proteins, fiber, vitamins, and minerals, and are a healthy snack choice and ingredient (232, 233). Almonds are used in sweet and salty preparations and are the key ingredient of almond milk, a tasty drink with a creamy texture and nutty flavor. Hazelnuts and pistachios are typically produced in Italy and Spain and are used in

many traditional sweet preparations, like the Levantine *baklava*, a sweet filo pastry filled with chopped nuts and honey. Sesame seeds are used in the production of *tahini*, a sesame paste added to hummus or used as dressing for chickpea *falafel*.

Milk and dairy are also recommended, and milk is today consumed on a daily basis in many countries. **Fermented milk products like yogurt and kefir should be preferred**, due to the presence of probiotics, healthy agents for the gut's health and the intestine microbiota (234). *Labneh* is a type of white yogurt, made with sheep's, cow's, or occasionally with goat's milk, typical of North African and Levantine cuisines that is often served with mint, thyme and olive oil accompanied by pita bread.

Legumes and fish are recommended sources of protein. Legumes originated from the Nile valley, the Far East and later from the Americas. Beans are very common, present in many different varieties: cannellini, borlotti, Spanish, black, Mexican, and red kidney beans. Chickpeas are an example of how a single ingredient can be conjugated into many different dishes, from the Moroccan *tajine* to *hummus* with tahini, lemon, and garlic, to the Italian *farinata*, a chickpea flour flatbread. Lentils were present in the Greek and Roman diet and are grown in different varieties adapted to the territories of the Mediterranean regions, while the lupine is widely grown, especially in southern Italy, Lebanon, and Israel. Legumes are also a valuable crop from an agricultural and environmental point of view as they help to fix atmospheric nitrogen in the soil, improving its fertility and reducing dependence on artificial or energy-intensive fertilizers (235).

Fish is an important resource for the countries of the Mediterranean basin and its consumption is variable depending on the proximity to the sea. Sardines, mackerel, and anchovies are common fatty fish species of the Mediterranean Sea, rich in omega-3 fats, associated with a reduction in the risk of coronary heart disease (236). Octopus, shrimps, and shellfish are also tasty ingredients of many coastal local dishes. According to the latest FAO report on the status of fisheries and aquaculture, more than 60% of fish stocks³ are fished at unsustainable levels (237).

Other sources of protein, to be alternated during the week, include cheese, eggs and poultry. The history of cheese has very ancient origins in the Mediterranean basin, probably born as a result of the shepherds' habit of carrying milk in animal stomachs, in which the milk curdled and transformed into cheese. Countless cheese varieties are currently produced in the Mediterranean, with different flavors, textures, and maturations according to regions and traditions. Soft and fresh cheeses such as ricotta or cottage cheese have a higher water content and lower fat than aged cheese. Hard cheeses, on the other hand, contain less water and production includes numerous stages like cooking, pressing, salting and maturation. Parmesan and halloumi are just a few examples. In addition to cow's milk, sheep and goat milks are also widely used. Goat's milk has a nutritional composition similar to cow's milk, with a comparable overall fat content, and the presence of medium chain fatty acids contributes to the characteristic sour taste. Buffalo milk has a higher fat and protein content and is suitable for the production of curd cheeses, such as the famous buffalo mozzarella. Eggs are often consumed and represent a good alternative to meat. Chicken eggs are the most common but eggs from thrushes, partridges, or quails are also eaten in some regions. Among poultry, chicken is the most commonly raised and eaten in the Mediterranean basin, but turkey and rabbit are sometimes consumed on special occasions according to local traditions.



Couscous, rice, and white bread are among high glycemic foods, which should be consumed less frequently than their low glycemic and wholegrain counterparts. Couscous is popular in North Africa and in the eastern Mediterranean, made of durum wheat semolina, and served as a complete meal mixed with vegetables, meat, or fish, as in the Moroccan *tajine*, or as an accompaniment to other dishes. Rice has become part of the Mediterranean tradition in more recent times, but its aroma and great adaptability to many cooking methods made it a protagonist of the Italian risotto or the Spanish paella. Nowadays, every Mediterranean region has its own bread, from flatbreads such as *pita*, *lavosh*, *pide*, pizza, to leavened bread. Stale bread is also an important ingredient for salads or soups; grated into sauces, meatballs, or dumplings; and even used in desserts like Spanish *torrijas* (238). This category also includes filo pastry, an unleavened dough used for making pastries such as baklava.

On the next level we find red meat, to be consumed occasionally. Examples are beef and pork which used to be very expensive foods, and many traditional cuisines exploit all parts of the animal. Goat, sheep, and lamb meat are common in Eastern Mediterranean countries while in Western Europe they are only eaten in particular regions or on special occasions. The long tradition of cured meats, in the last group of food items, arises from the need to preserve large quantities of meat for a long time, creating traditional products like hams, salamis and other processed meats. Butter, cream, and lard are sometimes used in some local dishes, but they are less common than olive oil.

This Mediterranean Double Pyramid, which includes traditional and contemporary elements, is an attempt to give an example of how adopting a healthy diet can preserve its cultural elements and can also provide significant benefits for the environment, reducing GHG emissions.

3. Statistics are based on data referring to 2017 and covering Mediterranean Sea and Black Sea together.



ALMA®

La Scuola Internazionale
di Cucina Italiana

CHEF MARTA CONFENTE

CHICKPEAS RAVIOLI, SMOKED EGGPLANT AND PAPRIKA

We thought about a pasta dish that could express Italian principle and at the same time keep in consideration the whole Mediterranean basin. The inspiration for this dish came from a recipe linked to the ancient Rome, "lasagne with chickpeas". Durum wheat pasta becomes a stuffed pasta, welcoming chickpeas, eggplants and sweet paprika, symbols of the Mediterranean culture.



METHOD AND PRESENTATION

FILLING

1. Soak the chickpeas in water overnight.
2. When ready, cook them in abundant water until soft, drain them.
3. Keep a spoon on the side for the decoration.
4. Finely chop the onion, cook it with the extra virgin olive oil, salt and thyme until golden brown.
5. Deglaze with the apple vinegar.
6. Blend the rest of the chickpeas with the onion until a smooth, add little water if needed.

PASTA

1. Mix semola and water together, let it rest in the refrigerator for 30 min.
2. Roll the pasta into thin sheets, place the filling then fold the pasta over it, making sure not to leave any extra air in it.
3. Cut the ravioli, then fold the edges together, keep on a tray ready to cook.

ROASTED EGGPLANT CREAM

1. Poke the eggplants with the tip of a knife, bake them at 220°C until black outside and soft inside.
2. Scoop the inside with the help of a spoon, let the pulp drain over a sieve.
3. In a large pan, heat the extra virgin olive oil, add the chopped garlic and paprika, nicely fry them.
4. Add the eggplant pulp and cook until dry.
5. Season with salt and pepper then blix it into a cream.

PRESENTATION

- Place the cooked chickpeas into a bowl, season with paprika.
- Toast them in the oven at 200°C for around 30 min, chop them and reserve.
- Cook the ravioli in abundant boiling salted water, drain them.
- On a plate, place a full spoon of the roasted eggplant cream.
- Place the ravioli.

INGREDIENTS 4 PEOPLE

	G
Semolina Flour	200
Water	100
Chickpeas dried	200
Salt	7
Apple vinegar	10
Extra virgin olive oil	15
Onion	60
Fresh thyme	8
Eggplant	600
Extra virgin olive oil	50
Garlic	25
Paprika (saffron)	10
Salt	8
Black pepper	2
Fresh thyme leaves	12
Paprika (saffron)	3
Fresh oregano leaves	12

ENERGY AND NUTRIENTS, PER PERSON

Kcal	558
Proteins	19 g
Fat	21 g
Carbohydrates	71 g
Fibre	15 g

CARBON FOOTPRINT, PER PERSON

0,14 Kg CO₂ eq

THE NORDICS AND CANADA

At a glance

The Nordic and Canadian Double Pyramid has been developed by analyzing the traditions and dietary patterns of Finland, Norway, Sweden, Denmark, Iceland, and Canada, but it could be applied to promote health and sustainability in other Western Europe countries as well. **Due to their similar latitude, these regions have similar natural ecosystems, and their populations have developed similar farming practices over the decades;** despite being a North American country, Canada has many similarities with Northern Europe. Forests cover 38% of Canada's land, and around 70% of Sweden and Finland (239) and numerous wild animals like buffalos, reindeers, bears, deer, boars, and many species of birds live in the cold flourishing nature of these countries. However, deforestation and ecosystem fragmentation pose a significant threat to natural resources, with millions of hectares are subtracted to wildlife each year. Another key feature of all these countries is the presence of long coastlines, which make fishing and aquaculture a staple economic activity and a precious source of food. Food used to be scarce in winter and the population relied on fish and potatoes, still popular today. Berries are another common feature: wild berries can be harvested during spring and summer while berries like strawberries and blueberries are massively grown in greenhouses. As in the rest of the Western world, eating habits have gradually included a wide range of foods from distant regions and out-of-season ingredients. **Generally, tradition has evolved towards a common "western" diet, low in fiber and nutrients and high in ultra-refined grains, red meat, energy, sugars, salt, and saturated fats.** This phenomenon, paired with low levels of physical activity, has led to an increase in overweight rates, both in Scandinavia (around 50% of adults) and in Canada (64%)(240).

Food Culture

In Nordic countries, breakfast often represents the main meal and includes a large variety of savory foods and sweet foods such as bread with butter, vegetables, cheese, eggs, coffee, orange juice, yogurt and muesli. Lunch can range from a hot meal to a quick slice of bread with cheese or spreads and salad; dinner is generally served in the late afternoon; it is usually quite light and generally includes a meat or a fish course. However, both in Northern Europe and in Canada, the tradition of three meals a day is becoming less frequent, and more meals are being consumed outside the household in pursuit of convenience. Additionally, it is worth noting that the Nordics and Canada are among the world's top 10 coffee consuming nations (241), and it is common to have coffee breaks accompanied with crispbread with cheese and a piece of fruit.

In order to promote locally sourced healthy ingredients, in 2004 the New Nordic diet was officially developed (242), with a particular attention to health and environmental sustainability and seasonality. The consumption of local ingredients is emphasized, making the diet easily accessible



for the local population. Like the Mediterranean diet, the New Nordic diet favors simple dishes; it is rich in healthy unsaturated fats like omega-3 and fiber from fruit, vegetables, and wholegrain cereals and low in sugars and saturated fats (243). These characteristics make the New Nordic diet a healthy diet, protective against cancer, diabetes or cardiovascular diseases, as it is being demonstrated by growing scientific evidence (244-246). Some authors have suggested that, however, the high share of dairy products might rise some concerns on its environmental impact (247).

In this context, **the Nordic and Canadian Double Pyramid aims to support the adoption of a sustainable and healthy diet that celebrates the diversity and richness of local and traditional ingredients**, taking into consideration also new ingredients and eating habits that are inevitably gaining importance in the modern lifestyle. It is worth mentioning that Canada has recently released new official dietary guidelines (248), Sweden provides recommendations for a sustainable diet (249), and that Denmark advises people to eat healthier and more climate-friendly foods, with

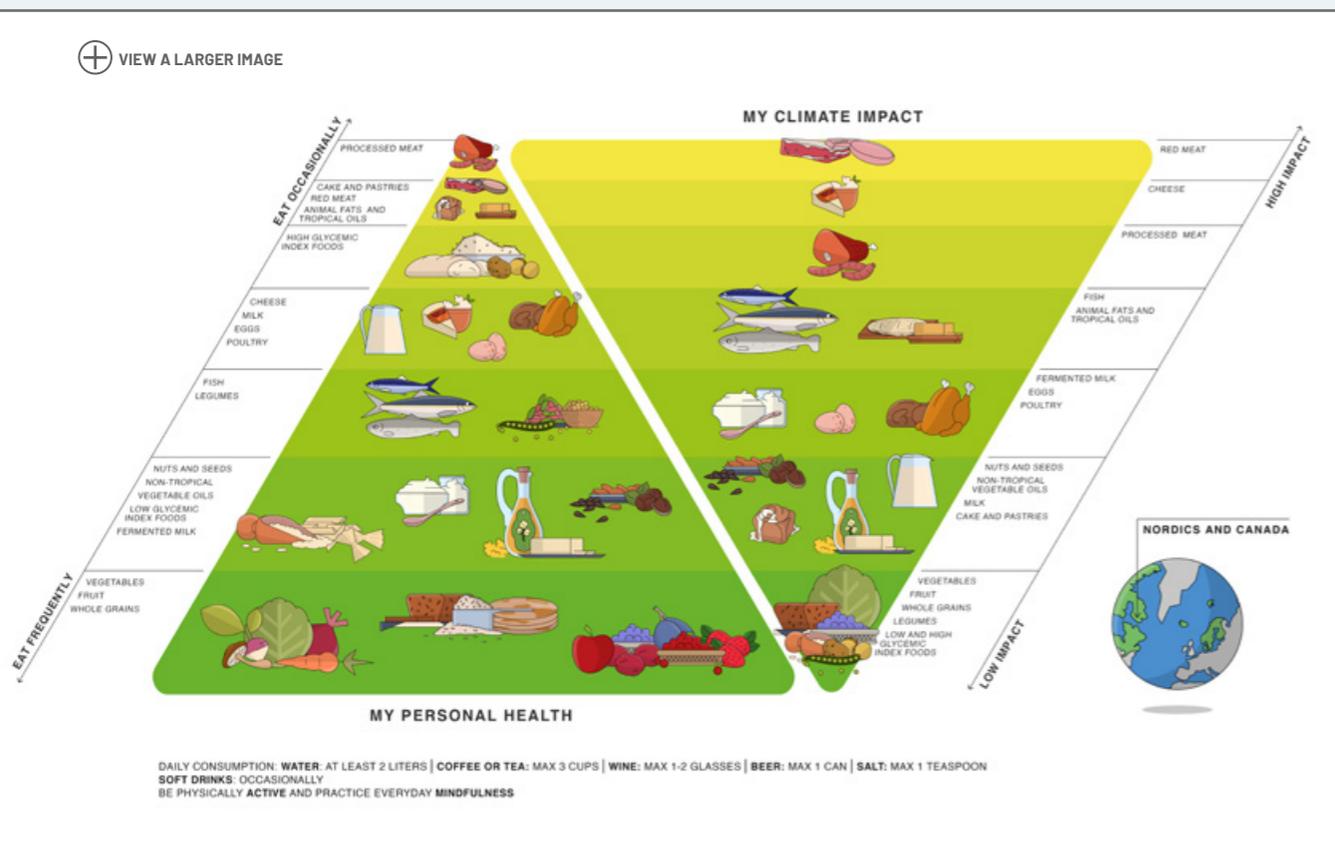
more legumes, more vegetables, and less meat. The new Danish dietary guidelines are part of the government's plan to reduce its climate footprint by 70% by 2030 (250).

The Nordic and Canada Double Pyramid

This section is a reading guide for the Nordic and Canada Double Pyramid. In the Health Pyramid, plant-based foods have a prominent role and the bottom layer includes fruit and vegetables like the typical berries and root vegetables, as well as wholegrain products like rye bread and porridge. Among protein sources, legumes are recommended together with local fish, poultry, eggs and cheese. Canola oil is recommended for health and environment, being a vegetable oil that can be produced locally. High glycemic foods such as potatoes also have a place in the pyramid, but are recommended to be consumed in moderation, just as red and processed meat. The Climate Pyramid shows that the production of animal-based products - especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products - generally makes the highest contribution to climate change, while plant-based products make the smallest.

are high in antioxidants like anthocyanins, vitamins (mostly C and A) and minerals like calcium, magnesium, and potassium. Fruit and berries are widely used also as a base for condiments paired with game meat dishes (especially lingonberries), desserts, jams, drinks (like apple cider), and syrups (251). Stone fruits such as apples, pears and plums are commonly grown in the region, while other fruit like oranges, cherries and others are imported and widely available. Production in greenhouses is steadily increasing (252), and the resulting GHG emissions can be between 4 to 5 times higher than open-field cultivation (117). The cultivation of root vegetables like turnips, beetroot, celery root, rutabaga, and carrots go well with the cold climate and therefore these ingredients are constant protagonists of Nordic tables. Other cornerstone vegetables include cabbage, broccoli, cauliflower, and kale, rich in sulphurated antioxidants and vitamins B, C, and K. Pumpkin and mushrooms are frequent, and summer brings tomatoes, cucumbers, and asparagus (251).

Among wholegrains, we find rye bread, rolled oats, and wholegrain flatbread. The consumption is recommended daily, and although in Scandinavia wholegrain consumption is still below recommended levels, is among the highest worldwide (253). Rye is an ancient grain that thrives



Starting from the base, we find fruit and vegetables, recommended daily. The relatively low temperatures and long daylight hours during the summer provide the ideal conditions for growing berries, with many unique varieties: from strawberries, blueberries, blackberries, raspberries, usually grown in orchards and farms, to the wild varieties of lingonberries, cloudberry, black and red currants, gooseberries, and arctic brambles, which can be picked in the wild between May and October. Canada is one of the major producers of cranberries, a native fruit of North America. Berries

in cold and wet weather and adapts to different soils, grown in Nordic countries for thousands of years. Traditional all-rye breads, like pumpernickel, require a slow rise and a hot, steamy bake. In Iceland, rye breads were sealed and baked underground, using steam from natural geothermal springs (254). Crispy flatbreads made of unrefined flours, as well as oat, in the form of porridge for breakfast, are wholegrain carbohydrate rich foods that should be consumed more frequently. **Among vegetable oils, we find rapeseed oil and soft margarine.** Rapeseed and canola oil is derived



from the seeds of rapeseed but is low in erucic acid, a monounsaturated omega-9 fatty acid linked with heart toxicity if consumed at high doses (255). The term “canola” is a combination of “Can” from Canada and “OLA ” meaning “Oil, low acid”. It has a milder taste than olive oil, but they both have a healthy lipidic profile thanks to the high presence of unsaturated fatty acids. Soft margarine, obtained from interesterification of vegetable oils, which, unlike hydrogenation, does not generate saturated fatty acids, also falls into this category. **Nuts and seeds are an exceptional source of healthy fats and also contain proteins and minerals like potassium, magnesium, calcium, and iron.** Nuts are recommended daily, and examples include common varieties like almonds, hazelnuts and sunflower seeds, and linseed and poppy seeds are often added to cakes and pastries. On the same level, we find low-glycemic foods, and pearled barley and pasta are some examples.

Yogurt and other fermented milks are recommended daily, and examples include the Icelandic skyr or the Swedish *filmjölk* are usually consumed for breakfast and are obtained with low temperature *Bifidobacterium lactis* fermentation (17-22° C), which preserves the product and gives it a characteristic acidic and nutty taste (256). **Legumes are recommended as a main source of protein**, and include peas as well as beans, lentils, and chickpeas which are recently gaining importance in Scandinavia also due to the presence of Arab immigrants in the region. The market however still relies on imports, while pulse production has rapidly grown in Canada, and beans have been among the main agricultural crops of various indigenous groups.

Fish is an equally important source of proteins. The habit of smoking and drying fish dates as far back as the Vikings, when cod was traditionally dried on racks for several months. Thanks to the ideal temperature, wind and local know-how, the fish could be kept for several years. Stockfish was mentioned in the Icelandic Egil's Saga, and the fourteenth century has been called ‘Norska öldin’, the Norwegian Age, which saw the growth of the stockfish trade (257). Norway has a historical

tradition of salmon fishing and farming. Norwegian salmon belongs to the *Salmo salar* specie, common in the Atlantic Ocean (258) while Pacific salmon is more common in Canada and can belong to different species like *Pink salmon*, mild and delicate, or *Sockeye*, with a rich flavor. Salmon and other smaller oily fishes like herrings, sardines, and mackerel are rich in essential fatty acids like EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) omega-3 and are widely consumed. Norwegian and Canadian salmons are considered extremely refined and are exported worldwide, fresh or smoked, wild or farmed. Farmed salmons deliver higher fats and omega-3, resulting in higher caloric values and can be harvested year-round while wild salmons, more common in the Pacific, can be fished only in certain year periods and present a higher content of minerals like iron, potassium and zinc (259). Herrings are served baked, grilled, pickled, fermented, or fried and are very present on Scandinavian tables at festivities like Easter, Christmas, and Midsummer. According to the Food Sustainability Index, 5% of Finnish, 44% of Danish and Canadian, and 46% of Swedish fish stocks are overexploited or collapsed (260). Fishing requires a reflection on its sustainability, which means preserving species, respecting habitats, and ensuring fishermen's livelihoods.

Poultry, eggs and cheese are recommended weekly. Eggs are eaten either for breakfast or as part of a later meal and are usually chicken eggs but the eggs of seabirds like seagulls or guillemots can be found along the extreme Northern coasts and are eaten more as a delicacy. Chicken and turkey account for almost the total consumption of poultry. In the same layer we find cheese, and each region produces its own varieties like *brunost*, the Norwegian creamy and sweet brown cheese, or the Swedish *västerbotten* and *priest* cheeses, but fresh cheeses similar to cottage cheese, like the Finnish *leipäjuusto* (also known as “squeaky cheese”), are available everywhere in the Nordic countries. In Canada, the region of Québec has become the country's main cheese production area and produces more than 700 cheese varieties, like Oka cheese (a semi-soft cow's milk cheese), British-style cheese like cheddar or French-style cheeses like blue cheeses or brie (251).

High glycemic foods **include white bread and flatbread**, refined rice and potatoes, and are recommended less frequently than the low glycemic and wholegrain counterparts. Potatoes are the most common starchy roots and are served roasted, fried, or boiled in many dishes. In Sweden, the potato was first mentioned in print in 1658, in a Latin text listing the plants in Uppsala University's botanical garden. The tuber, however, is closely linked to the figure of Jonas Alströmer, who published a small book promoting the potato in 1727. After observing the growth of potatoes in Britain, he encouraged their growth in the highly suitable soil and climate of his homeland. His implicit call for an agricultural reform, especially for the less fortunate, who faced the constant threat of famine, made him responsible for the breakthrough of the practice of growing the tuber (261). **Cakes and pastries are represented by cinnamon buns, and this food group should be eaten occasionally.**

Red meat is placed on the sixth layer, and includes beef and pork but also game meat like reindeer, bison and deer meat consumed in some regions of Finland, Norway, and Sweden. Game meat tends to be leaner compared to farm-raised animals and is also the basis for well-known hams and cured meats like reindeer or mutton cured meats, which fall in the processed meat group. In Canada, pork sausages and bacon are quite common, especially for breakfast.

Despite modern eating habits that can be distant from scientific recommendations for a healthy diet, **the Nordics and Canada are full of local ingredients which, if consumed in the right proportions, can represent an optimal basis for a diet promoting health, well-being, and environmental sustainability**, with an attention to low-impact food production practices and biodiversity.



CHEF PATRICK SECORD

RAINBOW TROUT WITH CARROT, FENNEL AND BARLEY PILAF

The Mi'kmaq and Indigenous communities first taught settlers around 1600 about distilling maple sap to make syrup. Today the eastern provinces of Canada are known for their cabane à sucre (sugar house), with maple syrup production long being a part of the cultural fabric of Canada. During February and March, the sap runs best for collection, with cold nights and warmer days. It takes about 40 L of sap to reduce to make 1 L of maple syrup.

Canada is the third largest barley producer in the world, producing over 10 million metric tonnes in 2019/2020, all mostly from the western provinces. Cereal grains have long been cultivated in the prairie provinces and are being currently grown by over 23,000 farmers, making it Canada's third largest crop after wheat and canola (GoBarley.com). Grains native to Canada, such as wild rice, may be used to compliment the barley in this dish.



RAINBOW TROUT: INGREDIENTS 4 PEOPLE

	G
Whole rainbow trout, scaled	800
or Skin on trout fillets	600
Cedar board	1 piece (roughly 20x35x2 cm)
Red bell pepper	n. 1
Canola oil	5 ml
Maple Syrup	45 ml
Smoked hot paprika	2
Ground cumin	2
Garlic	1 clove
Tomato paste	10 ml
Canola oil	10 ml
Salt and pepper	To taste

RAINBOW TROUT: ENERGY AND NUTRIENTS, PER PERSON

Kcal	260
Proteins	31 g
Fat	9 g
Carbohydrates	12 g
Fibre	1 g

CARBON FOOTPRINT, PER PERSON

0,89 Kg CO₂ eq

RAINBOW TROUT: METHOD AND PRESENTATION

1. Preheat oven to 400°F/205°C.
2. Fillet and debone trout, keeping skin intact. Portion to 150 g per person.
3. Rub skin with oil and place on cedar board, skin side down. Place in fridge uncovered to allow flesh to dry slightly.

RED PEPPER GLAZE

1. Rub red pepper with 5 ml canola oil and roast over open flame to char the skin, or roast in the preheated oven till soft and skins are loose.
2. Cool, then peel and seed the pepper.
3. In a blender, purée cleaned pepper and the remaining ingredients and transfer to a saucepan. Heat through and reduce to the desired consistency.

PRESENTATION

- Brush glaze onto fish.
- Roast in oven at 400°F or on the cool side of BBQ grill with no flame beneath the plank just until cooked through and fish flakes easily.

BARLEY PILAF INGREDIENTS 4 PEOPLE

	G
Pot barley (or pearl barley)	175
Canol oil	10 ml
Fennel or caraway seeds	1
Cooking onion, diced	100
Garlic	1 clove
Chicken stock, hot (or vegetable stock)	600 ml
Bay leaves	n. 2
Fennel, medium dice (1 cm)	250
Carrot, medium dice (1 cm)	200
Dried blueberries	30
Parsley, chopped	10
Fresh thyme leaves, chopped	7
Rosemary leaves, chopped	2
Salt and pepper	To taste

BARLEY PILAF: ENERGY AND NUTRIENTS, PER PERSON

Kcal	310
Proteins	10 g
Fat	5 g
Carbohydrates	58 g
Fibre	11 g

CARBON FOOTPRINT, PER PERSON

0,07 Kg CO₂ eq

BARLEY PILAF: METHOD AND PRESENTATION

1. Preheat oven to 400°F/205°C.
2. Spread barley on an unlined sheet pan and toast barley until fragrant.
3. In a heavy bottomed pot or Dutch oven over medium heat, add 5 mL of the vegetable oil. Fry caraway and fennel seeds for 30-60 seconds. Add onion and sauté until softened and translucent.
4. Add garlic to the pan and cook for 1 minute.
5. Add toasted the barley and stir to coat the kernels with oil.
6. Add the stock and bay leaves spice bag; bring to a low simmer, cover, and cook until barley is tender.
7. Meanwhile, toss the fennel in the remaining oil and season with salt and pepper. Place on a parchment lined baking sheet and roast until tender (approximately 15-20 minutes). Remove from oven and set aside to cool.
8. When barley is cooked, add the roasted carrots, fennel, dried blueberries, and parsley and herbs.
9. Season to taste. Serve with Cedar Plank Trout



USA

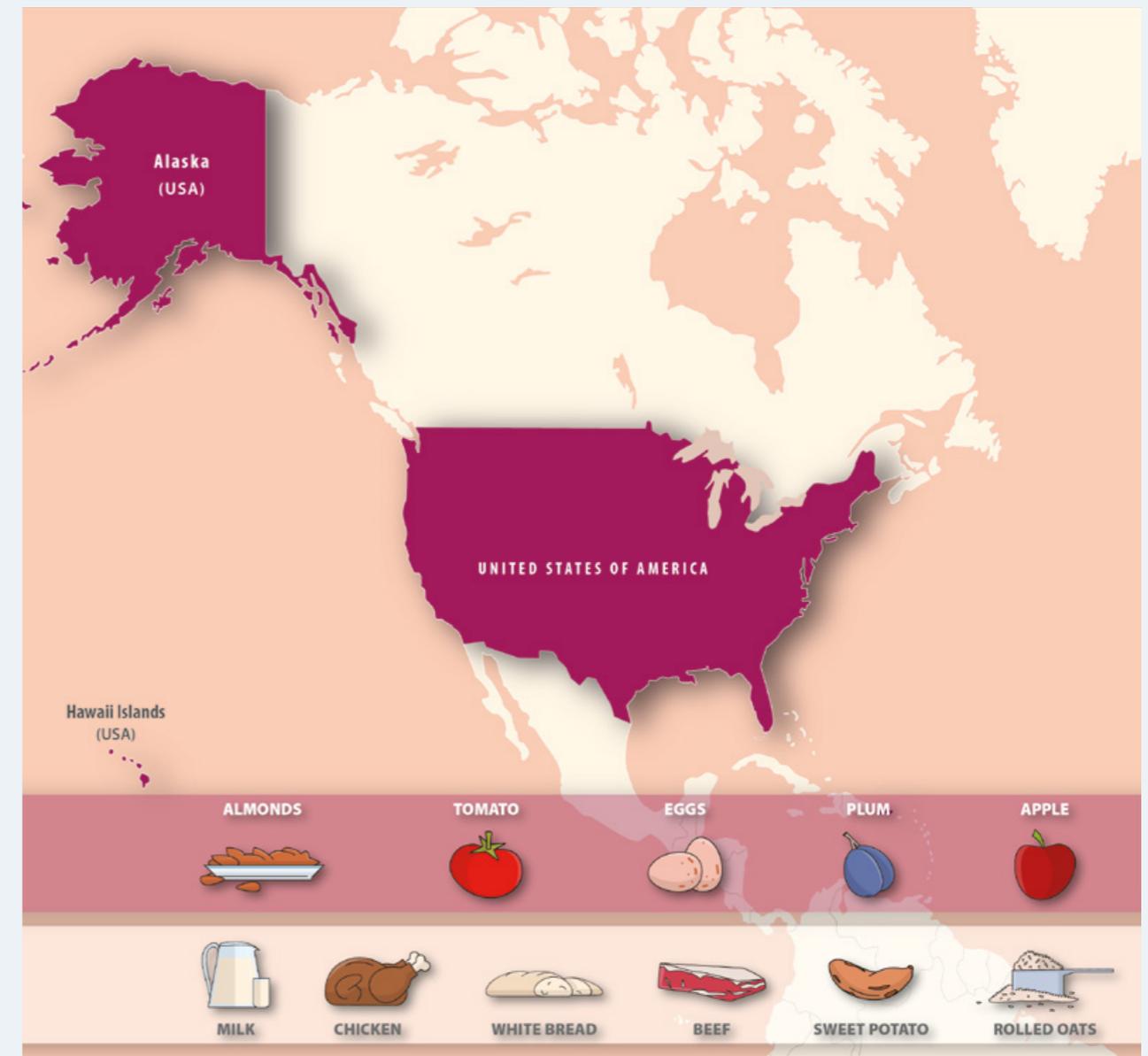
At a glance

The United States is the world's largest "melting pot", a term that derives from Israel Zangwill's play (262), and has grown to include many different ethnic and cultural groups overtime, leading to very diverse food preferences and eating habits. **Traditional Native American and Indigenous foods such as corn, squash, beans, cranberries, and maple syrup are some examples of indigenous North American foods** (263) and, further south, Native Americans grew peanuts and tomatoes and harvested wild Jerusalem artichokes, while on the Pacific coasts dried salmon and fruit were stored in the summer to build supplies for the rest of the year. Apples, apricots, carrots, lentils, peaches, and turnips, as well as cattle and sheep were instead introduced by Europeans (264).

Today, culinary culture includes contributions from African and Latin Americans, Europeans, and Pacific Islanders. Asian Indians are one of the fastest growing immigrant groups in the United States, and the Latino population is expected to be larger than the Black, Indigenous, People of Color (BIPOC) by the mid-21st century (265). This is paired with geographical richness across what is the third-largest country in the world: its physical environment ranges from the frozen expanses of the Arctic to the deserts of Arizona and the deciduous forests of Virginia and Carolina, from the great plains along the Mississippi-Missouri river system to swamps of Florida (266). Each of these ecosystems contains a great variety of animals and plants from which numerous types of food derive. This incredible diversity is summarized in the USA Double Pyramid.

The current scenario presents several challenges: according to the US Department of Agriculture (267), about three quarters of Americans have diets that do not meet the recommendations of the Dietary Guidelines for Americans. Increasing daily consumption of grain products, added sugars and sweeteners, and protein foods from 1970 to 2014 exceeded the levels recommended, while consumption of fruits, vegetables, and dairy products is below the recommendation (268, 269). The FSI highlights how sugar and meat consumption levels are the highest among the 67 analyzed countries, and that the prevalence of overweight in children and adolescents (42%) and adults (68%) is a significant challenge in terms of public health and individual wellbeing. The increase in the prevalence of obesity among all ages and racial groups in the United States is alarming, and this increase is particularly pronounced among African Americans and Hispanic Americans (270), for which an underlying genetic predisposition has been suggested to this condition and to related diseases, such as hypertension, cardiovascular diseases, type 2 diabetes, and some types of cancer (271, 272).

These challenges are strictly related to agricultural policy and the creation of an obesogenic food environment (273). In addition, food deserts, especially for marginalized communities, are still an issue: in the US, more than 5.6% of the population still lives in low-access communities, and racial and economic disparities in food access persist (274). One of the solutions lies in a strong collaboration between the USDA, the US Department of Health and Human Services, and the US Food



and Drug Administration, to reform nutrition policies based on scientific evidence and a common good approach (275, 276).

The USA Double Pyramid is an attempt to include the diversity of the region, while recommended healthy and low-carbon food choices, underlining how sustainability can be pursued, building on local traditions and cultures of the diverse USA context.

Food Culture

The US has welcomed a large number of different populations and cultures, so it is difficult to talk about one North American cuisine in the strict sense, considering the great variety of food styles, but also the availability of ingredients from all over the world and the possibility of trying foods from other ethnic groups in typical restaurants. Besides the different world influences, American cuisine can be divided into Northeast, Midwest, South and West. Some parts of the South are characterized

by traditional African American fare, sometimes referred to as “soul food”; the Northeast includes more seafood, the Midwest meat and poultry, while in the West the abundance of seafood, dairy products, fruits and vegetables has led to the creation of cuisines that emphasize what is fresh and local. In terms of meals, breakfast is traditionally abundant and includes both sweet and savory foods, including fruit juices, muffins, cereals with milk, donuts, pancakes with maple syrup, American coffee, eggs, and bacon (263). Lunch is often replaced by a quick snack or sandwich, while dinner is usually the moment of family gathering and dishes can be influenced by many different culinary traditions, often linked to the origins of the single family. According to a study, only 40 percent of families cook at least once a day, and in more than one-quarter of all homes cooking is done less than once a day, with increasing take-out foods and meals purchased at restaurants. Already in 2004, the share of expenditures for food away from home surpassed the share spent on food at home (277).

The USA Double Pyramid

The section is a guide to read the USA Double Pyramid, with recommended frequency of consumption of food groups, considering the local context and climate impact. In the Health Pyramid, plant-based foods found at the base, such as fruits, vegetables, wholegrains, and vegetable oils should be consumed daily, followed by protein sources that include legumes, fish, dairy, poultry and eggs, with high-glycemic foods and red meat at the top, to be eaten occasionally. From an environmental perspective, the Climate Pyramid shows that the production of animal-based products - especially red meat, followed by cheese, processed meat, fish, poultry, eggs, and dairy products - generally makes the highest contribution to climate change, while plant-based products make the smallest.

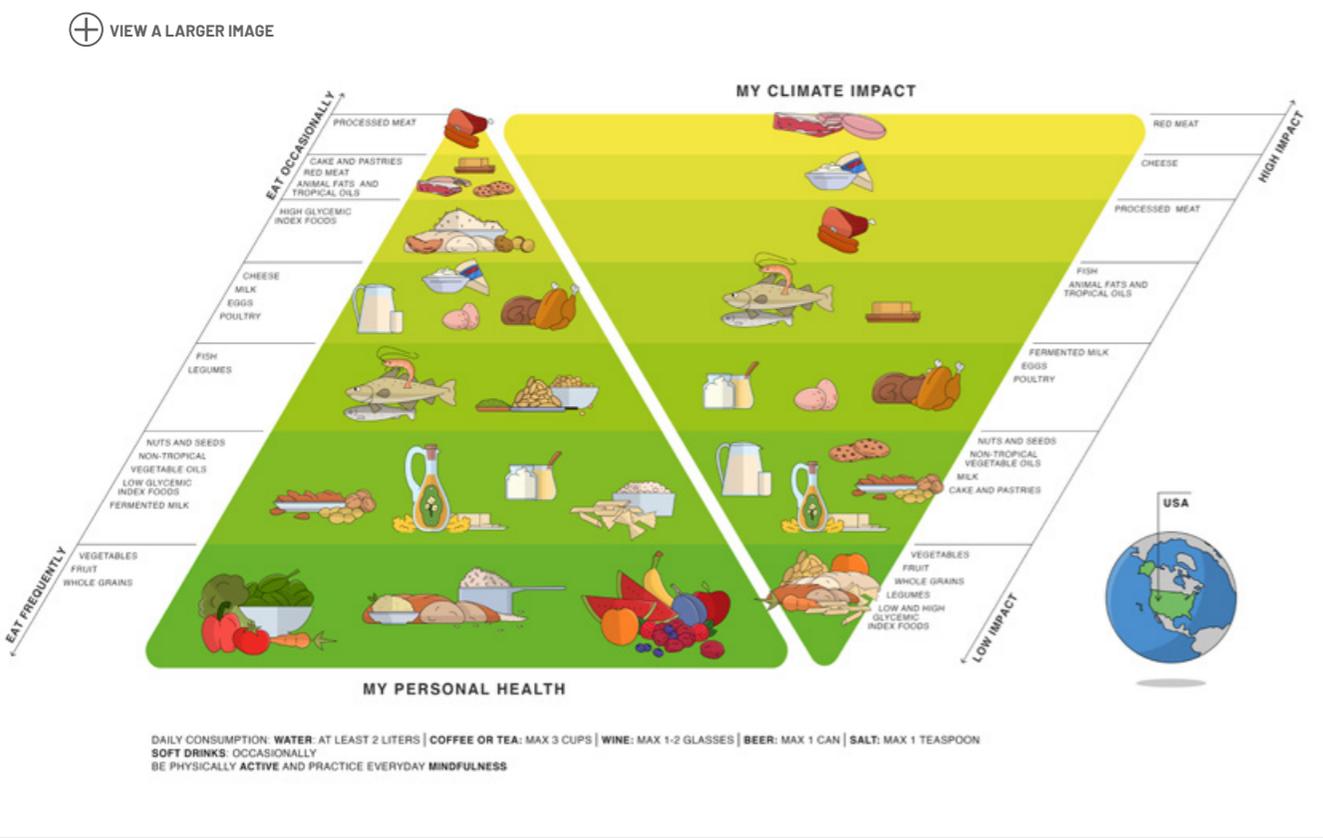
Starting from the base, the vegetable group includes tomato, carrot, bell pepper and broccoli. A variety of leafy vegetables, such as collard, mustard, turnip, and dandelion greens, kale, spinach, and pokeweed are known collectively as “greens” and are a staple of soul food, usually boiled in large pots. Among fruits we find bananas, apples, berries, oranges, watermelons, and plums. Between mid-September and late October, apples are ripe for picking all over the northeast United States, and there are plenty of orchards where people can go to take part in the fall festivities. The United States is the world’s top producer of cranberries, known for their high levels of antioxidants, and cranberry sauce is also a traditional accompaniment to turkey at Christmas and Thanksgiving. Georgia produces high quality fruit like peaches, and oranges are the foundation of the Florida citrus industry, where 70% of the U.S. citrus crop is grown, and nearly all the oranges are processed into juice. However, fruit juices should be consumed in moderation and not as a substitute for fruit, unless freshly squeezed and with pulp. Dried fruits like figs, apricot, raisins, and prunes are also widely common, but due to their lower water content, servings should be downsized proportionally. It is worth mentioning that **California is the biggest agricultural producer in the USA** and the fraction of agricultural water use is significant (up to 80%) especially in dry years, which are becoming more frequent due to climate change (278-280).

A daily consumption of whole grains is recommended for health, and the group includes brown rice, quinoa, and oats, which contain the entire kernel, including the endosperm, bran, and germ. However, the category also includes products where grains are an ingredient, such as wholegrain bread and pasta, whole wheat tortillas, and whole corn tortillas. Oats (*Avena sativa*) were introduced by Scottish settlers, and the gluten-free grain is receiving considerable attention because of the high dietary fiber and phytochemical content, and health benefits such as cholesterol reduction.

Non-tropical vegetable oils include canola, corn, olive, peanut, safflower, soybean, and sunflower oils. Similar healthy fats are also naturally present in nuts, seeds, olives, and avocados. Coconut oil, palm kernel oil, and palm oil are not included in the category because they contain a higher percentage of saturated fats and should be consumed with the same frequency as butter (281). **Among nuts, almonds and walnuts stand out as a healthy snack choice**, and it is worth mentioning that California produces 80% of the world’s almonds, which are native to the Mediterranean, and 100% of the USA supply (282). Peanut butter is a spread made from ground and roasted peanuts and its habitual consumption is not associated with a lower cardiovascular risk, probably due to its high fat content and to additional ingredients such as salt, sweeteners, palm oil and emulsifiers. It is placed in the nuts category provided that it is free of additional ingredients.

Milk is recommended daily or weekly, and is consumed for breakfast and in the many coffees drunk during the day. It is still common for children and adolescents, and sometimes even adults, to drink it at all meals. Although it is recommended daily, it should be limited to one serving. Buttermilk is a common ingredient in biscuits and cornbread. Other products sold as “milks” but made from plants (almond, rice, coconut, oat, and hemp) are gaining popularity, but they are not included as part of the dairy group because their overall nutritional content is not similar to dairy milk or fortified soy beverages (soymilk), and because their health effects have not yet been studied.

In the low-glycemic group we find pasta, extremely popular due to the influence of Italian migrants who made it a common ingredient of the American diet, **as well as pearled barley** which can be used in tasty salads or used as a first-course ingredient. Tex-Mex cuisine results from the fusion of American and Mexican cuisines, deriving from the culinary creations of the Tejanos, inhabitants of Texas of ancient Spanish or Mexican origin. It is widespread especially in the south-eastern states of





the United States and makes extensive use of corn-based low-glycemic foods such as tortillas and tacos. Maize flour is also an ingredient of southern grits, hoecakes, and cornbread, which fall in the high-glycemic category, while corn on the cob features sweet corn when kernels are still tender, a popular Fourth of July food.

Legumes and fish are recommended sources of protein. Legumes like chickpeas, beans (pinto, navy, lima, butter, kidney), lentils and peas (black-eyed, field, green, crowder, butter) can be easily found and are often included in many dishes, like “hoppin john” (rice with black-eyed peas), red kidney beans and rice, and succotash (corn with lima beans). On the same level we find fish, and the long extension of the coasts makes fish and seafood easily available even in inland areas thanks to modern transport systems. Salmon and cod are eaten almost everywhere while crustaceans define local cuisines. Shrimps in Louisiana are the key ingredient of shrimp creole with diced tomatoes, onion, celery and bell pepper, hot pepper, or cayenne-based seasoning, and served over rice. Crabs in California, especially the Dungeness variety, are an ingredient of the Cioppino fish stew that features the catch of the day, and Maine mussels and clams are an ingredient of the New England clambake, steamed over layers of seaweed.

In the middle section of the Pyramid we find cheeses, which are broadly produced in the United States. The cheeses consumed resemble the ones in Great Britain, like cheddar, and the variety

produced in Wisconsin is particularly prized. In attempting to duplicate the popular Neufchatel cheese of France, in the late 1800s William Lawrence of Chester, New York, accidentally developed a method of producing cream cheese, an unripen cheese that was even richer and creamier than the original, and today is a main cheesecake ingredient.

Poultry is found on the same level, and is widely enjoyed in various forms: from chicken to large stuffed turkeys typical of the Thanksgiving holiday accompanied by mashed potatoes, cranberry sauce, and mixed vegetables. Poultry can be consumed up to three times per week but considering the great popularity of fried chicken it is important to specify that cooking methods also have an impact on the healthiness of a food. **Eggs are on the same level** of the Pyramid, and are extremely common and are a regular presence in American breakfasts, usually served as omelets, scrambled or poached on toast.

Among high-glycemic foods, white bread, refined rice, potatoes and sweet potatoes are some examples, and should be consumed occasionally compared to the wholegrain and low glycemic foods. Among white bread, bagels are large ring-shaped leavened dough, boiled briefly in water and then baked in the oven, are a typical Jewish bread immensely popular across the country, especially in New York City. Potatoes are grown in almost every state, mostly harvested in September and October but available all year round due to the fact that 60% of the total harvest is processed into products like frozen fries, crisps, dehydrated potato and starch (283). Sweet potatoes and purple sweet potatoes are other common tubers, consumed mashed, fried, or incorporated into other dishes. White rice is also consumed, especially in dishes of Asian or Latin American origins like sushi, Chinese fried rice or the popular Latin pairing of rice and beans. Among high-glycemic foods, breakfast cereals like corn flakes are widely consumed in the morning but, due to their high sugar content, switching to healthier options like oatmeal, porridge or granola is recommended. Cakes and cookies should be consumed occasionally, and typical American cakes include cheesecake and pumpkin pie, but many other types of cakes can be found, together with several cookies, brownies, pancakes, or cupcakes.

Animal fats and tropical oils should be consumed occasionally, opting for non-tropical vegetable oils instead. In this category we find butter, both in its traditional form, used for cooking, or in the salted version, used for cold seasoning. Cream and sour cream are also popular cooking fats while sauces like mayonnaise, BBQ sauce, ranch sauce are popular, but their use should be limited.

In the same layer, we find red meat. The great plains of North America provided endless pasture for cattle imported from Europe. Widespread availability influenced frequent consumption and use as the main component of meals, to the detriment of starchy foods. Barbecues became a typical convivial rite and the abundance of red meat also favored the habit of ground meat preparations such as hamburgers or various types of meatballs and meatloaf. Beef and pork are both extremely popular and are also the basis of many processed meats that we find in the top layer of our pyramid and should therefore be consumed occasionally. According to the latest FAO data, livestock activities directly contribute to 48% of total agricultural GHG emission in the USA, due to the only enteric fermentation and manure management (137).

The USA Double Pyramid is an attempt to recommend a healthy and sustainable way of eating based on the local characteristics, favoring local ingredients, and the pleasure of cooking and sharing a meal with family and friends. Moreover, it offers the opportunity to take advantage from the variety of cooking traditions spread by the large number of different populations contributing to the gastronomic culture of American people.



CHEF MARTA CONFENTE

ROASTED TURKEY WITH CORN SAUCE

SERVED WITH SPINACH SALAD, ROASTED TOMATO AND SWEET POTATO MASH

It would be hard to pick a single recipe that could express the vast American territory. We started selecting some representative ingredients, each of which brings with it stories, consumption occasions, traditions. The most important characteristics though are their simplicity, being inexpensive and everyday food. Nonetheless, these ingredients can become part of a healthy and fancy recipe.

METHOD AND PRESENTATION

1. Marinate the turkey breast with 50 g of buttermilk, 10 g of salt and 2 g of black pepper overnight
2. The day after, drain the marinade then cook the breast at 200°C until it reaches 72°C
3. Mix the cooking juices with the cooked corn, adjust with salt if needed, reserve the sauce on the side
4. Cut the tomatoes in half, season it with 5 g of salt and let it marinate for couples of minutes
5. In a no-stick pan, gently roast the tomatoes, allowing the flavors to concentrate, reserve
6. Wash the spinach, dry them and put them in a large bowl
7. Toast the peanuts, mix half of them with the canola oil until smooth, keep the dressing on the side
8. Chop the rest of the peanuts and add it to the spinach leaves, season with the dressing
9. Boil the sweet potatoes in salted water until soft, drain them then pass them through a sieve
10. Add the rest of the buttermilk, some black pepper then the finely cut chive, then reserve warm

PRESENTATION

- Carve the breast into thin slices.
- On a plate arrange the turkey, one half roast tomato, the spinach and peanut salad and one spoon of the sweet potatoes mash.
- Put the sweet corn sauce on the turkey then serve.

INGREDIENTS 4 PEOPLE

	G
Turkey breast	400
Sweet corn, cooked	100
Peanuts	30
Canola oil	10
Tomatoes	n. 2
Black pepper	4
Buttermilk	75
Baby spinach leaves, fresh	240
Sweet potato	100
Salt	20

ENERGY AND NUTRIENTS, PER PERSON

Kcal	391
Proteins	37 g
Fat	15 g
Carbohydrates	29 g
Fibre	3,6g

CARBON FOOTPRINT, PER PERSON

0,52 Kg CO₂ eq





4. CONCLUSIONS

Conclusions and recommendations

Food systems can nurture human health and well-being and favor longevity, while contributing to environmental sustainability. Transforming food systems with integrated and systemic approaches, from farm to fork, is key to accelerate the pathway towards the 17 Sustainable Development Goals for a world that is more resilient, equitable, sustainable for people, planet and prosperity that delivers sufficient, safe, and nutritious food to all, while preserving the environment. Changing diets at global level is a powerful way to increase the health of people and the planet (18, 21, 284, 285).

This report has presented a new version of the Double Pyramid, designed to show the relationship between health and the climate impact of food. The Double Pyramid is intended to contribute to the shift towards sustainable and healthy diets that reverse the global syndemic of obesity, undernutrition, and climate change (286). A sustainable diet is a “code for better consumption”, as we know that the capacity to produce food, the well-being of ecosystems and human health are inextricably linked (287) and is part of a much wider call to rethink consumption (288).

The tool has the ambition to inform policymakers, to foster the adoption of healthier and more sustainable dietary patterns at international, national, and local levels, while mitigating climate change, as well as supporting food and agriculture companies. The agri-food sector will play a crucial role and is urged to address the impacts of its products, services, and strategies on human well-being and the planet’s sustainability, and to support the achievement of the SDGs (289). Furthermore, the Double Pyramid aims to serve an educational purpose, and to inspire communication and information campaigns for citizens and other targeted groups. Chefs and professionals in the hospitality sector are also recognized as key stakeholders because of the role they can play as ambassadors of healthy and sustainable food choices.

The new Double Pyramid corroborates the message that through a varied and balanced diet we can promote our health, longevity, and wellbeing, while reducing our carbon footprint. In fact, foods that should be consumed more frequently for our health also have a low climate impact. It shows that all foods can be part of a healthy and sustainable diet, provided that they are consumed with

proper frequency and servings, and that sustainable diets can reflect local tradition, culture, and preferences. A healthy and sustainable diet includes a large amount of plant-based foods, such as fruit, vegetables, and wholegrains. It includes a variety of protein sources, mainly legumes and nuts, but also dairy, fish, poultry and eggs, and a moderate consumption of red meat and high glycemic foods. A few other principles of a healthy and sustainable diet can be devised, e.g. to prefer fresh, seasonal, and local food; to avoid over-consumption of food; to reduce, re-use and recycle food packaging.

Producing food within planetary boundaries and adapting to local contexts is necessary to reduce the environmental impacts of food systems, as well as to prevent food loss and food waste. In the present report, carbon footprint has been used to build the Climate Pyramid, based on an open access database to support accounting, monitoring, and reporting of food-related environmental impacts, developed in the framework of the EU-funded Su-Eatable Life project (106). It is acknowledged, however, that the impacts of food systems on the ecosystems are multiple and include other dimensions, such as biodiversity loss, water use, land use, soil quality and erosion, energy use, etc.

While it is possible to identify a few common principles, any pursuit of a healthy and sustainable diet adoption must consider cultural differences. Context-specific messages should be developed considering local culture, heritage, taste, norms. Therefore, to celebrate the richness and diversity of culinary traditions around the world, this report has proposed a first attempt to develop seven experimental Cultural Double Pyramids for a limited number of areas in the world (Africa, South Asia, East Asia, the Mediterranean, the Nordics and Canada, Latin America, USA). Further research directions include the development of other Cultural Double Pyramids.

Celebrating the richness of different culinary traditions can incentivize a new approach to food. Many diets around the world contain the fundamental elements, ingredients and recipes of a healthy and sustainable diet. Dishes from different traditions can contribute to the desirability and to the gastronomic appeal of a sustainable way of eating, especially for

younger generations. In short, the message of the Cultural Double Pyramids is that healthy and sustainable food choices can be implemented everywhere, respecting the local culinary traditions and individual preference, and inspire variety and diversity across the globe.

The research allows to draw 10 key strategic recommendations⁵ to be drawn that aim to orient food systems towards healthy and sustainable diets across policy, food supply chains, and consumers, leading to win-win solutions for people and the planet:

- 1 Include sustainability and health across all policies and sectors**, including in schools, health care, worksites, agricultural and economic policies through broader food education and information campaigns.
- 2 Establish standards on sustainable diets**, setting and monitoring indicators, and address the key trade-offs through multi-stakeholder collaboration and participatory governance.
- 3 Promote and reconnect sustainability with traditions**, heritage, and culinary history, while promoting global safety regulations and protocols for nutritious food.
- 4 Devise policy interventions that establish framework change** to address the totality of dietary change, as well as the socio-economic and environmental implications.
- 5 Foster integrated urban food policies**, that sustain shorter supply chains, deliver urban agriculture programs to support local markets and fight food deserts.
- 6 Build infrastructure and promote training and education programs** to support (smallholder) farmers to grow sustainably and access markets for nutritious food.
- 7 Adopt a greener food procurement policy** that ensures access to healthy, nutritious, and sustainable food in all public and private institutions, while supporting local economies and farmers.
- 8 Propose, test and fine-tune sustainability principles** in food-based dietary guidelines and ensure that nutritional recommendations are based on the best available scientific evidence.
- 9 Redirect agriculture subsidies** from staple crops to nutritious and sustainable food to ensure availability and affordability for the most vulnerable groups.
- 10 Favor the adoption of healthy and sustainable food choices** through enabling food environments, and by fully harnessing the potential of food advertising and marketing.

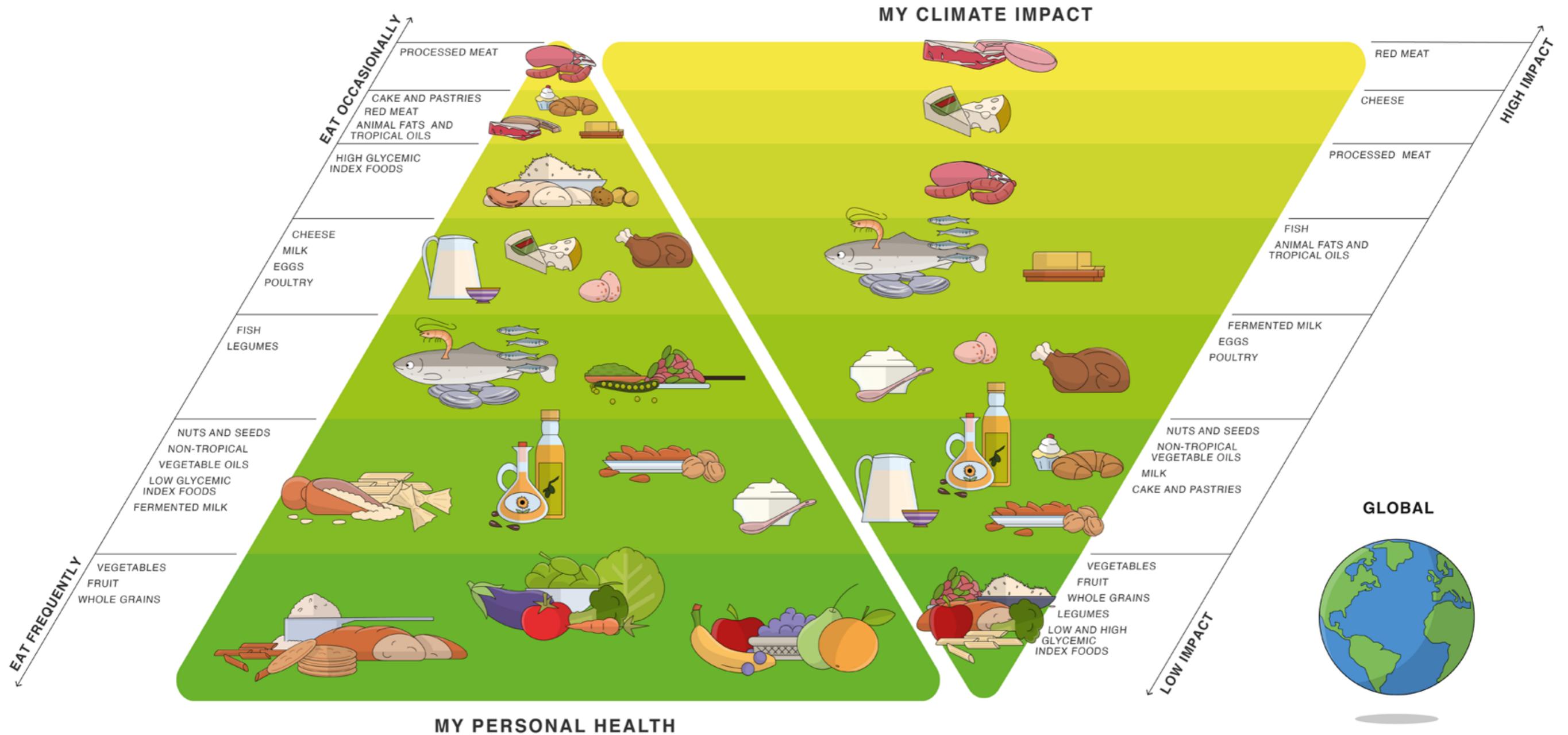
5. For a comprehensive list of 42 policies and actions to orient food systems towards healthier diets for all, the reader is referred to Hawkes, C., Walton, S., Haddad, L., Fanzo, J. (2020) 42 policies and actions to orient food systems towards healthier diets for all. London: Centre for Food Policy, City, University of London.

APPENDIX

Table 3. REPRESENTATIVE FOOD ITEMS IN THE CULTURAL DOUBLE PYRAMIDS

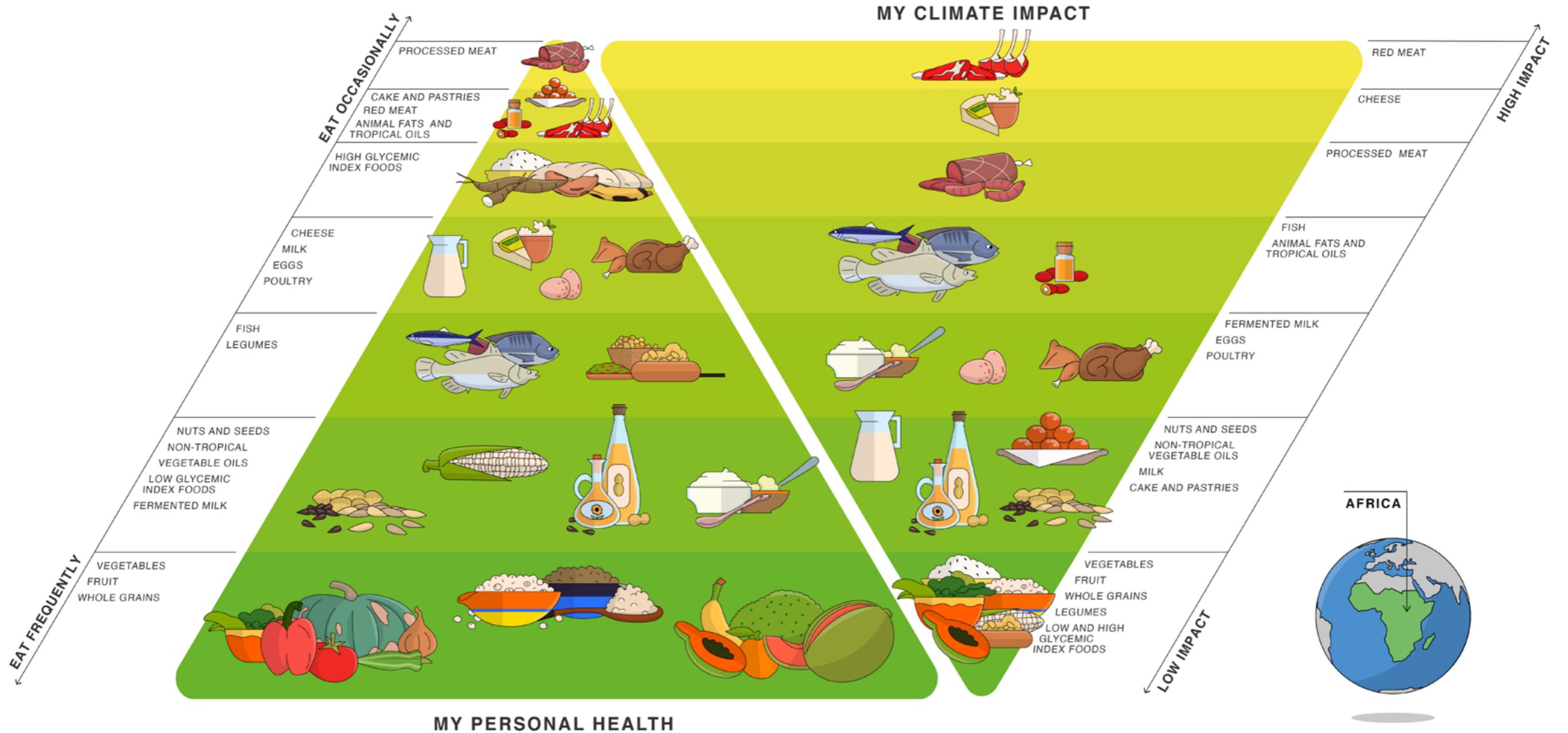
FOOD GROUP	NORDICS and CANADA	USA	LATIN AMERICA	MEDITERRANEAN	EAST ASIA	SOUTH ASIA	AFRICA
VEGETABLES	Beetroot Carrot Mushrooms Cabbage Turnip	Tomato Carrot Bell pepper Broccoli Spinach	Bell pepper Onion Pumpkin/squash Nopal Tomato	Tomato Eggplant Artichoke Cucumber Chard	Leafy vegetables (pak choi, Chinese broccoli, mustard leaves, fenugreek, spinach) Bamboo shoots Mushrooms Daikon radish Cucumber Seaweed	Leafy vegetables (mustard leaves, fenugreek, spinach) Okra Onion/scallion/leek Carrot Eggplant Tomato	Green leaves (spinach, mustard/cassava /sweet potato /pumpkin leaves) Okra Pumpkin Onion Bell pepper Tomato
FRUIT	Raspberry Strawberry Blueberry Plum Apple Cranberry	Apple Banana Berries Orange Watermelon Plum	Açaí Papaya Tangerine banana Guava Pineapple	Orange Dry fig Apricot Grapes Pomegranate Watermelon	Orange/tangerine Winter melon Asian pear Lichee Persimmon Pomelo	Mango Papaya Orange/tangerine Banana Pineapple Jackfruit	Papaya Oranges Banana Jackfruit Tangerine Melon
WHOLE GRAINS	Rye bread Rolled oat Wholegrain flatbreads	Rolled oat Quinoa Wholegrain bread	Brown rice Quinoa Wholegrain bread	Bulgur Wholegrain pasta Wholegrain bread Wholegrain biscuits	Brown rice Soba noodles Millet	Brown rice Sorghum Millet	Millet Sorghum Teff
NUTS AND SEEDS	Almonds Hazelnuts Sunflower seeds	Almonds Peanuts Walnuts	Cashew Pecan nuts Peanuts	Almonds Sesame seeds/ tahina Walnuts	Pine nuts Peanuts Sesame seeds	Cashew Peanuts Pistachios	Sunflower seeds Peanuts Melon seeds
NON TROPICAL VEGETABLE OILS	Canola oil Soft margarine	Canola oil Soft margarine	Sunflower oil Avocado	Olive oil Olives	Canola oil Soybean oil	Peanut oil Sunflower oil	Sunflower oil Peanut oil
LOW GLYCEMIC INDEX FOODS	Barley Pasta	Pasta Barley	Corn taco Corn tortilla Corn	Pasta Barley	Noodles (rice/wheat/egg noodles)	Chapati Roti	White maize
FERMENTED MILK	Yogurt Skyr	Yogurt Buttermilk	Yogurt Kefir	Yogurt Kefir	Yogurt Fermented milk	Yogurt Lassi	Yogurt Fermented milk
FISH	Salmon Herring Mackerel	Salmon Cod Shrimps	Crab Seabass Mackerel	Sardines Cod Octopus	Tuna Shrimp Salmon	King fish White snapper Indian mackerel Shrimp	Nile perch Tilapia Mackerel
LEGUMES	Beans Peas Chickpeas	Chickpeas Beans Lentils	Beans (red/brown /white/black) Peas Lentils	Chickpeas Lentils Fava beans	Beans (mung, azuki, broad beans) Soy beans / edamame Tofu	Beans (black, red, green) Split peas Lentils (red and green)	Beans (black eyed) Chickpeas Lentils
CHEESE	Cottage cheese Hard cheese	Cream cheese Cheddar	Sour cream Queso (hard cheese)	Cottage cheese (ricotta-like) Hard cheese	Fresh white cheese Hard cheese	Cottage cheese Paneer cheese	Cottage cheese Hard cheese
MILK	Milk	Milk	Milk	Milk	Milk	Milk	Milk
EGGS	Eggs	Eggs	Eggs	Eggs	Eggs	Eggs	Eggs
POULTRY	Chicken Turkey	Chicken Turkey	Chicken Turkey	Chicken Turkey	Chicken Duck	Chicken Duck	Chicken Guinea hen
HIGH GLYCEMIC INDEX FOODS	White bread White rice Potatoes Refined flatbread	White rice Potatoes White bread Sweet potato	Potatoes White rice Cassava Sweet potato	White rice Potatoes Pita bread Bread	Bao White rice Potatoes Lotus root	Naan bread White rice Potatoes Plantains	Cassava White rice White bread Sweet potato Plantains
CAKES AND PASTRIES	Cinnamon buns	Cookies	Churros	Phyllo pastries	Sweet rice cakes	Mithai	Sweet fried flour balls
RED MEAT	Beef Pork	Beef Pork	Beef Pork	Beef Lamb	Beef Pork	Mutton Lamb	Goat Lamb
ANIMAL FATS & TROPICAL OILS	Butter	Butter	Butter	Butter	Butter	Ghee	Palm oil
PROCESSED MEAT	Sausage Ham	Hotdogs Ham	Sausage Ham	Sausage Ham	Sausage Ham	Chicken sausage	Sausage Salty dried meat

Table 4. THE GLOBAL DOUBLE PYRAMID



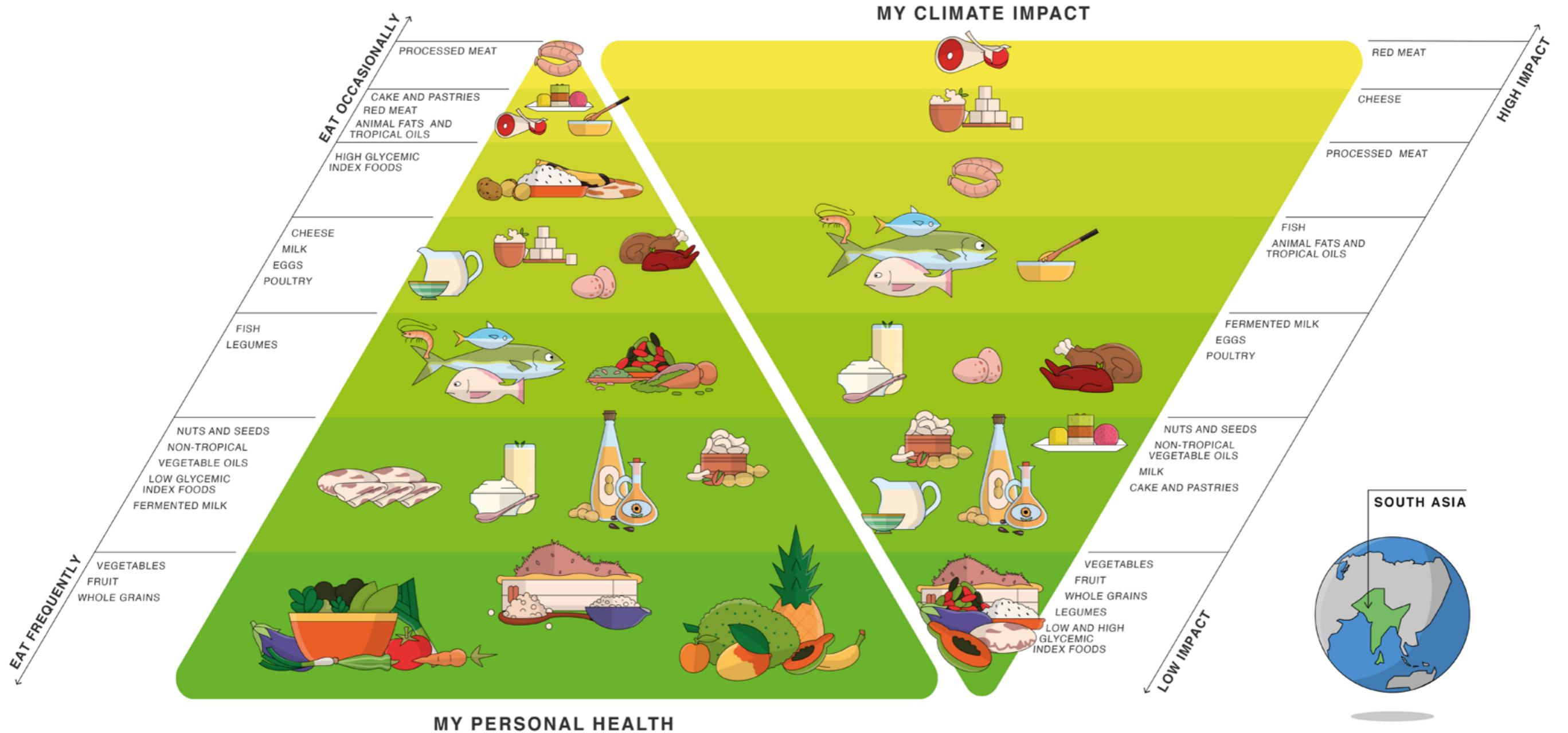
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 5. THE AFRICAN DOUBLE PYRAMID



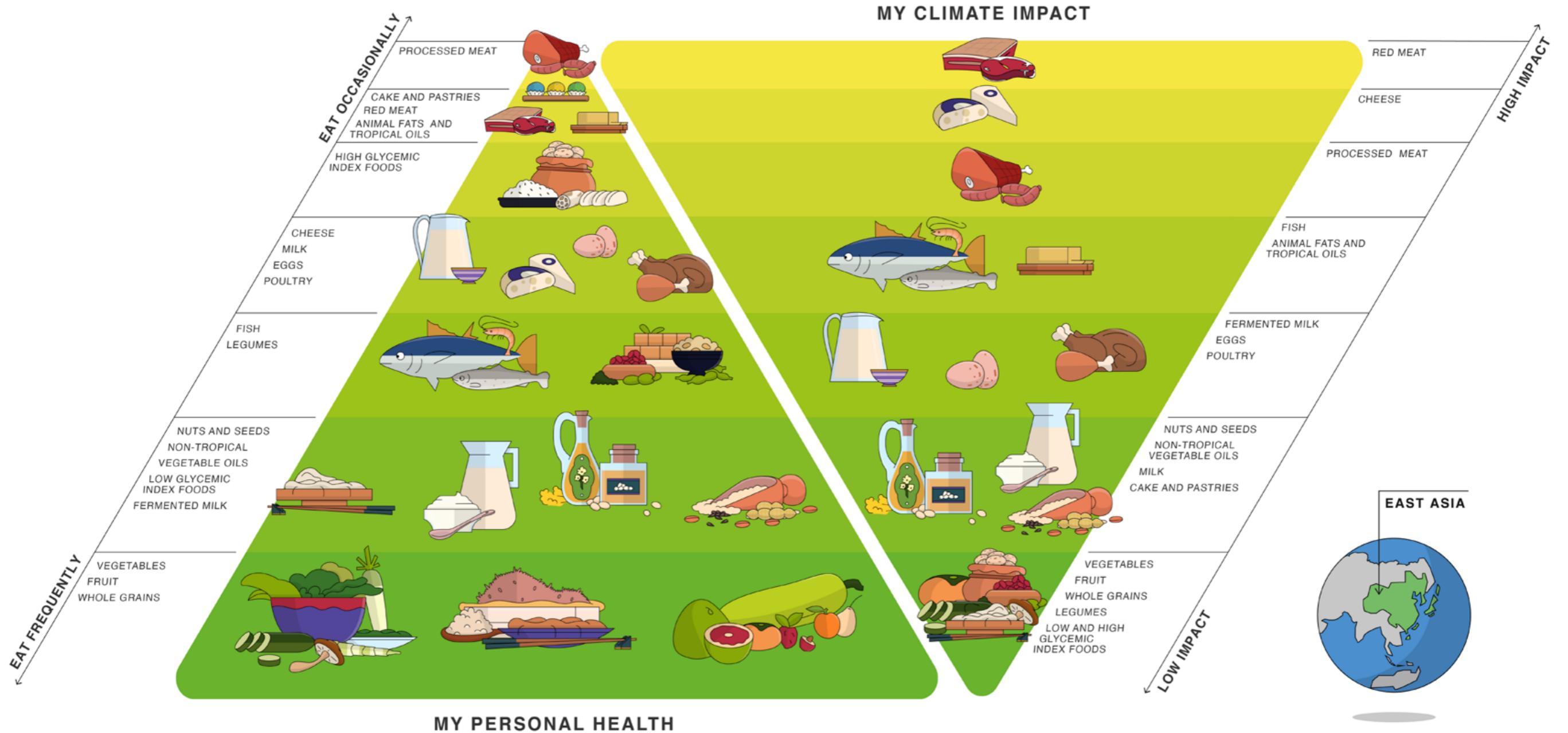
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 6. THE SOUTH ASIAN DOUBLE PYRAMID



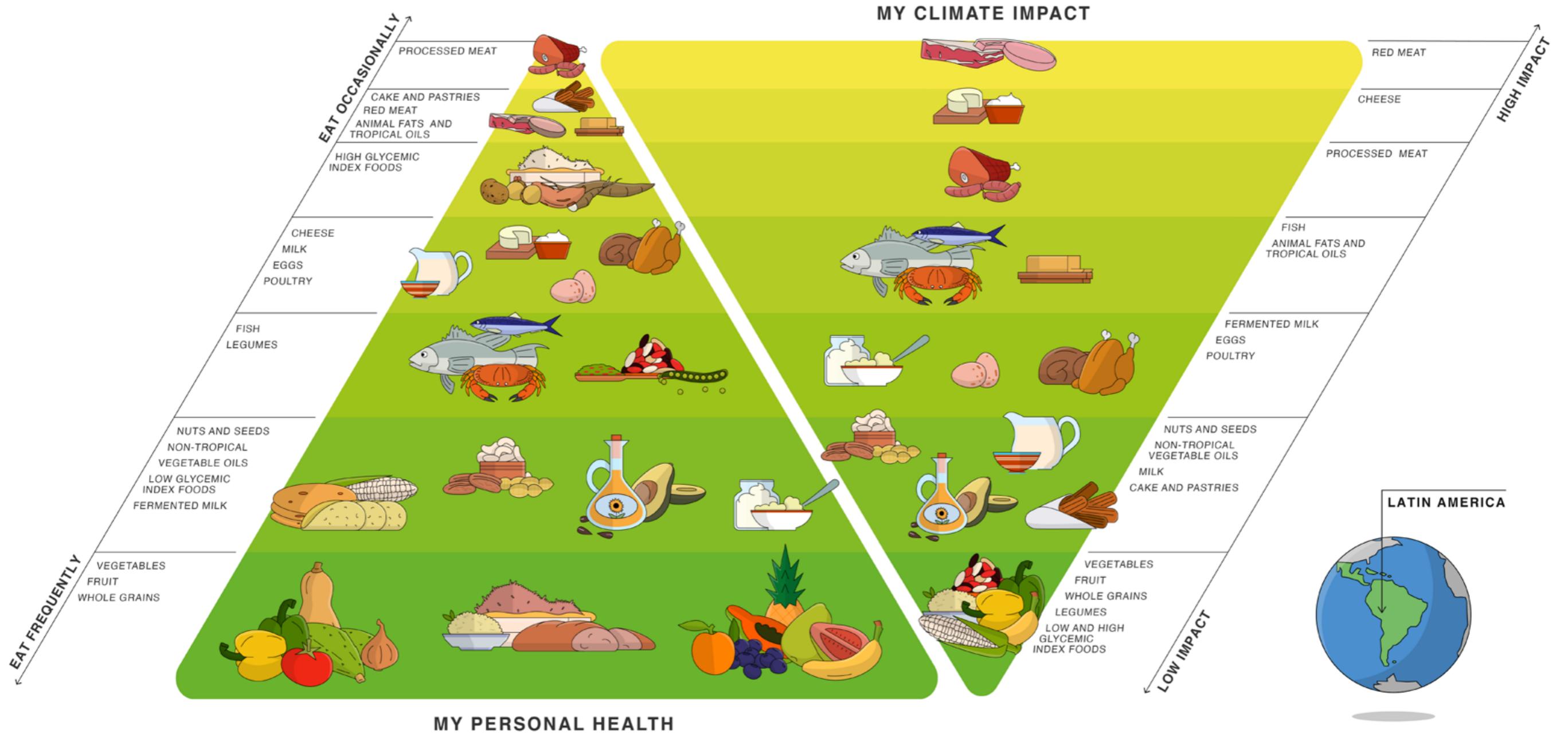
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 7. THE EAST ASIAN DOUBLE PYRAMID



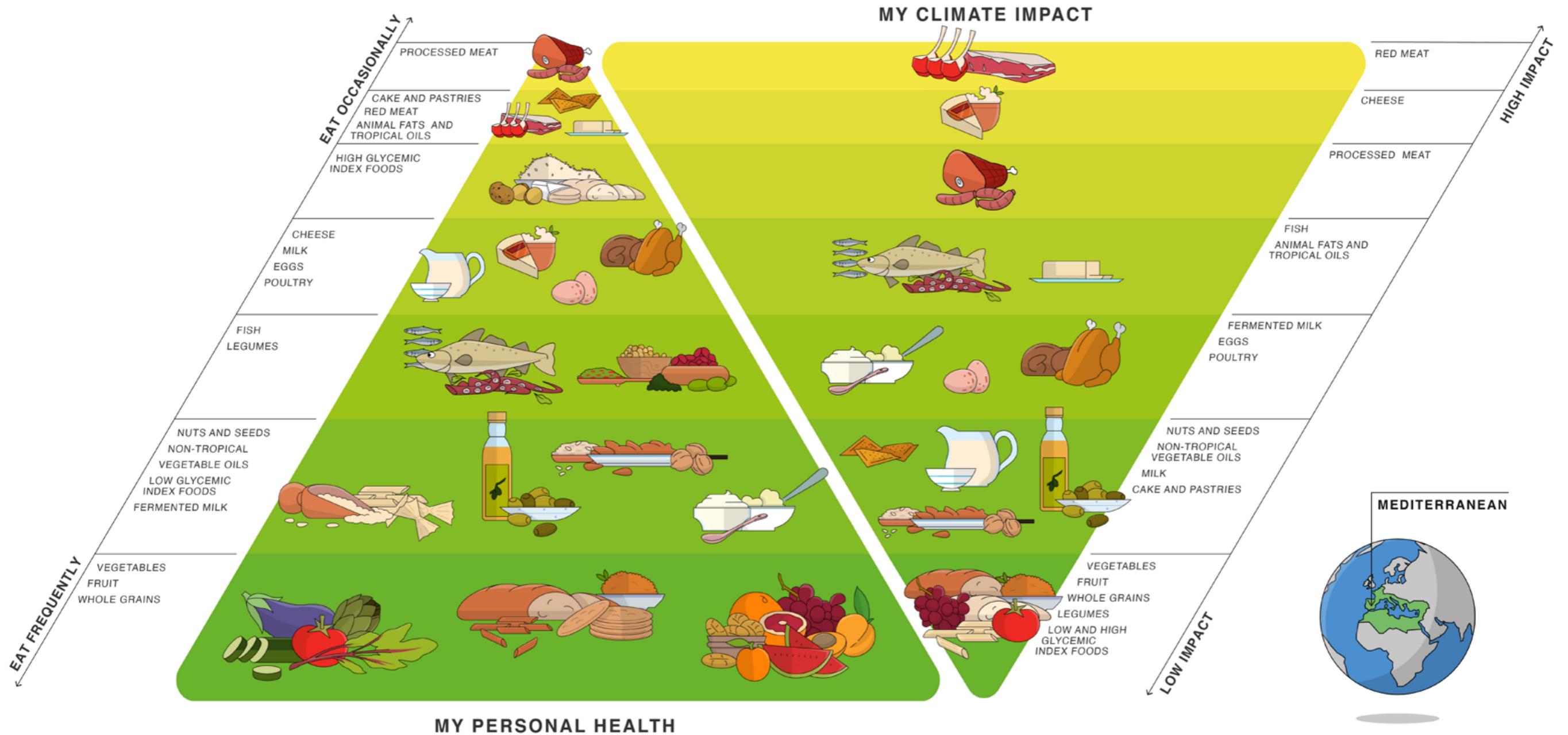
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 8. THE LATIN AMERICAN DOUBLE PYRAMID



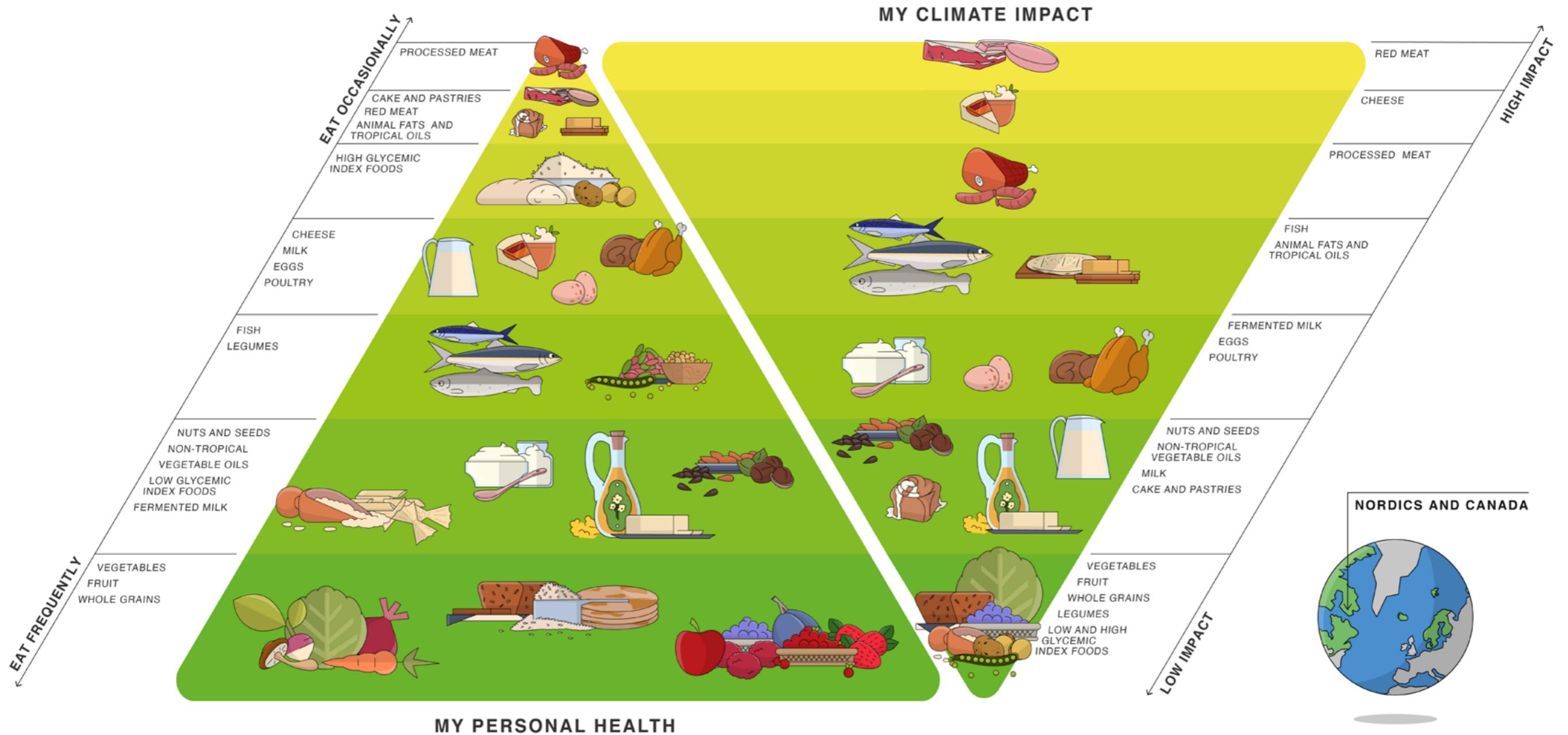
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 9. THE MEDITERRANEAN DOUBLE PYRAMID



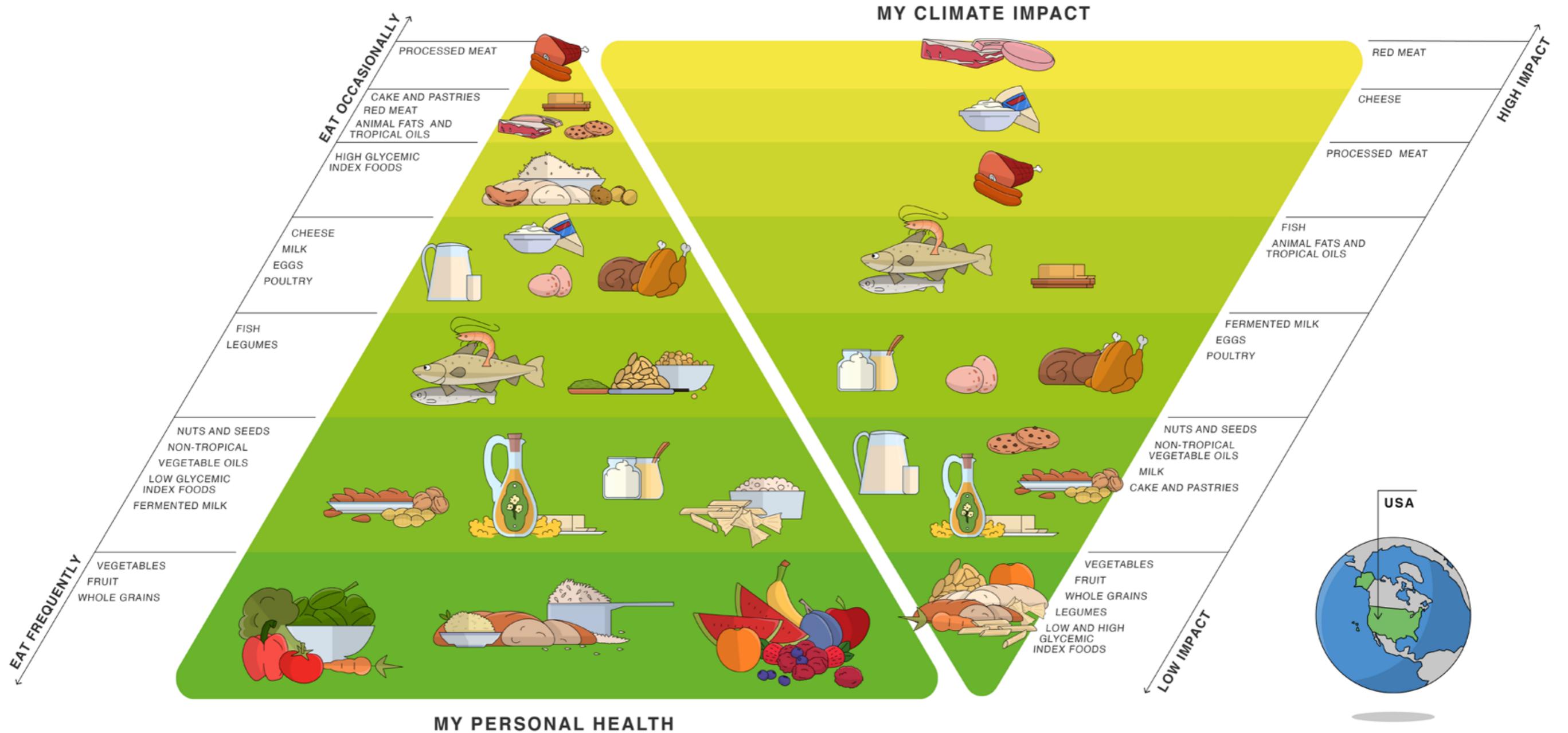
DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 10. THE NORDICS AND CANADA DOUBLE PYRAMID



DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

Table 11. THE USA DOUBLE PYRAMID



DAILY CONSUMPTION: **WATER:** AT LEAST 2 LITERS | **COFFEE OR TEA:** MAX 3 CUPS | **WINE:** MAX 1-2 GLASSES | **BEER:** MAX 1 CAN | **SALT:** MAX 1 TEASPOON
SOFT DRINKS: OCCASIONALLY
 BE PHYSICALLY **ACTIVE** AND PRACTICE EVERYDAY **MINDFULNESS**

BIBLIOGRAPHY

1. FAO, I. *The State of Food Security and Nutrition in the World 2020: Transforming food systems for affordable healthy diets.* (FAO, IFAD, UNICEF, WFP and WHO, 2020). doi:10.4060/ca9692en
2. FAO. *The State of Food and Agriculture 2020: Overcoming water challenges in agriculture.* (FAO, 2020). doi:10.4060/cb1447en
3. FAO. *The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction.* (2019).
4. Springmann, M. et al. The healthiness and sustainability of national and global food based dietary guidelines: modelling study. *BMJ* 370, m2322 (2020).
5. 2020 *Global Nutrition Report. 2020 Global Nutrition Report: Action on equity to end malnutrition - World.* (2020). at <https://reliefweb.int/report/world/2020-global-nutrition-report-action-equity-end-malnutrition>
6. IPCC. *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.* (2019). at <https://www.ipcc.ch/srccl/>
7. WWF. *Planet-Based Diets | WWF. Planet-Based Diets - Sci.-Based Platf. Encourage Diets Are Good People Planet* at <https://planetbaseddiets.panda.org/>
8. American Veterinary Medical Association. *One Health: A New Professional Imperative.* (2008). at <https://www.avma.org/resources-tools/reports/one-health-ohitf-final-report-2008>
9. Garcia, S. N., Osburn, B. I. & Jay-Russell, M. T. One Health for Food Safety, Food Security, and Sustainable Food Production. *Front. Sustain. Food Syst.* 4, (2020).
10. Riccardi, G., Vitale, M. & Vaccaro, O. Are Europeans moving towards dietary habits more suitable for reducing cardiovascular disease risk? *Nutr. Metab. Cardiovasc. Dis.* 30, 1857-1860 (2020).
11. World Health Organisation. *Diet, nutrition and the prevention of chronic diseases.* 916, 1-149 (WHO, 2003). at <https://www.who.int/dietphysicalactivity/publications/trs916/en/>
12. Montanarella, L. Agricultural policy: Govern our soils. *Nat. News* 528, 32 (2015).
13. Mueller, N. D. et al. Correction: Corrigendum: Closing yield gaps through nutrient and water management. *Nature* 494, 390-390 (2013).
14. Borrelli, P. et al. Land use and climate change impacts on global soil erosion by water (2015-2070). *Proc. Natl. Acad. Sci.* 117, 21994-22001 (2020).
15. Williams, D. R. et al. Proactive conservation to prevent habitat losses to agricultural expansion. *Nat. Sustain.* 1-9 (2020). doi:10.1038/s41893-020-00656-5
16. Bélanger, J. & Pilling, D. (eds). *The State of the World's Biodiversity for Food and Agriculture.* (FAO, 2019). doi:10.4060/CA3129EN
17. Convention on Biological Diversity. Convention on Biological Diversity. *Conv. Biol. Divers.* at <https://www.cbd.int/www.cbd.int>
18. Willett, W., Rockstrom, J., Loken, B., et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems - The Lancet. 393, 447-492 (2019).
19. Caporaso, L. et al. in *Achiev. Sustain. Dev. Goals Sustain. Food Syst.* (eds. Valentini, R., Sievenpiper, J. L., Antonelli, M. & Dembska, K.) 35-61 (Springer International Publishing, 2019). doi:10.1007/978-3-030-23969-5_3
20. Paustian, K. et al. Climate-smart soils. *Nature* 532, 49-57 (2016).
21. Tilman, D. & Clark, M. Global diets link environmental sustainability and human health. *Nature* 515, 518-522 (2014).
22. Morris, C., Kirwan, J. & Lally, R. Less Meat Initiatives: An Initial Exploration of a Diet-focused Social Innovation in Transitions to a More Sustainable Regime of Meat Provisioning. *Int. J. Sociol. Agric. Food* 21, 189-208 (2014).
23. Leach, A. M. et al. Environmental impact food labels combining carbon, nitrogen, and water footprints. *Food Policy* 61, 213-223 (2016).
24. Gonzalez Fischer, C. & Garnett, T. *Plates, pyramids, planet: Developments in national healthy and sustainable dietary guidelines: a state of play assessment.* (FAO, 2016). at <http://www.fao.org/documents/card/en/c/d8dfeaf1-f859-4191-954f-e8e1388cd0b7/>
25. Springmann, M. et al. Mitigation potential and global health impacts from emissions pricing of food commodities. *Nat. Clim. Change* 7, 69-74 (2017).
26. IPCC. *Climate Change 1995: The Science of Climate Change - IPCC.* (1996). at <https://www.ipcc.ch/report/ar2/wg1/>
27. European Commission. A European Green Deal. *Eur. Comm. - Eur. Comm.* at <https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en>
28. European Commission, J. Farm to Fork Strategy - for a fair, healthy and environmentally-friendly food system. *Food Saf. - Eur. Comm.* (2019). at <https://ec.europa.eu/food/farm2fork_en>
29. European Commission. Single Market for Green Products - Environment - European Commission. at <https://ec.europa.eu/environment/eussd/smgp/dev_methods.htm>
30. Weidema, B. P., Thrane, M., Christensen, P., Schmidt, J. & Løkke, S. Carbon Footprint - A Catalyst for Life Cycle Assessment? *J. Ind. Ecol.* 12, 3-6 (2008).
31. Laurent, A., Olsen, S. I. & Hauschild, M. Z. Limitations of Carbon Footprint as Indicator of Environmental Sustainability. *Environ. Sci. Technol.* 46, 4100-4108 (2012).
32. FAO and WHO. *Sustainable healthy diets: Guiding principles.* (FAO and WHO, 2019). doi:10.4060/CA6640EN. Also Available in: Chinese Spanish French Russian.
33. Montanari, M. *Food Is Culture.* 168 Pages (Columbia University Press, 2006).
34. Armelagos, G. J. Brain evolution, the determinates of food choice, and the omnivore's dilemma. *Crit. Rev. Food Sci. Nutr.* 54, 1330-1341 (2014).
35. Precone, V. et al. Taste, olfactory and texture related genes and food choices: implications on health status. *Eur. Rev. Med. Pharmacol. Sci.* 23, 1305-1321 (2019).
36. Breslin, P. A. S. An Evolutionary Perspective on Food and Human Taste. *Curr. Biol.* 23, R409-R418 (2013).
37. Liem, D. G. & Russell, C. G. The Influence of Taste Liking on the Consumption of Nutrient Rich and Nutrient Poor Foods. *Front. Nutr.* 6, 174 (2019).
38. Chen, P.-J. & Antonelli, M. Conceptual Models of Food Choice: Influential Factors Related to Foods, Individual Differences, and Society. *Foods* 9, 1898 (2020).
39. Kang, J., Jun, J. & Arendt, S. W. Understanding customers' healthy food choices at casual dining restaurants: Using the Value-Attitude-Behavior model. *Int. J. Hosp. Manag.* 48, 12-21 (2015).
40. Barreiro-Hurlé, J., Gracia, A. & de-Magistris, T. Does nutrition information on food products lead to healthier food choices? *Food Policy* 35, 221-229 (2010).
41. Annunziata, A. & Scarpato, D. Factors affecting consumer attitudes towards food products with sustainable attributes. *Agric. Econ.* 60 (2014), 353-363 (2014).
42. Pollard, J., Kirk, S. F. L. & Cade, J. E. Factors affecting food choice in relation to fruit and vegetable intake: a review. *Nutr. Res. Rev.* 15, 373-387 (2002).
43. Glanz, K., Sallis, J. F., Saelens, B. E. & Frank, L. D. Healthy nutrition environments: concepts and measures. *Am. J. Health Promot. AJHP* 19, 330-333, ii (2005).
44. Hansen, T., Sørensen, M. I. & Eriksen, M.-L. R. How the interplay between consumer motivations and values influences organic food identity and behavior. *Food Policy* 74, 39-52 (2018).
45. Verhoef, P. C. Explaining purchases of organic meat by Dutch consumers. *Eur. Rev. Agric. Econ.* 32, 245-267 (2005).
46. Asili, D. et al. Making sense of the "clean label" trends: A review of consumer food choice behavior and discussion of industry implications. *Food Res. Int.* 99, 58-71 (2017).
47. Krebs-Smith, S. M. & Kantor, L. S. Choose a Variety of Fruits and Vegetables Daily: Understanding the Complexities. *J. Nutr.* 131, 487S-501S (2001).
48. Rao, M., Afshin, A., Singh, G. & Mozaffarian, D. Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. *BMJ Open* 3, e004277 (2013).
49. European Commission. Eurobarometer survey (2020). (2020). at <https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/survey/getsurveydetail/instruments/special/surveyky/2241>
50. Muth, M. K. et al. A systems approach to assessing environmental and economic effects of food loss and waste interventions in the United States. *Sci. Total Environ.* 685, 1240-1254 (2019).
51. Springmann, M. et al. Options for keeping the food system within environmental limits. *Nature* 562, 519-525 (2018).
52. Wood, S. L. R., Alam, M. & Dupras, J. Multiple Pathways to More Sustainable Diets: Shifts in Diet Composition, Caloric Intake and Food Waste. *Front. Sustain. Food Syst.* 3, (2019).
53. Chen, C., Chaudhary, A. & Mathys, A. Nutritional and environmental losses embedded in global food waste. *Resour. Conserv. Recycl.* 160, 104912 (2020).
54. FAO. *Global food losses and food waste.* (2011). at <http://www.fao.org/3/mb060e/mb060e00.htm>
55. Parfitt, J., Barthel, M. & Macnaughton, S. Food waste within food supply chains: quantification and potential for change to 2050. *Philos. Trans. R. Soc. B Biol. Sci.* 365, 3065-3081 (2010).
56. Canali, M. et al. Food Waste Drivers in Europe, from Identification to Possible Interventions. *Sustainability* 9, 37 (2017).
57. Meacham, T., Parfitt, J., Hollins, O. & Barthel, M. *Food waste within global food systems-September 2013.* (2013). at </paper/Food-waste-within-global-food-systems-September-Meacham-Parfitt/6c91c4a4bd7b73d2e51344f5fa8117532f80ceec>
58. Principato, L. *Food Waste at Consumer Level: A Comprehensive Literature Review.* (Springer International Publishing, 2018). doi:10.1007/978-3-319-78887-6
59. Principato, L., Mattia, G., Di Leo, A. & Pratesi, C. A. The household wasteful behaviour framework: A systematic review of consumer food waste. *Ind. Mark. Manag.* (2020). doi:10.1016/j.indmarman.2020.07.010
60. Waste Watcher. Waste Watcher International Observatory | Spreco Zero. <https://www.sprecozero.it/> (2020). at <https://www.sprecozero.it/waste-watcher/>
61. WRAP & Icaro Consulting. *Citizen responses to the covid-19 lockdown - food purchasing, management and waste.* (2020). at <https://wrap.org.uk/resources/report/citizens-and-food-during-lockdown>
62. Pappalardo, G., Cerroni, S., Nayga, R. M. J. & Yang, W. Impact of Covid-19 on Household Food Waste: The Case of Italy. *Front. Nutr.* 7, (2020).
63. Jribi, S., Ben Ismail, H., Doggui, D. & Debbabi, H. COVID-19 virus outbreak lockdown: What impacts on household food

- wastage? *Environ. Dev. Sustain.* 1-17 (2020). doi:10.1007/s10668-020-00740-y
64. Principato, L., Secondi, L., Cicatiello, C. & Mattia, G. Caring more about food: The unexpected positive effect of the Covid-19 lockdown on household food management and waste. *Socioecon. Plann. Sci.* 100953 (2020). doi:10.1016/j.seps.2020.100953
65. Bräutigam, K.-R., Jörissen, J. & Priefer, C. The extent of food waste generation across EU-27: different calculation methods and the reliability of their results. *Waste Manag. Res. J. Int. Solid Wastes Public Clean. Assoc.* ISWA 32, 683-694 (2014).
66. Monier, V., Mudgal, S. & Escalon, V. *Preparatory study on food waste across EU 27*. (European Commission (DG ENV) Directorate C-Industry, 2010). at <https://www.eea.europa.eu/data-and-maps/data/external/preparatory-study-on-food-waste>
67. Principato, L., Pratesi, C. A. & Secondi, L. Towards Zero Waste: an Exploratory Study on Restaurant managers. *Int. J. Hosp. Manag.* 74, 130-137 (2018).
68. Stenmarck, Å. *et al. Estimates of European food waste levels.* (2016). at <http://edepot.wur.nl/378674>
69. Gruber, V., Holweg, C. & Teller, C. What a Waste! Exploring the Human Reality of Food Waste from the Store Manager's Perspective. *J. Public Policy Mark.* 35, 3-25 (2016).
70. Cicatiello, C., Franco, S., Pancino, B., Blasi, E. & Falasconi, L. The dark side of retail food waste: Evidences from in-store data. *Resour. Conserv. Recycl.* 125, 273-281 (2017).
71. Buzby, J. C., Bentley, J. T., Padera, B., Ammon, C. & Campuzano, J. Estimated Fresh Produce Shrink and Food Loss in U.S. Supermarkets. *Agriculture* 5, 626-648 (2015).
72. Reynolds, C. *et al. Review: Consumption-stage food waste reduction interventions - What works and how to design better interventions.* *Food Policy* 83, 7-27 (2019).
73. Brazdova, D. Z. & Ellul, M. *CINDI dietary guide.* 39 (WHO Regional Office for Europe, 2000). at <https://www.euro.who.int/__data/assets/pdf_file/0010/119926/E70041.pdf>
74. Bach-Faig, A. *et al. Mediterranean diet pyramid today. Science and cultural updates.* *Public Health Nutr.* 14, 2274-2284 (2011).
75. Harvard School of Public Health. Healthy Eating Pyramid. *Nutr. Source* (2008). at <https://www.hsph.harvard.edu/nutritionsource/healthy-eating-pyramid/>
76. Aune, D. *et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-a systematic review and dose-response meta-analysis of prospective studies.* *Int. J. Epidemiol.* 46, 1029-1056 (2017).
77. Aune, D. *et al. Whole grain consumption and risk of cardiovascular disease, cancer, and all cause and cause specific mortality: systematic review and dose-response meta-analysis of prospective studies.* *BMJ* 353, i2716 (2016).
78. Livesey, G. & Livesey, H. Coronary Heart Disease and Dietary Carbohydrate, Glycemic Index, and Glycemic Load: Dose-Response Meta-analyses of Prospective Cohort Studies. *Mayo Clin. Proc. Innov. Qual. Outcomes* 3, 52-69 (2019).
79. Aune, D. *et al. Nut consumption and risk of cardiovascular disease, total cancer, all-cause and cause-specific mortality: a systematic review and dose-response meta-analysis of prospective studies.* *BMC Med.* 14, 207 (2016).
80. Wu, L. & Sun, D. Consumption of Yogurt and the Incident Risk of Cardiovascular Disease: A Meta-Analysis of Nine Cohort Studies. *Nutrients* 9, (2017).
81. Martínez-González, M. A., Domínguez, L. J. & Delgado-Rodríguez, M. Olive oil consumption and risk of CHD and/or stroke: a meta-analysis of case-control, cohort and intervention studies. *Br. J. Nutr.* 112, 248-259 (2014).
82. Farvid, M. S. *et al. Dietary linoleic acid and risk of coronary heart disease: a systematic review and meta-analysis of prospective cohort studies.* *Circulation* 130, 1568-1578 (2014).
83. Vigiouk, E. *et al. Associations between Dietary Pulses Alone or with Other Legumes and Cardiometabolic Disease Outcomes: An Umbrella Review and Updated Systematic Review and Meta-analysis of Prospective Cohort Studies.* *Adv. Nutr. Bethesda Md* 10, S308-S319 (2019).
84. Bechthold, A. *et al. Food groups and risk of coronary heart disease, stroke and heart failure: A systematic review and dose-response meta-analysis of prospective studies.* *Crit. Rev. Food Sci. Nutr.* 59, 1071-1090 (2019).
85. Lupoli, R. *et al. White meat consumption, all-cause mortality, and cardiovascular events: a meta-analysis of prospective cohort studies.* *Nutrients* 13, 476 (2021).
86. Drouin-Chartier, J.-P. *et al. Egg consumption and risk of cardiovascular disease: three large prospective US cohort studies, systematic review, and updated meta-analysis.* *BMJ* 368, m513 (2020).
87. Chen, G.-C. *et al. Cheese consumption and risk of cardiovascular disease: a meta-analysis of prospective studies.* *Eur. J. Nutr.* 56, 2565-2575 (2017).
88. Guo, J. *et al. Milk and dairy consumption and risk of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies.* *Eur. J. Epidemiol.* 32, 269-287 (2017).
89. Li, Y. *et al. Saturated Fat as Compared With Unsaturated Fats and Sources of Carbohydrates in Relation to Risk of Coronary Heart Disease: A Prospective Cohort Study.* *J. Am. Coll. Cardiol.* 66, 1538-1548 (2015).
90. Wang, Y.-J., Yeh, T.-L., Shih, M.-C., Tu, Y.-K. & Chien, K.-L. Dietary Sodium Intake and Risk of Cardiovascular Disease: A Systematic Review and Dose-Response Meta-Analysis. *Nutrients* 12, (2020).
91. Yin, J. *et al. Intake of Sugar-Sweetened and Low-Calorie Sweetened Beverages and Risk of Cardiovascular Disease: A Meta-Analysis and Systematic Review.* *Adv. Nutr. Bethesda Md* (2020). doi:10.1093/advances/nmaa084
92. Costanzo, S., Di Castelnuovo, A., Donati, M. B., Iacoviello, L. & de Gaetano, G. Wine, beer or spirit drinking in relation to fatal and non-fatal cardiovascular events: a meta-analysis. *Eur. J. Epidemiol.* 26, 833-850 (2011).
93. Zhang, C. *et al. Tea consumption and risk of cardiovascular outcomes and total mortality: a systematic review and meta-analysis of prospective observational studies.* *Eur. J. Epidemiol.* 30, 103-113 (2015).
94. Ding, M., Bhupathiraju, S. N., Satija, A., van Dam, R. M. & Hu, F. B. Long-term coffee consumption and risk of cardiovascular disease: a systematic review and a dose-response meta-analysis of prospective cohort studies. *Circulation* 129, 643-659 (2014).
95. He, F. J., Tan, M., Ma, Y. & MacGregor, G. A. Salt Reduction to Prevent Hypertension and Cardiovascular Disease: JACC State-of-the-Art Review. *J. Am. Coll. Cardiol.* 75, 632-647 (2020).
96. WHO. *Guideline: sodium intake for adults and children.* (World Health Organization (WHO), 2012). at <https://www.who.int/publications/i/item/9789241504836>
97. He, F. J. & MacGregor, G. A. A comprehensive review on salt and health and current experience of worldwide salt reduction programmes. *J. Hum. Hypertens.* 23, 363-384 (2009).
98. WHO. *Global Health Estimates: Life expectancy and leading causes of death and disability.* (2012). at <https://www.who.int/data/maternal-newborn-child-adolescent-ageing/advisory-groups/gama/activities-of-gama>
99. Mahalakshmi, B., Maurya, N., Lee, S.-D. & Bharath Kumar, V. Possible Neuroprotective Mechanisms of Physical Exercise in Neurodegeneration. *Int. J. Mol. Sci.* 21, (2020).
100. Paillard, T., Rolland, Y. & de Souto Barreto, P. Protective Effects of Physical Exercise in Alzheimer's Disease and Parkinson's Disease: A Narrative Review. *J. Clin. Neurol. Seoul Korea* 11, 212-219 (2015).
101. WHO. *WHO guidelines on physical activity and sedentary behaviour.* (World Health Organization (WHO), 2020). at <https://www.who.int/publications/i/item/9789240015128>
102. Bhasin, M. K. *et al. Specific Transcriptome Changes Associated with Blood Pressure Reduction in Hypertensive Patients After Relaxation Response Training.* *J. Altern. Complement. Med. N. Y. N* 24, 486-504 (2018).
103. Gu, J., Strauss, C., Bond, R. & Cavanagh, K. How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clin. Psychol. Rev.* 37, 1-12 (2015).
104. Harvard School of Public Health. Mindful Eating. *Nutr. Source* (2020). at <https://www.hsph.harvard.edu/nutritionsource/mindful-eating/>
105. Petersson Tashina, Secondi Luca, Magnani Andrea, Antonelli Marta, Dembska Katarzyna, Valentini Riccardo, Varotto Alessandra, Castaldi Simona. 2021 SUEATABLE_LIFE: a comprehensive database of carbon and water footprints of food commodities. at <https://doi.org/10.6084/m9.figshare.13271111>
106. SU-EATABLE. SU-EATABLE LIFE. (2020). at <https://www.sueatablelife.eu/it/>
107. BCFN Foundation. *Doppia Piramide 2016.* (2016). at <https://www.barillacfn.com/m/publications/doppiapiramide2016-futuro-piu-sostenibile-dipende-da-noi.pdf>
108. Rousseeuw, P. J. Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. *J. Comput. Appl. Math.* 20, 53-65 (1987).
109. Poore, J. & Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* 360, 987-992 (2018).
110. Iribarren, D., Vázquez-Rowe, I., Hospido, A., Moreira, M. T. & Feijoo, G. Estimation of the carbon footprint of the Galician fishing activity (NW Spain). *Sci. Total Environ.* 408, 5284-5294 (2010).
111. Vázquez-Rowe, I., Moreira, M. T. & Feijoo, G. Inclusion of discard assessment indicators in fisheries life cycle assessment studies. Expanding the use of fishery-specific impact categories. *Int. J. Life Cycle Assess.* 17, 535-549 (2012).
112. Vázquez-Rowe, I., Moreira, M. T. & Feijoo, G. Life cycle assessment of horse mackerel fisheries in Galicia (NW Spain): Comparative analysis of two major fishing methods. *Fish. Res.* 106, 517-527 (2010).
113. Pelletier, N., Ibarburu, M. & Xin, H. A carbon footprint analysis of egg production and processing supply chains in the Midwestern United States. *J. Clean. Prod.* 54, 108-114 (2013).
114. Leinonen, I., Williams, A. G., Wiseman, J., Guy, J. & Kyriazakis, I. Predicting the environmental impacts of chicken systems in the United Kingdom through a life cycle assessment: broiler production systems. *Poult. Sci.* 91, 8-25 (2012).
115. Bengtsson, J. & Seddon, J. Cradle to retailer or quick service restaurant gate life cycle assessment of chicken products in Australia. *J. Clean. Prod.* 41, 291-300 (2013).
116. Maraseni, T. N., Cockfield, G., Maroulis, J. & Chen, G. An assessment of greenhouse gas emissions from the Australian vegetables industry. *J. Environ. Sci. Health B* 45, 578-588 (2010).
117. Clune, S., Crossin, E. & Verghese, K. Systematic review of greenhouse gas emissions for different fresh food categories. *J. Clean. Prod.* 140, 766-783 (2017).
118. Kim Hyunju *et al. Plant-Based Diets Are Associated with a Lower Risk of Incident Cardiovascular Disease, Cardiovascular Disease Mortality, and All-Cause Mortality in a General Population of Middle-Aged Adults.* *J. Am. Heart Assoc.* 8, e012865 (2019).
119. Marshall, S. *et al. The Effect of Replacing Refined Grains with Whole Grains on Cardiovascular Risk Factors: A Systematic Review and Meta-Analysis of Randomized Controlled Trials with GRADE Clinical Recommendation.* *J. Acad. Nutr. Diet.*

- 120, 1859-1883.e31(2020).
120. Dernini, S. & Berry, E. M. Mediterranean Diet: From a Healthy Diet to a Sustainable Dietary Pattern. *Front. Nutr.* 2, (2015).
121. Sofi, F., Macchi, C., Abbate, R., Gensini, G. F. & Casini, A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. *Public Health Nutr.* 17, 2769-2782 (2014).
122. Muyonga, J. H., Nansereko, S., Steenkamp, I., Manley, M. & Okoth, J. K. *Traditional African Foods and Their Potential to Contribute to Health and Nutrition: Traditional African Foods*. 320-346 (IGI Global, 2017). doi:10.4018/978-1-5225-0591-4.ch015
123. Ndubuaku, M., Ndubuaku, N. C. & Ndubuaku, E. Yield Characteristics of Moringa oleifera Across Different Ecologies in Nigeria as an Index of Its Adaptation to Climate Change. *Sustain. Agric. Res.* 3, p95 (2014).
124. Shiferaw, B. et al. Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options. *Weather Clim. Extrem.* 3, 67-79 (2014).
125. IPCC. *AR4 Climate Change 2007: Impacts, Adaptation, and Vulnerability - IPCC*. (IPCC, 2007). at <https://www.ipcc.ch/report/ar4/wg2/>
126. Benson, C. & Clay, E. *Drought and Sub-Saharan African Economies. Africa Region Findings & Good Practice*. (World Bank, 1998). at <https://openknowledge.worldbank.org/handle/10986/9884>
127. Pandey, D. N., Gupta, A. K. & Anderson, D. M. Rainwater harvesting as an adaptation to climate change. *Curr. Sci.* 85, 46-59 (2003).
128. National Research Council. *Lost Crops of Africa: Volume I: Grains*. (1996). doi:10.17226/2305
129. Oktay, S. & Sadıkoğlu, S. The gastronomic cultures' impact on the African cuisine. *J. Ethn. Foods* 5, 140-146 (2018).
130. Ordway, E. M., Naylor, R. L., Nkongho, R. N. & Lambin, E. F. Oil palm expansion and deforestation in Southwest Cameroon associated with proliferation of informal mills. *Nat. Commun.* 10, 114 (2019).
131. Miracle, M. P. The Introduction and Spread of Maize in Africa. *J. Afr. Hist.* 6, 39-55 (1965).
132. Oniang'o, R. K., Mutuku, J. M. & Malaba, S. J. Contemporary African food habits and their nutritional and health implications. *Asia Pac. J. Clin. Nutr.* 12, 331-336 (2003).
133. FAO. Traditional crops - Bambara groundnut. *Food Agric. Organ. U. N.* at <http://www.fao.org/traditional-crops/bambaragroundnut/en/>
134. Moyo, N. A. G. & Rapatsa, M. M. A review of the factors affecting tilapia aquaculture production in Southern Africa. *Aquaculture* 535, 736386 (2021).
135. Troell, M. & Berg, H. Cage fish farming in the tropical Lake Kariba, Zimbabwe: impact and biogeochemical changes in sediment. *Aquac. Res.* 28, 527-544 (1997).
136. WWF & Trygg Mat Trackin (TMT). *Unregulated fishing on the high seas of the Indian Ocean - the impacts on, risks to, and challenges for sustainable fishing and ocean health*. (WWF European Policy Office, 2020). at <https://wwf.eu.awsassets.panda.org/downloads/wwftmt_unregulated_fishing_on_the_high_seas_of_the_indian_ocean_2020.pdf>
137. FAO. FAOSTAT. (2021). at <http://www.fao.org/faostat/en/#data>
138. Kelemu, S. et al. African edible insects for food and feed: inventory, diversity, commonalities and contribution to food security. *J. Insects Food Feed* 1, 103-119 (2015).
139. Srinivas, T. Exploring Indian culture through food. *Education about Asia* 16, 38-41 (2011).
140. Lipoeto, N. I., Geok Lin, K. & Angeles-Agdeppa, I. Food consumption patterns and nutrition transition in South-East Asia. *Public Health Nutr.* 16, 1637-1643 (2013).
141. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet Lond. Engl.* 363, 157-163 (2004).
142. Park, Y.-W., Allison, D. B., Heymsfield, S. B. & Gallagher, D. Larger Amounts of Visceral Adipose Tissue in Asian Americans. *Obes. Res.* 9, 381-387 (2001).
143. Ishige, N. The Dietary Culture of Asia. *Asia Soc.* (2008). at <https://asiasociety.org/blog/asia/dietary-culture-asia>
144. Agricultural & Processed Food Products Export Development Authority. at <http://apeda.gov.in/apedaweb/site/SubHead_Products/Other_Fresh_Fruits.htm#:~:text=India%20is%20the%20largest%20producer,Papaya%2C%20Sapota%20and%20Water%20Melons>
145. FAO. *Sorghum and millets in human nutrition*. (1990). at <http://www.fao.org/3/T0818e/T0818E01.htm>
146. Mujumdar, M. et al. in *Assess. Clim. Change Indian Reg. Rep. Minist. Earth Sci. MoES Gov. India* (eds. Krishnan, R. et al.) 117-141 (Springer, 2020). doi:10.1007/978-981-15-4327-2_6
147. Asoka, A., Gleeson, T., Wada, Y. & Mishra, V. Relative contribution of monsoon precipitation and pumping to changes in groundwater storage in India. *Nat. Geosci.* 10, 109-117 (2017).
148. Government of India Ministry of Water Resources. *River Development and Ganga Rejuvenation Minor Irrigation (statistics) Wing 2017. Report of 5th census of minor irrigation schemes*. (2017). at <http://www.indiaenvironmentportal.org.in/files/file/Report%20of%205th%20Census%20of%20Minor%20Irrigation%20Schemes.pdf>
149. Sacks Frank M. et al. Dietary Fats and Cardiovascular Disease: A Presidential Advisory From the American Heart Association. *Circulation* 136, e1-e23 (2017).
150. The sustainable trade initiatives. Palm oil demand in India. (2020). at <https://www.idhsustainabletrade.com/news/palm-oil-demand-in-india/>
151. Austin, K. G., Schwantes, A., Gu, Y. & Kasibhatla, P. S. What causes deforestation in Indonesia? *Environ. Res. Lett.* 14, 024007 (2019).
152. Carlson, K. M. et al. Carbon emissions from forest conversion by Kalimantan oil palm plantations. *Nat. Clim. Change* 3, 283-287 (2013).
153. Lam, W. Y. et al. Greenhouse gas footprints of palm oil production in Indonesia over space and time. *Sci. Total Environ.* 688, 827-837 (2019).
154. Sommer, J. M., Restivo, M. & Shandra, J. M. India, Palm Oil, and Ecologically Unequal Exchange: A Cross-national Analysis of Forest Loss. *Sociol. Perspect.* 63, 312-332 (2020).
155. Elsevier. *Elaeis Guineensis - an overview | ScienceDirect Topics*. (2021). at <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/elaeis-guineensis>
156. Siddiky, M. N. A. & Faruque, M. O. Buffaloes for dairying in South Asia: potential, challenges and way forward. *SAARC J. Agric.* 15, 227-239 (2017).
157. Fisberg, M. & Machado, R. History of yogurt and current patterns of consumption. *Nutr. Rev.* 73 Suppl 1, 4-7 (2015).
158. Abate, T. et al. *Tropical Grain Legumes in Africa and South Asia: Knowledge and Opportunities*. (International Crops Research Institute for the Semi-Arid Tropics, 2012). at <http://oar.icrisat.org/5680/>
159. Mihiranie, S., Jayasinghe, J. K., Jayasinghe, C. V. L. & Wanasundara, J. P. D. Indigenous and traditional foods of Sri Lanka. *J. Ethn. Foods* 7, 42 (2020).
160. Bishwajit, G. et al. Self-sufficiency in rice and food security: a South Asian perspective. *Agric. Food Secur.* 2, 10 (2013).
161. Asia Foundation. *Food security in Asia and the changing role of rice*. (2010). at <https://www.asiafoundation.org/resources/pdfs/OccasionalPaperNo4FoodSecurityFinal.pdf>
162. Ganguli, N. C. & Jain, M. K. Ghee: Its Chemistry, Processing and Technology. *J. Dairy Sci.* 56, 19-25 (1973).
163. Li, J. & Hsieh, Y.-H. P. Traditional Chinese food technology and cuisine. *Asia Pac. J. Clin. Nutr.* 13, 147-155 (2004).
164. University of Kansas. Regions of Chinese food-styles/flavors of cooking. at <http://www.kas.ku.edu/archived-site/chinese_food/regional_cuisine.html>
165. Lipman, J. Chinese Geography through Chinese Cuisine. *Soc. Educ.* 74, 17-20 (2010).
166. Ma, G. Food, eating behavior, and culture in Chinese society. *J. Ethn. Foods* 2, 195-199 (2015).
167. Kim, S. H. et al. Korean diet: Characteristics and historical background. *J. Ethn. Foods* 3, 26-31 (2016).
168. Ministry of foreign Affairs in Japan. *JAPANESE FOOD CULTURE - Enjoying the old and welcoming the new. Result and Survey of Consumption Trend - Survey for Foreigners Visiting Japan: Report from July 2017 to September 2017*. (2017). at <https://web-japan.org/factsheet/en/pdf/e36_food.pdf>
169. Ashkenazi, M. & Jacob, J. *Food Culture in Japan*. (Greenwood Publishing Group, 2003).
170. Sang-Hun, C. Starship Kimchi: A Bold Taste Goes Where It Has Never Gone Before. *N. Y. Times* (2008). at <https://www.nytimes.com/2008/02/24/world/asia/24kimchi.html>
171. Chin, M. The Art of Kimchi. *Saveur* (2009). at <http://www.saveur.com/article/Kitchen/The-Art-of-Kimchi/>
172. Kimchi Nutritional Value | My Korean Diet. (2014). at <web.archive.org>
173. Jung, J. Y. et al. Metatranscriptomic analysis of lactic acid bacterial gene expression during kimchi fermentation. *Int. J. Food Microbiol.* 163, 171-179 (2013).
174. Seaweed as Human Food. Seaweed.ie: Seaweed as human food. at <https://www.seaweed.ie/uses_general/humanfood.php>
175. MacArtain, P., Gill, C. I. R., Brooks, M., Campbell, R. & Rowland, I. R. Nutritional value of edible seaweeds. *Nutr. Rev.* 65, 535-543 (2007).
176. Lewin, J. The health benefits of seaweed. *BBC Good Food* (2017). at <https://www.bbcgoodfood.com/howto/guide/health-benefits-seaweed>
177. Pan, W.-H. et al. Diet and Health Trends in Taiwan: Comparison of Two Nutrition and Health Surveys from 1993-1996 and 2005-2008. *Asia Pac. J. Clin. Nutr.* (2011). at <https://search.informit.org/doi/abs/10.3316/informit.120681050263248>
178. Niu, M. & Hou, G. G. Increasing Whole Grain Consumption in China: Processing and Sensory Challenges. *Cereal Foods World* 65, (2020).
179. International Nut & Dried Fruit. Statistical Yearbook 2016/17. (2017). at <https://www.nutfruit.org/consumers/news/detail/statistical-yearbook-2016-17>
180. Escobar, N. et al. Spatially-explicit footprints of agricultural commodities: Mapping carbon emissions embodied in Brazil's soy exports. *Glob. Environ. Change* 62, 102067 (2020).
181. Pauly, D., Palomares, M. L. D. & Zeller, D. Sea Around Us Concepts, Design and Data. (2020). at <seararoundus.org>
182. Wendling, Z. et al. Environmental Performance Index. (2018). at <https://epi.yale.edu/>
183. Crona, B. et al. China at a Crossroads: An Analysis of China's Changing Seafood Production and Consumption. *One Earth*

- 3, 32-44 (2020).
184. FAO. FAO Fisheries & Aquaculture - FI fact sheet search. (2017). at <http://www.fao.org/fishery/countryprofiles/search/en>
185. Liu, Q., Li, J. & Wang, W. Freshwater fish culture in China « Global Aquaculture Advocate. *Glob. Aquac. Alliance* (2007). at <https://www.aquaculturealliance.org/advocate/freshwater-fish-culture-in-china/>
186. Nutritionix. Calories in Duck, domesticated, meat only, cooked, roasted - 0.5 duck from USDA. *Nutritionix* at <https://www.nutritionix.com/i/usda/duck-domesticated-meat-only-cooked-roasted-0.5-duck/513fceb475b8dbbc2100088f>
187. Lawrence, W. by F., McGregor, read by A. & Barnard, produced by S. Can the world quench China's bottomless thirst for milk? - podcast. *The Guardian* (2019). at <https://www.theguardian.com/news/audio/2019/apr/08/can-the-world-quench-chinas-bottomless-thirst-for-milk-podcast>
188. Enciclopedia Treccani. riso nell'Enciclopedia Treccani. at <https://www.treccani.it/enciclopedia/riso>
189. Le, C. N. *Asian-nation: the landscape of Asian America*. (2008).
190. Sumpio, B. E., Cordova, A. C., Berke-Schlessel, D. W., Qin, F. & Chen, Q. H. Green tea, the 'Asian paradox,' and cardiovascular disease. *J. Am. Coll. Surg.* 202, 813-825 (2006).
191. Nishimura, M. et al. Tea in the Historical Context of East Asia: Cultural Interactions across Borders. *undefined* (2010). at </paper/Tea-in-the-Historical-Context-of-East-Asia%3A-across-Nishimura-Otsuki/5d3ff78a8c712e4e0d05bad2e0a5b05ae87c4df6>
192. Munasinghe, M., Deraniyagala, Y., Dassanayake, N. & Karunarathna, H. Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka. *Sustain. Prod. Consum.* 12, 155-169 (2017).
193. Kalita, R. M., Das, A. K., Sileshi, G. W. & Nath, A. J. Ecosystem carbon stocks in different aged tea agroforestry systems: implications for regional ecosystem management. *Trop. Ecol.* 61, 203-214 (2020).
194. Lovera, J. R. *Food Culture in South America*. (Greenwood Publishing Group, 2005).
195. Popkin, B. M. & Reardon, T. Obesity and the food system transformation in Latin America. *Obes. Rev. Off. J. Int. Assoc. Study Obes.* 19, 1028-1064 (2018).
196. Altieri, M. A. & Toledo, V. M. The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants. *J. Peasant Stud.* 38, 587-612 (2011).
197. Jalava, M., Kumm, M., Porkka, M., Siebert, S. & Varis, O. Diet change—a solution to reduce water use? *Environ. Res. Lett.* 9, 074016 (2014).
198. Santos, H. O., Howell, S., Earnest, C. P. & Teixeira, F. J. Coconut oil intake and its effects on the cardiometabolic profile - A structured literature review. *Prog. Cardiovasc. Dis.* 62, 436-443 (2019).
199. Mekonnen, M. M. & Hoekstra, A. Y. The green, blue and grey water footprint of crops and derived crop products. *Hydrol. Earth Syst. Sci.* 15, 1577-1600 (2011).
200. Caro, D., Alessandrini, A., Sporchia, F. & Borghesi, S. Global virtual water trade of avocado. *J. Clean. Prod.* 285, 124917 (2021).
201. Britannica. tomato | Description, Cultivation, & History. *Encycl. Br.* at <https://www.britannica.com/plant/tomato>
202. Cancino-Espinoza, E., Vázquez-Rowe, I. & Quispe, I. Organic quinoa (*Chenopodium quinoa* L.) production in Peru: Environmental hotspots and food security considerations using Life Cycle Assessment. *Sci. Total Environ.* 637-638, 221-232 (2018).
203. Gomes, C. et al. in Ind. Ferment. *Food Process. Nutr. Sources Prod. Strateg.* (2010).
204. FAO. *The State of World Fisheries and Aquaculture 2018: Meeting the sustainable development goals*. (FAO, 2018). at <http://www.fao.org/documents/card/en/c/19540EN/>
205. Costa-Neto, E. m. Anthro-entomophagy in Latin America: an overview of the importance of edible insects to local communities. *J. Insects Food Feed* 1, 17-23 (2015).
206. FAO. Biodiversity for food security in Latin America and the Caribbean | FAO. (2016). at <http://www.fao.org/americas/noticias/ver/en/c/387596/>
207. Nepstad, D. et al. Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science* 344, 1118-1123 (2014).
208. Nepstad, D. C., Stickler, C. M., Filho, B. S.- & Merry, F. Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point. *Philos. Trans. R. Soc. B Biol. Sci.* 363, 1737-1746 (2008).
209. Serra-Majem, L., Bach-Faig, A. & Raido Quintana, B. Nutritional and Cultural Aspects of the Mediterranean Diet. *Int. J. Vitam. Nutr. Res. Int. Z. Für Vitam.-Ernährungsforschung J. Int. Vitaminol. Nutr.* 82, 157-62 (2012).
210. UNESCO. Nomination file no. 00884 for Inscription in 2013 on the Representative List of the Intangible Cultural Heritage of Humanity approved in Baku, Azerbaijan in December 2013 and Nomination file no. 00394 for Inscription on the Representative List of the Intangible Cultural Heritage of Humanity approved in Nairobi, Kenya in November 2010. (2010). at <http://www.unisob.na.it/ateneo/c002_i.htm?vr=1>
211. Mazzocchi, A., Leone, L., Agostoni, C. & Pali-Schöll, I. The Secrets of the Mediterranean Diet. Does [Only] Olive Oil Matter? *Nutrients* 11, (2019).
212. Willett, W. C. The Mediterranean diet: science and practice. *Public Health Nutr.* 9, 105-110 (2006).
213. Keys, A. *Seven Countries: a multivariate analysis of death and coronary heart disease. Seven Ctries.* (Harvard University Press, 2013). at <https://www.degruyter.com/document/doi/10.4159/harvard.9780674497887/html>
214. Serra-Majem, L. et al. Benefits of the Mediterranean diet: Epidemiological and molecular aspects. *Mol. Aspects Med.* 67, 1-55 (2019).
215. Kargin, D., Tomaino, L. & Serra-Majem, L. Experimental Outcomes of the Mediterranean Diet: Lessons Learned from the Predimed Randomized Controlled Trial. *Nutrients* 11, (2019).
216. Estruch, R. et al. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet Supplemented with Extra-Virgin Olive Oil or Nuts. *N. Engl. J. Med.* 378, e34 (2018).
217. Serra-Majem, L., Roman, B. & Estruch, R. Scientific evidence of interventions using the Mediterranean diet: a systematic review. *Nutr. Rev.* 64, S27-47 (2006).
218. Sofi, F., Cesari, F., Abbate, R., Gensini, G. F. & Casini, A. Adherence to Mediterranean diet and health status: meta-analysis. *BMJ* 337, a1344 (2008).
219. Sofi, F., Macchi, C., Abbate, R., Gensini, G. F. & Casini, A. Mediterranean diet and health. *BioFactors Oxf. Engl.* 39, 335-342 (2013).
220. The World Bank. Life expectancy at birth, total (years) | Data. (2019). at <https://data.worldbank.org/indicator/SP.DYN.LE00.IN>
221. Burlingame, B. & Dernini, S. Sustainable diets: the Mediterranean diet as an example. *Public Health Nutr.* 14, 2285-2287 (2011).
222. Arbex de Castro Vilas Boas, A., Page, D., Giovinazzo, R., Bertin, N. & Fanciullino, A.-L. Combined Effects of Irrigation Regime, Genotype, and Harvest Stage Determine Tomato Fruit Quality and Aptitude for Processing into Puree. *Front. Plant Sci.* 8, (2017).
223. Cramer, W. et al. Climate change and interconnected risks to sustainable development in the Mediterranean. *Nat. Clim. Change* 8, 972-980 (2018).
224. Xynias, I. N. et al. Durum Wheat Breeding in the Mediterranean Region: Current Status and Future Prospects. *Agronomy* 10, 432 (2020).
225. Zampieri, M., Ceglar, A., Dentener, F. & Toreti, A. Wheat yield loss attributable to heat waves, drought and water excess at the global, national and subnational scales. *Environ. Res. Lett.* 12, 064008 (2017).
226. Fontana, G., Toreti, A., Ceglar, A. & De Sanctis, G. Early heat waves over Italy and their impacts on durum wheat yields. *Nat. Hazards Earth Syst. Sci.* 15, 1631-1637 (2015).
227. Zampieri, M. et al. Climate resilience of the top ten wheat producers in the Mediterranean and the Middle East. *Reg. Environ. Change* 20, 41 (2020).
228. European Commission. Food, Farming, Fisheries. at <https://ec.europa.eu/info/food-farming-fisheries>
229. Beauchamp, G. K. et al. Phytochemistry: ibuprofen-like activity in extra-virgin olive oil. *Nature* 437, 45-46 (2005).
230. Pelucchi, C., Bosetti, C., Negri, E., Lipworth, L. & La Vecchia, C. Olive oil and cancer risk: an update of epidemiological findings through 2010. *Curr. Pharm. Des.* 17, 805-812 (2011).
231. Tanasijevic, L., Todorovic, M., Pereira, L. S., Pizzigalli, C. & Lionello, P. Impacts of climate change on olive crop evapotranspiration and irrigation requirements in the Mediterranean region. *Agric. Water Manag.* 144, 54-68 (2014).
232. de Souza, R. G. M., Schincaglia, R. M., Pimentel, G. D. & Mota, J. F. Nuts and Human Health Outcomes: A Systematic Review. *Nutrients* 9, (2017).
233. Sabaté, J., Ros, E. & Salas-Salvadó, J. Preface Nuts: Nutrition and health outcomes. *Br. J. Nutr.* 96 Suppl 2, S1-2 (2006).
234. European Commission. Food-Based Dietary Guidelines in Europe. *EU Sci. Hub - Eur. Comm.* (2018). at <https://ec.europa.eu/jrc/en/health-knowledge-gateway/promotion-prevention/nutrition/food-based-dietary-guidelines>
235. Serra-Majem, L. et al. Updating the Mediterranean Diet Pyramid towards Sustainability: Focus on Environmental Concerns. *Int. J. Environ. Res. Public Health* 17, (2020).
236. Mayo Clinic. Mediterranean diet for heart health. *Mayo Clin.* (2019). at <https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/mediterranean-diet/art-20047801>
237. FAO. *The State of World Fisheries and Aquaculture 2020*. (FAO, 2020). doi:10.4060/ca9229en
238. Helstosky, C. *Food Culture in the Mediterranean*. (Greenwood Publishing Group, 2009).
239. The World Bank. Forest area (% of land area) | Data. (2016). at <https://data.worldbank.org/indicator/AG.LND.FRST.ZS>
240. WHO. GHO | By category | Prevalence of overweight among adults, BMI ≥ 25, age-standardized - Estimates by country. (2017). at <https://apps.who.int/gho/data/node.main.A897A?lang=en>
241. Coffee: Who grows, drinks and pays the most? *BBC News* (2018). at <https://www.bbc.com/news/business-43742686>
242. Corliss, J. The Nordic diet: Healthy eating with an eco-friendly bent. *Harv. Health Blog* (2015). at <https://www.health.harvard.edu/blog/the-nordic-diet-healthy-fare-with-an-eco-friendly-bent-20151198673>
243. Meltzer, H. M. et al. Environmental Sustainability Perspectives of the Nordic Diet. *Nutrients* 11, (2019).
244. Berild, A., Holven, K. B. & Ulven, S. M. Recommended Nordic diet and risk markers for cardiovascular disease. *Tidsskr. Den Nor. Laegeforening Tidsskr. Prakt. Med. Ny Raekke* 137, 721-726 (2017).
245. Noerman, S. et al. Associations of the serum metabolite profile with a healthy Nordic diet and risk of coronary artery disease. *Clin. Nutr. Edinb. Scotl.* (2020). doi:10.1016/j.clnu.2020.10.051

246. Lankinen, M., Uusitupa, M. & Schwab, U. Nordic Diet and Inflammation—A Review of Observational and Intervention Studies. *Nutrients* 11, (2019).
247. González-García, S., Esteve-Llorens, X., Moreira, M. T. & Feijoo, G. Carbon footprint and nutritional quality of different human dietary choices. *Sci. Total Environ.* 644, 77–94 (2018).
248. Health Canada. *Canada's Dietary Guidelines*. (Health Canada, 2019). at <<https://food-guide.canada.ca/en/guidelines/>>
249. Livsmedelsverket. *Find your way, to eat greener, not too much and be active - THE SWEDISH DIETARY GUIDELINES*. (2019). at <https://issuu.com/livsmedelsverket/docs/find_your_way_english>
250. foodnavigator.com. Danish official dietary guidelines include CO2 emissions for first time. *foodnavigator.com* (2021). at <<https://www.foodnavigator.com/Article/2021/01/12/Danish-official-dietary-guidelines-include-CO2-emissions-for-first-time>>
251. Adamsson, V. et al. What is a healthy Nordic diet? Foods and nutrients in the NORDIET study. *Food Nutr. Res.* 56, (2012).
252. Davik, J., Daugaard, H. & Svensson, B. Strawberry Production in the Nordic Countries. *Advances in Strawberry Research* 19, (2000).
253. Kyrø, C. et al. Intake of whole grain in Scandinavia: Intake, sources and compliance with new national recommendations. *Scand. J. Public Health* 40, 76–84 (2012).
254. Moskin, J. Rye, a Grain With Ancient Roots, Is Rising Again. *N. Y. Times* (2017). at <<https://www.nytimes.com/2017/01/10/dining/rye-grain-bread.html>>
255. Lin, L. et al. Evidence of health benefits of canola oil. *Nutr. Rev.* 71, 370–385 (2013).
256. Tamime, A., Tamime, A. Y. & Tamime, A. *Fermented Milks*. (John Wiley & Sons, 2006).
257. Amilien, V., Vittersø, G. & Tangeland, T. in *Sustain. Eur. Food Qual. Schemes Multi-Perform. Struct. Gov. PDO PGI Org. Agri-Food Syst.* (eds. Arfini, F. & Bellassen, V.) 507–527 (Springer International Publishing, 2019). doi:10.1007/978-3-030-27508-2_26
258. FAO. FAO Fisheries & Aquaculture - Cultured Aquatic Species Information Programme - *Salmo salar* (Linnaeus, 1758). at <http://www.fao.org/fishery/culturedspecies/Salmo_salar/en>
259. Sissener, N. H. Are we what we eat? Changes to the feed fatty acid composition of farmed salmon and its effects through the food chain. *J. Exp. Biol.* 221, (2018).
260. Sachs, J. et al. *Sustainable Development Report 2020 The Sustainable Development Goals and Covid-19*. (Cambridge University Press, 2020). at <https://s3.amazonaws.com/sustainabledevelopment.report/2020/2020_sustainable_development_report.pdf>
261. Bodensten, E. A societal history of potato knowledge in Sweden c. 1650–1800. *Scand. J. Hist.* 46, 42–62 (2021).
262. BCFN Foundation. The United States food melting pot. (2018). at <<https://www.barillacfn.com/en/magazine/food-and-society/the-united-states-food-melting-pot/>>
263. Kittler, P. G., Sucher, K. P. & Nelms, M. *Food and Culture*. (Cengage Learning, 2011).
264. Kittler, P. G. & Sucher, K. P. *Food and Culture in America: A Nutrition Handbook*. (Van Nostrand Reinhold, 1989).
265. Kulkarni, K. D. Food, Culture, and Diabetes in the United States. *Clin. Diabetes* 22, 190–192 (2004).
266. Britannica. United States | History, Map, Flag, & Population. *Encycl. Br.* at <<https://www.britannica.com/place/United-States>>
267. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015–2020 Dietary Guidelines | health.gov*. (U.S. Department of Health and Human Services and U.S. Department of Agriculture., 2015). at <<https://health.gov/our-work/food-nutrition/previous-dietary-guidelines/2015>>
268. Bentley, J. *U.S. Trends in Food Availability and a Dietary Assessment of Loss-Adjusted Food Availability, 1970–2014*. (US Dep. Agric. Econ. Res. Serv., 2017). at <<http://www.ers.usda.gov/publications/pub-details/?pubid=82219>>
269. Watts, M. L., Hager, M. H., Toner, C. D. & Weber, J. A. The art of translating nutritional science into dietary guidance: history and evolution of the Dietary Guidelines for Americans. *Nutr. Rev.* 69, 404–412 (2011).
270. Cossrow, N. & Falkner, B. Race/ethnic issues in obesity and obesity-related comorbidities. *J. Clin. Endocrinol. Metab.* 89, 2590–2594 (2004).
271. CDC. Differences in Prevalence of Obesity Among Black, White, and Hispanic Adults — United States, 2006–2008. (2009). at <<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5827a2.htm>>
272. Young, K. L., Graff, M., Fernandez-Rhodes, L. & North, K. E. Genetics of Obesity in Diverse Populations. *Curr. Diab. Rep.* 18, 145 (2018).
273. Woteki, C. E., Kramer, B. L., Cohen, S. & Lancaster, V. A. Impacts and Echoes: The Lasting Influence of the White House Conference on Food, Nutrition, and Health. *Annu. Rev. Nutr.* 40, 437–461 (2020).
274. Karpyn, A. E., Riser, D., Tracy, T., Wang, R. & Shen, Y. E. The changing landscape of food deserts. *UNSCN Nutr.* 44, 46–53 (2019).
275. Azétsop, J. & Joy, T. R. Access to nutritious food, socioeconomic individualism and public health ethics in the USA: a common good approach. *Philos. Ethics Humanit. Med. PEHM* 8, 16 (2013).
276. Slavin, J. L. The challenges of nutrition policymaking. *Nutr. J.* 14, 15 (2015).
277. U.S. Energy Information Administration. Residential Energy Consumption Survey (RECS) - Energy Information Administration. (2015). at <<https://www.eia.gov/consumption/residential/>>
278. Mount, J. & Hanak, E. Water Use in California. *Public Policy Inst. Calif.* (2019). at <<https://www.ppic.org/publication/water-use-in-california/>>
279. McDonald, R. I. et al. Urban growth, climate change, and freshwater availability. *Proc. Natl. Acad. Sci.* 108, 6312–6317 (2011).
280. IPCC. *AR5 Synthesis Report: Climate Change 2014 - IPCC*. (2014). at <<https://www.ipcc.ch/report/ar5/syr/>>
281. Dietary Guidelines for Americans. *Dietary Guidelines for Americans*. (2020). at <<https://www.dietaryguidelines.gov/>>
282. Almonds Boards of California. Almonds Industry Factsheet. (2016). at <https://www.almonds.com/sites/default/files/2016_almond_industry_factsheet.pdf>
283. FAO. Potato world: North America - International Year of the Potato 2008. (2008). at <<http://www.fao.org/potato-2008/en/world/northamerica.html>>
284. Springmann, M., Godfray, H. C. J., Rayner, M. & Scarborough, P. Analysis and valuation of the health and climate change cobenefits of dietary change. *Proc. Natl. Acad. Sci.* 113, 4146–4151 (2016).
285. Springmann, M. et al. Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *Lancet Planet. Health* 2, e451–e461 (2018).
286. Swinburn, B. A. et al. The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *The Lancet* 393, 791–846 (2019).
287. Mason, P. & Lang, T. *Sustainable Diets: How Ecological Nutrition Can Transform Consumption and the Food System*. (Routledge, 2017).
288. Reisch, L. A. & Thøgersen, J. *Handbook of Research on Sustainable Consumption*. (Edward Elgar Publishing, 2015).
289. Sachs, J. et al. *FIXING THE BUSINESS OF FOOD 2020 - BCFN Foundation*. (Barilla Foundation, UN Sustainable Development Solutions Network, Columbia Center on Sustainable Investment, Santa Chiara Lab University of Siena., 2020). at <<https://www.barillacfn.com/en/publications/fixing-the-business-of-food-1/>>



FOLLOW US ON THE SOCIAL NETWORK



Via Madre Teresa di Calcutta, 3/a | 43121 Parma | Italy | www.barillacfn.com | info@barillacfn.com